Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)
Acetone	67-64-1	6,000	†
Acrylonitrile	107-13-1	5	†
Alachor	15972-60-8	2	NA
Aldicarb	116-06-3	7	NA
Aldicarb sulfone	1646-88-4	7	NA
Aldicarb sulfoxide	1646-87-3	7	NA
Aldrin	309-00-2	0.04	†
Allyl chloride	107-05-1	7.4	†
Antimony	7440-36-0	6	NA
Arsenic	7440-38-2	10	NA
Atrazine	1912-24-9	3	†
Barium	7440-39-3	2,000	NA
Benzene	71-43-2	5	2,000
Benzidine	92-87-5	0.8	†
Benzoic Acid	65-85-0	28,000	†
Beryllium	7440-41-7	4	NA
Biphenyl, 1,1-	92-52-4	350	NA
Bisphenol A	80-05-7	120	†
Boron	7440-42-8	620	†
Bromodichloromethane	75-27-4	0.6	NA
Bromoform	75-25-2	5 (4)②	2,000
Bromomethane	74-83-9	10	10
n-Butylbenzene	104-51-8	260	†
sec-Butylbenzene	135-98-8	260	†
tert-Butylbenzene	98-06-6	260	†
Cadmium	7440-43-9	5	NA
Camphor	76-22-2	200	†
Carbofuran	1563-66-2	40	†
Carbon disulfide	75-15-0	70	†
Carbon tetrachloride	56-23-5	5	40
Chlordane	57-74-9	2	NA
Chloroaniline, p-	106-47-8	28	NA
bis-(2-chloroethyl)ether	111-44-4	10	†
bis-(2-chloroisopropyl)ether	39638-32-9	300	†
bis-(chloromethyl)ether	542-88-1	10	†
Chloromethane	74-87-3	30	†
Chlorophenol, 2-	95-57-8	35	NA
Chlorotrifluoroethylene (CFC-1113)	79-38-9	5	†
Chlorotoluene, o-	95-49-8	100	†
Chromium (Total)	7440-47-3	100	NA
Chromium (III)	16065-83-1	††	NA

Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)
Chromium (VI)	18540-29-9	††	NA
Clopyralid	1702-17-6	3,500	†
Copper	7440-50-8	1,300	†
Cyanazine	21725-46-2	1	†
Cyanide	57-12-5	200	NA
2,4-D (Dichlorophenoxyacetic acid, 2,4-)	94-75-7	70	†
Dalapon	75-99-0	200	†
DDD (Dichlorodiphenyl dichloroethane, p,p')	72-54-8	0.1	NA
DDE (Dichlorodiphenyl dichloroethylene, p,p')	72-55-9	0.1	NA
DDT (Dichlorodiphenyl trichloroethane, p,p')	50-29-3	0.1	NA
Dibromochloromethane	124-48-1	60	NA
Dibromochloropropane	96-12-8	0.2	†
Dibutylphthalate	84-74-2	800	†
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	600	20,000
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	600	†
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	75	50,000
Dichlorobenzidine, 3,3'-	91-94-1	1.3	NA
Dichlorodifluoromethane (Freon 12)	75-71-8	1,000	†
Dichloroethane, 1,1-	75-34-3	81	10,000
Dichloroethane, 1,2-	107-06-2	5	300
Dichloroethylene, 1,1-	75-35-4	7	1,000
Dichloroethylene, cis-1,2-	156-59-2	70	NA
Dichloroethylene, trans-1,2-	156-60-5	100	NA
Dichloromethane (Methylene chloride)	75-09-2	5	1,000
Dichlorophenol, 2,4-	120-83-2	21	NA
Dichloropropane, 1,2-	78-87-5	5	200
Dichloropropene, 1,3-	542-75-6	5 (0.4)②	†
Dieldrin	60-57-1	0.002	NA
Diethyl ether (ethyl ether)	60-29-7	1,400	†
Diethyl phthalate	84-66-2	‡	NA
Di(ethylhexyl)adipate	103-23-1	400	†
Di(ethylhexyl)phthalate (bis-(2-ethylhexyl)phthalate)	117-81-7	6	†
Diisopropyl ether (DIPE)	108-20-3	120	†
Dimethyl phthalate	131-11-3	50,000③	NA
Dimethylphenol, 2,4-	105-67-9	140	NA
Dinitrophenol, 2,4-	51-28-5	50 (14)②	NA
Dinitrotoluene, 2,4-	121-14-2	10	NA
Dinoseb	88-85-7	7	†
1,4-Dioxane	123-91-1	3	†
1,2-Diphenylhydrazine	122-66-7	10	†
Diquat	85-00-7	20	†

Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)
Endosulfan	115-29-7	42	NA
Endothall	145-73-3	100	†
Endrin	72-20-8	2	NA
Ethylbenzene	100-41-4	700	50,000
Ethylene dibromide	106-93-4	0.05	700
Ethylene glycol	107-21-1	7,000	†
Ethyl tert butyl ether (ETBE)	637-92-3	40	†
Fluoride	16984-48-8	4,000	†
Formaldehyde	50-00-0	100	†
Glyphosate	1071-83-6	700	†
Gross alpha radionuclides		15 Pci/L	†
Heptachlor	76-44-8	0.4	NA
Heptachlor epoxide	1024-57-3	0.2	NA
Hexachlorobenzene	118-74-1	1	NA
Hexachlorobutadiene	87-68-3	0.5	†
Hexachlorocyclohexane, alpha	319-84-6	0.006	†
Hexachlorocyclohexane, beta	319-85-7	0.02	†
Hexachlorocyclohexane, gamma	58-89-9	0.02	NA
Hexachlorocyclopentadiene	77-47-4	50	†
Hexachlorodibenzodioxin	34465-46-8	0.0221	†
Hexachloroethane	67-72-1	1.0	†
Isophorone	78-59-1	100	†
Isopropyl benzene (Cumene)	98-82-8	800	NA
p-Isopropyltoluene	99-87-6	260	†
Lead	7439-92-1	15	NA
Manganese	7439-96-5	840	NA
Mercury	7439-97-6	2	NA
Methanol	67-56-1	4000	†
Methoxychlor	72-43-5	40	NA
Methyl ethyl ketone	78-93-3	4,000	50,000
Methyl isobutyl ketone	108-10-1	2,000	50,000
Methyl mercury	22967-92-6	‡	NA
Methyl phenol, 2-	95-48-7	40	†
Methyl phenol, 4-	106-44-5	40	†
Methyl tert butyl ether	1634-04-4	13	10,000
Metolachlor	51218-45-2	70	†
Metribuzin	21807-64-9	100	†
Monochlorobenzene (Chlorobenzene)	108-90-7	100	3,000
Nickel	7440-02-0	100	NA
Nitrate	14797-55-8	10,000	†
Nitrite	14797-65-0	1,000	†

Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)
Oxamyl	23135-22-0	200	†
Pentachlorophenol	87-86-5	1	NA
Phenol	108-95-2	4,000	†
Picloram	1918-02-1	500	†
Polychlorinated biphenyls (PCBs)	1336-36-3	0.5	NA
Potassium	7440-09-7	35,000	†
n-Propylbenzene	103-65-1	260	†
Radium 226 and 228	7740-14-4	5 Pci/L	†
Selenium	7782-49-2	50	NA
Silver	7440-22-4	100	NA
Simazine	122-34-9	4	†
Strontium 90	7740-24-6	8 Pci/L	†
Styrene	100-42-5	100	50,000
Sulfate	14808-79-8	500,000	†
TCDD, 2,3,7,8- (Dioxin)	1746-01-6	0.00003	NA
Tertiary amyl methyl ether (TAME)	994-05-8	140	†
Tertiary butyl alcohol (TBA)	75-65-0	40	†
Tetrachloroethane, 1,1,1,2-	630-20-6	70	†
Tetrachloroethane, 1,1,2,2,-	79-34-5	2.0	1,000
Tetrachloroethylene (PCE)	127-18-4	5	80
Tetrachlorophenol, 2,3,4,6	58-90-2	200	†
Tetrahydrofuran	109-99-9	154	†
Thallium (thallium chloride)	7440-28-0	2	NA
Toluene	108-88-3	1,000	50,000
Total Coliform		CTS/100ml	†
Toxaphene	8001-35-2	3	†
TP, 2,4,5- (Trichlorophenoxyacetic acid, 2,4,5-)	93-76-5	50	†
Trichlorobenzene, 1,3,5-	108-70-3	40	†
Trichlorobenzene, 1,2,4-	120-82-1	70	1,000
Trichloroethane, 1,1,1-	71-55-6	200	20,000
Trichloroethane, 1,1,2-	79-00-5	5	500
Trichloroethylene	79-01-6	5	50
Trichlorofluoromethane (Freon 11)	75-69-4	2,000	†
Trichloromethane (Chloroform)	67-66-3	70	200
Trichlorophenol, 2,4,5-	95-95-4	700	NA
Trichlorophenol, 2,4,6-	88-06-2	3.0	†
Trichloropropane, 1,2,3-	96-18-4	40	†
Trihalomethanes (total)		80	†
1,2,4-Trimethylbenzene	95-63-6	330	3,000
1,3,5-Trimethylbenzene	108-67-8	330	1,000
Tritium	10028-17-8	20,000 Pci/L	†

Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)
Vinyl chloride	75-01-4	2	10
Xylenes (mixed isomers)	1330-20-7	10,000	30,000
Zinc	7440-66-6	‡	NA
Polynuclear Aromatic Hydrocarbons - Carcinogenic			
Benzo(a)anthracene	56-55-3	10 (0.05)②	NA
Benzo(a)pyrene	50-32-8	10 (0.2)②	NA
Benzo(b)fluoranthene	205-99-2	10 (0.05)②	NA
Benzo(k)fluoranthene	207-08-9	10 (0.5)②	NA
Chrysene	218-01-9	10 (5)②	NA
Dibenzo(a,h)anthracene	53-70-3	10 (0.005)②	NA
Indeno(1,2,3-cd)pyrene	193-39-5	10 (0.05)②	NA
Polynuclear Aromatic Hydrocarbons - Noncarcinogenic			
Acenaphthene	83-32-9	420	NA
Acenaphthylene	208-96-8	420	NA
Anthracene	120-12-7	2,100	NA
Benzo(g,h,i)perylene	191-24-2	210	NA
Fluoranthene	206-44-0	280	NA
Fluorene	86-73-7	280	NA
Methylnaphthalene, 2-	91-57-6	280	†
Naphthalene	91-20-3	20	2,000
Phenanthrene	85-01-8	210	NA
Pyrene	129-00-0	210	NA

Endnotes:

Changes to GW-2 values are highlighted.

① Category GW-2 groundwater is considered to be a potential source of vapors of contaminants to indoor air. The GW-2 values are intended to provide guidelines on when it may be appropriate to examine the indoor air exposure pathway. The GW-2 groundwater category is intended to be used where VOCs (non-petroleum) are detected in groundwater within 100 feet (vertically or horizontally) of an occupied building. At petroleum hydrocarbon sites, the GW-2 screening values are intended to be applied where petroleum VOCs are detected in groundwater within 30 feet (vertically or horizontally) of an occupied building.

② Standard based on estimated quantitation limits contained in SW 846, Final Update III. December 1996. These standards are subject to change, if improved analytical methods become readily available. The human health risk based number is shown in parenthesis.

③ Dimethyl pthalate is based on a ceiling limit of 50,000 ppb instead of the calculated value of 70,000 ppb.

† GW-2 groundwater guidelines are not currently available for these chemicals.

‡ New Hampshire Ambient Groundwater Quality Standards (AGQS) are not currently available for these chemicals. Supplemental information for these chemicals will be made available in an addendum to this policy when available.

Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)

††	The GW-1 standard for chromium is based on the sum of chromium (III) and (VI).
NA	Not Applicable.

Table 1
REVISED
BACKGROUND CONCENTRATIONS OF METALS IN SOIL[1]

NHDES Risk Characterization and Management Policy (Subsection 1.5(4)(c))

CHEMICAL NAME	SOIL CONCENTRATION (mg/kg)
Antimony	1.64
Arsenic	11
Beryllium	0.95
Lead	51
Mercury	0.31
Nickel	23
Selenium	5.0

Source: 95th percentile of data contained in 1) Appendix A of the NH DHHS "Preliminary Survey of Metal Concentrations in New Hampshire Soils, Final Report", May 1991 and 2) the background data (i.e., before sludge spreading) collected for the sludge application program prior to 10/23/1997.

[1] Only compounds with revised background concentrations are listed.

Table 3
REVISED
METHOD 1 SOIL STANDARDS[3]

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)
Arsenic	7440-38-2	**11**	**11**	**11**
Chlordane	57-74-9	**2.9**	**8.6**	**19**
Clopyralid	1702-17-6	**14,000**		
Cyanizine	21725-46-2	**1**		
Beryllium	7440-41-7	**0.95**	**0.95**	**1**
Mercury (inorganic)	7439-97-6	**13**	**13**	**13**
Methyl tert butyl ether	1634-04-4	**0.13**	**0.13**	**0.13**
Metolachlor	51218-45-2	**280**		
Metribuzin	21807-64-9	**360**		

***Endnotes:**

Column (1): Chemical Name.
Column (2): Chemical Abstract Service (CAS) Number.

Column (3): Method 1 Category S-1 Soil Standard.
Column (4): Method 1 Category S-2 Soil Standard.
Column (5): Method 1 Category S-3 Soil Standard.

[3] Only compounds with revised Method 1 soil standards are listed.

CONTAMINATED SITES

RISK CHARACTERIZATION
and
MANAGEMENT

POLICY

JANUARY 1998

NHDES CONTAMINATED SITES
RISK CHARACTERIZATION AND MANAGEMENT POLICY

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APPENDIX D: Methodology for the Determination of Ceiling Concentrations

APPENDIX E: Soil Standard Selection Methodology Summary Table

GLOSSARY

1.) **Activity and Use Restrictions** means the controls or restrictions imposed on the activities and use of a site, as necessary to achieve or maintain a condition that is protective of human health

and the environment, and recorded in the Registry of Deeds for the county in which the site is located.

2.) **Background** means those levels of contaminants that would exist in the absence of the site of concern which are:

1. ubiquitous and consistently present in the environment at and in the vicinity of the site of concern; and
2. attributable to geologic or ecologic conditions, atmospheric deposition of industrial process or engine emissions, fill materials containing wood or coal ash, releases to groundwater from a public water supply system and/or petroleum residues that are incidental to the normal operation of motor vehicles.

3.) **Certificate of Completion** means a certificate issued by NHDES which certifies that any necessary Activity and Use Restrictions have been implemented, any monitoring requirements are being met**,** all fees and costs due under RSA 147-E have been paid and the activities specified in an approved Remedial Action Plan have been completed.

4.) **Certificate of Partial Completion** means a certificate issued by NHDES which certifies that substantial progress has been made toward the implementation of an approved Remedial Action Plan. This certificate can be issued after a key phase of activity has been completed, a portion of the site has been remediated or key Activity and Use Restrictions have been implemented.

5.) **Certificate of No Further Action** means a certificate issued by NHDES which certifies that active phases of remedial activities in an approved Remedial Action Plan for a site have been completed and that no significant additional NHDES involvement is required at a site.

6.) **Chronic Exposure** means multiple or continuous exposures occuring over an extended period of time, or a significant fraction of an individual's lifetime. NHDES typically considers exposures lasting for one year or longer to be chronic in duration.

7.) **A Condition that is Protective of Human Health and the Environment** means a level of control of each contaminant of concern identified in the Risk Characterization, such that no such contaminant of concern presents a significant risk of harm to human health and the environment during a reasonably foreseeable period of time.

8.) **Contaminant** means:

1) hazardous waste as defined in RSA 147-A:2,VII. and RSA 147-B:2,VII., or identified in Part Env-Wm 400 "Identification and Listing of Hazardous Wastes";
2) hazardous materials (as defined in RSA 147-B:2,VIII.); or,
3) oil (as defined in RSA-146-A:2, III.).

9.) **Contamination** means the presence of contaminants in the soil, groundwater, air, sediment, or surface water at a site.

GLOSSARY (Cont.)

10.) **Contaminated Debris** means any debris that is contaminated by a release of oil, hazardous

waste and/or hazardous materials.

11.) **Contaminated Media** means any soil, groundwater, air, sediment, or surface water containing oil, hazardous waste and/or hazardous materials.

12.) **Current uses** are actual or possible uses given current circumstances.

13.) **Disposal** means the discharge, deposit, incineration, injection, dumping, spilling, leaking or placing of any waste into or onto any land or water so that the waste or any constituent of the waste may enter the environment, be emitted into the air or be discharged into any waters, including groundwater (as defined in RSA 147-A:2,III. and RSA 147-B:2,II.).

14.) **Environmental Receptor** means any living organism, other than humans, and/or any habitat which supports such organisms, and/or any other natural resource, as further described in Section 2.0 of this policy.

15.) **Foreseeable uses** are hypothetical (i.e., have not yet occurred) and may yet be changed or avoided.

16.) **Human Receptor** means a person who is likely to be affected by a site, as further described in Section 2.0 of this policy.

17.) **Imminent Hazard** means any hazard which would pose a significant risk of harm to health, safety, public welfare or the environment if it were present for even a short period of time, as further described in Section 5.0 of this policy.

18.) **Reference Dose (RfD)** means an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncarcinogenic effects during a lifetime.

19.) **Release** means any spilling leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment (RSA 147-B:2).

20.) **Remedial Action** is any measure or combination of measures which will, when implemented, ensure attainment of a level of control of each contaminant of concern at a site or in the surrounding environment such that no contaminant of concern will present a significant risk of harm to human health or the environment. Activity and Use Restrictions are an appropriate remedial action when approved by NHDES (See Section 11).

21.) **Site** means any structure, well, pit, pond, lagoon, impoundment, ditch, landfill, or other place or area, excluding ambient air or surface water, where contaminants have come to be located as a result of a release of contaminants. The term does not include any site containing only contaminants which: 1) resulted from emissions from the exhaust of an engine; 2) are building materials still serving their original intended use or emanating from such use; 3) are present due to the land application of sludge; or 4) are lead-based paint residues emanating from a point of original application of such paint.

22.) **Subchronic Exposure** means multiple or continuous exposures occurring over a period ranging from two weeks up to one year of a person's life.

NHDES
CONTAMINATED SITES
RISK CHARACTERIZATION and MANAGEMENT POLICY

1.0: Procedures and Standards for the Characterization of the Risk of Harm to Human Health, Safety and the Environment

The 'NHDES Contaminated Sites Risk Characterization and Management Policy' (RCMP) describes a tiered risk-based approach to characterize risks to human health and environment posed by the release of contaminants at sites in New Hampshire. The policy is based on current toxicology and risk assessment information and will be periodically updated. Figure 1 provides a flow chart overview of the NHDES risk based remedial action process. The main elements of the remedial action process illustrated in the flow chart that are discussed in the RCMP are: 1) three methods to evaluate risk and establish cleanup standards, ranging from "look-up" tables which list soil and groundwater standards to conducting a comprehensive risk assessment; 2) the protocols for requesting and issuance of a Certificate of Completion and a Certificate of No Further Action; 3) the process for the identification and implementation of Activity and Use Restrictions, which are used to manage the exposure to contaminants remaining at a site. The Policy complements the Groundwater Protection Rules (Env-Ws 410), Reporting and Remediation of Oil Discharge Rules (Env-Ws 412) and other regulations applicable to the remedial action process;these regulations include critical requirements such as the treatment, removal or containment of source areas, site notification, groundwater management permits, etc.

1.1: Applicability and General Requirements

(1) The procedures, criteria and standards in this policy are applicable to all sites in New

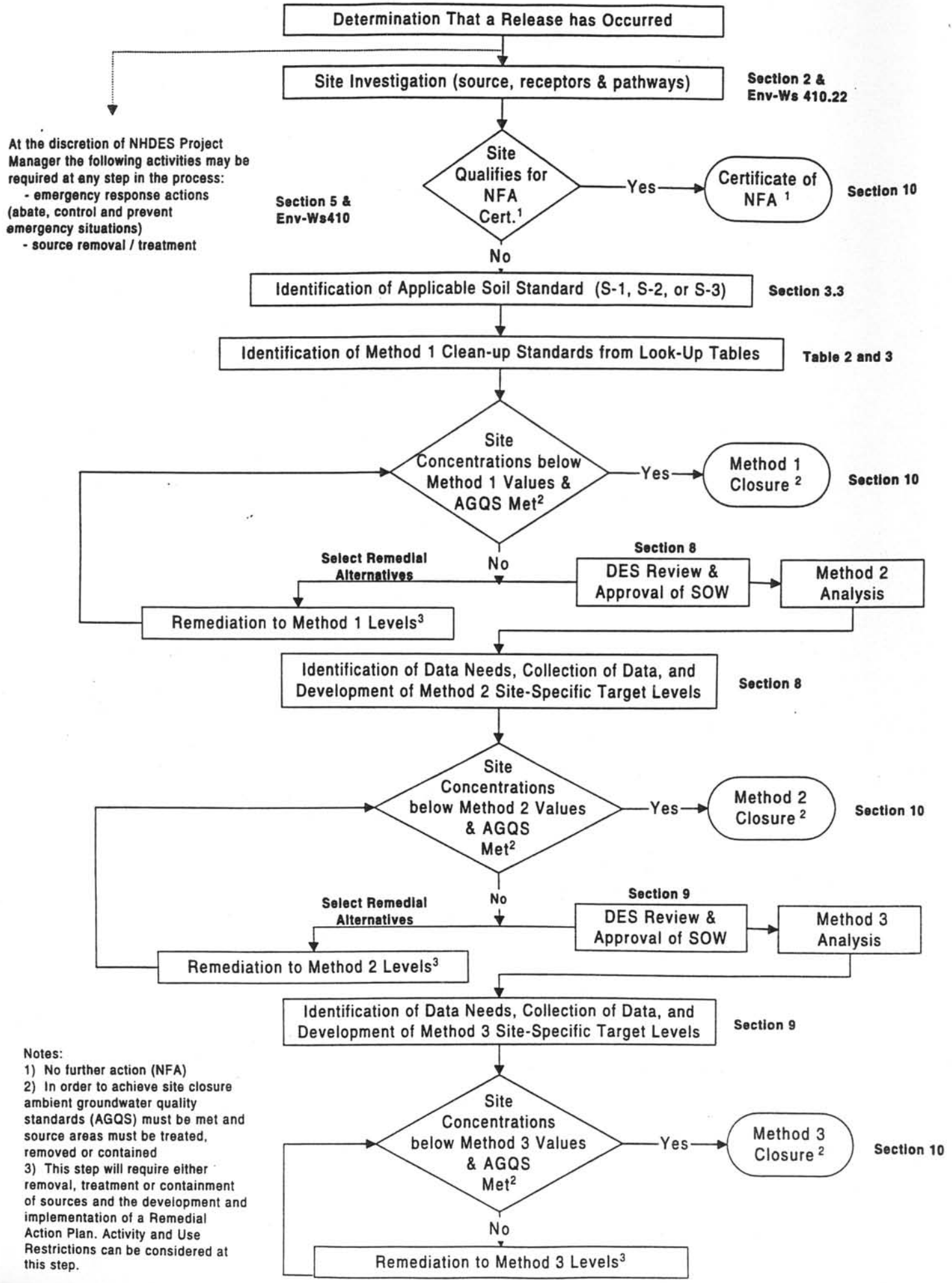
Hampshire with contaminated soil and/or groundwater where a remedial action or site investigation is required by state law. While this policy cannot supercede federal statutes and regulations, portions of the policy may be appropriate for use at federal remediation sites (e.g., CERCLA National Priority List and RCRA Corrective Action sites). NHDES and/or the appropriate federal program should be contacted for further information.

(2) Releases of contaminants to the environment are subject to the provisions of RSA 146-A "Oil Spillage in Public Waters", RSA 146-C "Underground Storage Facilities," RSA 146-D "Oil Discharge and Disposal Cleanup Fund," RSA 147-A "Hazardous Waste Management Act", RSA 147-B "Hazardous Waste Cleanup Fund," RSA 147-F "Brownfields Program," RSA 485-C "Groundwater Protection Act," RSA 149-M "Solid Waste Management," RSA 125-C "Air Pollution Control," and RSA 125-I "Air Toxic Control Act."

(3) The general procedures and standards which apply to all Risk Characterizations are described in Sections 1.0 through 3.0 of this policy. Requirements which are specific to the type and method of Risk Characterization being performed are described in Sections 4.0 through 9.0.

(4) Section 10.0 of this policy describes the general procedures for determining when remedial actions taken at a site are sufficient to meet the requirements of a Remedial Action

FIGURE 1 COMPONENTS OF THE RISK-BASED CORRECTIVE ACTION PROCESS



Notes:
1) No further action (NFA)
2) In order to achieve site closure ambient groundwater quality standards (AGQS) must be met and source areas must be treated, removed or contained
3) This step will require either removal, treatment or containment of sources and the development and implementation of a Remedial Action Plan. Activity and Use Restrictions can be considered at this step.

Plan (RAP) for the site and justify the issuance of a Certificate of Completion, or a Certificate of No Further Action.

(5) Section 11.0 of this policy describes the general procedures and requirements for determining the appropriate use and application of Activity and Use Restrictions.

(6) The characterization of risk of harm to human health and the environment is not required for a site where contaminant concentrations are at or below background levels, as described in Section 1.5 of this policy.

1.2 Purpose and General Approach of Risk Characterization

A Risk Characterization is performed to evaluate the risk of harm to human health and the environment that exists at a site due to the release of contaminants to soil and groundwater. Risk Characterizations provide the quantitative and qualitative information used to evaluate how the identified risks will be addressed, and determine whether a remedial action, or additional response actions are necessary at a contaminated site, pursuant to Section 10.0 of this policy.

(1) Risk Characterizations are used to determine whether conditions that are protective of human health and the environment exist or have been achieved. Two basic approaches to Risk Characterization are utilized:

(a) The chemical-specific approach compares site concentrations to standards in soil and groundwater, (Risk Characterization Methods 1 and 2, as described in Sections 7.0 and 8.0 of this policy, are chemical specific approaches); and,

(b) The cumulative risk approach (i.e., Risk Characterization Method 3, as described in Section 9.0 of this policy) compares site-specific information to:

1. a Cumulative Cancer Risk Limit of an Excess Lifetime Cancer Risk of one-in-one hundred thousand;
2. a Cumulative Noncancer Risk Limit which is a Hazard Index equal to one;
3. applicable or suitably analogous human health and environmental standards; and,
4. site-specific conditions.

(c) For the sites to which they are applicable, the soil and groundwater standards of the chemical-specific approach have been developed to meet the same objectives as those of the cumulative risk approach.

(d) "Screening" Risk Characterizations use worst-case exposure assumptions and conservative toxicity values to quickly demonstrate whether conditions that are protective of human health and the environment exist or have been achieved. If such a conclusion cannot be reached following a screening Risk Characterization, a more detailed assessment is appropriate.

1. Generally, the Method 2 and 3 Risk Characterizations require more detailed information (and a greater level of effort) than a Method 1 Risk Characterization.

(2) Notwithstanding the criteria described in Section 1.2(1)(b), for the purposes of this policy, if the concentration of a contaminant is at or below a background level, then that contaminant concentration is considered to be protective of human health and the environment. Sites at which all contaminants have been reduced to background levels are eligible for a Certificate of No Further Action (Section 10.4) even if such background levels exceed one or more of the numerical standards, or risk criteria, in Sections 7.0 and 8.0 of this policy.

1.3 Scope of the Risk Characterization and Supporting Documentation

(1) The scope and level of effort of the Risk Characterization depend on the complexity of the site and the remedial action being performed. The Risk Characterization must be of sufficient scope to meet the objectives of Section 1.4.

(2) The length and complexity of the Risk Characterization depend upon the nature of the site, the selected method of Risk Characterization and the scope of the required remedial action. A Risk Characterization may be submitted to NHDES as a separate report or as one or more components of the Site Investigation Report (Env-Ws 410.22), RAP (Env-Ws 410.23), or any other appropriate submittal required pursuant to the Groundwater Protection Rules (Env-Ws 410), the Reporting and Remediation of Oil Discharges (Env-Ws 412), or the Hazardous Waste Rules (Env-Wm 100 through 1000). Method 1 Risk Characterization (Section 7.0) may be presented in a summary table format with a concise risk characterization discussion and included in the relevant submittal (i.e., Site Investigation Report, RAP, etc.).

1.4 Risk Characterization Performance Requirements

(1) A Risk Characterization must be performed in a manner consistent with scientifically acceptable risk assessment practices.

(2) A Risk Characterization and related site investigations must be performed with the diligence necessary to obtain the quantity and quality of information adequate to:

(a) define the nature, extent and magnitude of contamination at a site;
(b) evaluate remedial action alternatives;
(c) design and implement specific remedial actions at a site that will achieve and maintain conditions that are protective of human health and the environment; and,
(d) support recommendations for the implementation of Activity and Use Restrictions at a site.

(3) Individuals preparing Risk Characterizations must:

(a) consider relevant regulations, policies and guidelines of the New Hampshire Department of Environmental Services (NHDES), the New Hampshire Department of Health and Human Services (NHDHHS) and the United States Environmental Protection Agency (USEPA);

(b) use accurate and up-to-date methods, standards and practices, equipment and technologies which are appropriate, available and generally accepted by the professional and trade communities; and

(c) use investigative practices which are scientifically defensible and of a level of precision and accuracy commensurate with the intended use of the results of such investigations.

1.5 Site Information Required for Risk Characterization

An adequate site characterization is a prerequisite to the characterization of risk of harm to human health and the environment. The appropriate type and amount of information required to complete a Risk Characterization will depend on the unique characteristics of the contaminant release and/or site. The Site Investigation should pay particular attention to the following site assessment parameters:

(1) Physical Characteristics. The physical characteristics of the site, such as the topography, geology, hydrogeology, and surface characteristics, are to be evaluated as warranted by the nature of the release and site conditions and adequately described in support of the Risk Characterization.

(2) Extent of Release. The Risk Characterization must contain a description of the source and extent of the release of the contaminant, including:

(a) the horizontal and vertical extent and concentrations of contaminants in all evaluated media;

(b) background concentrations of contaminants in all evaluated media; and

(c) all existing or potential migration pathways such as soil, groundwater, surface water, air, sediment, and food chain pathways.

(3) Characterization of the Contaminants. The Risk Characterization must describe the contaminants at the site, including the following:

(a) type, volume, composition, nature, physical, chemical and toxicological characteristics; and

(b) environmental fate and transport characteristics, including mobility, stability, volatility, ability and opportunity for bioaccumulation, and persistence in the environment.

(4) Background Levels of Contaminants

(a) Background means those levels of contaminants that would exist in the absence of the site of concern and are:

1. ubiquitous and consistently present in the environment at and in the vicinity of the site of concern; and
2. attributable to geologic or ecologic conditions, atmospheric deposition of industrial process or engine emissions, fill materials containing wood or coal ash, releases to groundwater from a public water supply system and/or petroleum residue that are incidental to the normal operation of motor vehicles.

(b) At sites where contaminant concentrations are at or below background concentrations, such concentrations are deemed to be protective of human health and the environment.

(c) Table 1 lists the concentrations of metals which may be used as background concentrations in soil in lieu of site-specific background concentrations in accordance with this policy. The concentrations listed in Table 1 are considered sufficiently

representative of non-urban (i.e., suburban and rural) locations in New Hampshire.
(d) Site specific background concentrations can be developed, following approval by NHDES of a proposed work scope. Background sample locations must be from areas that could not have received contamination from the site, but have the same basic characteristics as the medium of concern at the site.

Revised 4/3/01

Table 1

BACKGROUND CONCENTRATIONS OF METALS IN SOIL

NHDES Risk Characterization and Management Policy (Subsection 1.5(4)(c))

CHEMICAL NAME	SOIL CONCENTRATION (mg/kg)
Arsenic	12
Cadmium	1.9
Chromium	33
Lead	54
Mercury	0.33
Nickel	24
Selenium	2.2
Zinc	98

Source: 95th percentile of data contained in 1) Appendix A of the NH DHHS "Preliminary Survey of Metal Concentrations in New Hampshire Soils, Final Report", May 1991 and 2) the background data (i.e., before sludge spreading) collected for the sludge application program prior to 10/23/1997.

1.6 General Requirements for Conducting Remedial Actions

For each release or threat of release of a contaminant at a site:

(1) Remedial actions are required at a site if contaminant concentrations exceed the applicable Soil and Groundwater Standards (Sections 7.0, 8.0 or 9.0). No site is deemed to have had all the necessary and required remedial actions taken unless and until all applicable Soil and Groundwater Standards have been achieved by the use of active remedial measures or NHDES approved Activity and Use Restrictions (Section 11.0).

(2) A site investigation must be conducted in accordance with Env-Ws 410.

(3) A Risk Characterization, including the identification of all Activity and Use Restrictions necessary to protect human health and the environment, must be conducted in accordance with this policy and be completed prior to the approval of the RAP for the site.

(4) The RAP must be prepared and conducted in accordance with Env-Ws 410.23.

(5) Upon completion of all active components of the approved RAP, a Certificate of Completion (Section 10.4) may be requested.

(6) Where appropriate and at the discretion of NHDES, remedial actions may be implemented on a portion of a site or contaminated area, as part of a phased approach to complete RAP implementation.

(7) In determining whether a remedial action will protect human health and the environment, the criteria and standards set forth in this policy and the current or reasonably foreseeable uses of the site and the surrounding environment that may be affected by site-related contaminants, must be considered.

(8) Remedial actions at a site must be conducted by persons having the appropriate training and credentials, as required by NHDES.

(9) A remedial action must:

(a) be supported by investigations, evaluations, plans and reports conducted pursuant to NHDES requirements which are of sufficient scope, detail and level of effort to demonstrate that the remedial measures implemented have addressed the risk of harm created by the contamination at the site;

(b) be commensurate with the nature and extent of the release and the complexity of site conditions;

(c) ensure consistency with the approved Risk Characterization;

(d) conform with applicable requirements and procedures for conducting remedial actions.

2.0: Receptor Information Required for Risk Characterization

The identification of receptors must include an analysis of site activities and uses, exposure points and exposure point concentrations. The receptor analysis must provide information sufficient to estimate receptor exposure to contaminants.

2.1: Identification of Human Receptors

The Risk Characterization must identify and describe the Human Receptors who are likely to be present at the site or in the surrounding environment, and who, as a result, are likely to be exposed to site-related contaminants.

(1) The identification of the Human Receptors must consider the current and reasonably foreseeable uses of the site and the surrounding environment.

(2) The Human Receptors identified should not be specific individuals, but must be described as groups of individuals.

(3) Subpopulations which may be at increased risk due to increased sensitivity, particular behavior patterns or current or past exposures to chemicals in the environment must be identified as distinct receptors. Identification of the most sensitive subpopulation should be done on a site by site basis.

(4) The Human Receptors must be described in terms such as age group, occupation or other characteristics which will distinguish them from the general population. Examples of human receptor descriptions include the following:

(a) lifelong residents at the site;
(b) trespassers;
(c) women of childbearing age;
(d) construction and or maintenance workers; and
(e) children, ages one to six years.

2.2: Identification of Environmental Receptors

The Risk Characterization must identify and describe the Environmental Receptors which are likely to be present at the site and those who may be exposed to contamination at or from the site. For the purpose of carrying out this policy, “Environmental Receptor” means any living organism, other than humans, and/or any habitat which supports such organisms, and/or any other natural resource which comes into contact with contaminants as a result of a contaminant release to the environment.

(1) Examples of Environmental Receptors include:

(a) wildlife;

(b) fish and shellfish; and
(c) plants.

(2) Examples of habitats and natural resources may include the following:
(a) aquatic ecosystems such as surface waters;
(b) fresh and saltwater fisheries, fish habitats, shellfish areas;
(c) wetlands;
(d) benthic communities;
(e) terrestrial ecosystems such as forests and meadows; and
(f) wildlife sanctuaries and reserves.

(3) All relevant Federal and State Threatened Species or Endangered Species (RSA 212-A "Endangered Species Conservation Act"), or Rare or Sensitive Species (RSA 217-A "The Native Plant Protection Act") which are known or likely to be located at the site, or in the immediate surrounding area, are to be specifically identified as Environmental Receptors.

2.3: Identification of Site Activities and Uses

The Risk Characterization must identify and describe all current and reasonably foreseeable Activities and Uses of the site and the potentially affected environment (i.e., areas or locations where contaminants of concern at the site may come to be located) which could expose Human or Environmental Receptors to contaminants. The Site Activities and Uses must be used in combination with the criteria described in Section 3.0 of this policy to identify applicable groundwater and soil categories and to estimate the nature and magnitude of exposure pursuant to Section 9.0. The selection of site-specific exposure frequency and exposure duration should be representative of the full extent of Site Activities and Uses.

(1) The identification and description of current Site Activities and Uses include those associated with the land, with structures in and on the land, and with the groundwater, surface water, soil, sediment or air which could result in exposure of Human or Environmental Receptors to site-related contaminants. This evaluation should include consideration of activities which may not be occurring at the time of the evaluation, but are consistent with the current use of the site and immediate environment and may reasonably be expected to occur.

(2) The identification and description of reasonably foreseeable Site Activities and Uses include potential activities or uses which could result in exposures that are greater than the exposures associated with current Site Activities and Uses. Site Activities and Uses that are prohibited through the use of Activity and Use Restrictions in accordance with Section 11.0 of this policy may be eliminated from further consideration.

(3) If the Site Activities and Uses considered in the Risk Characterization will be limited through Activity and Use Restrictions, as described in Section 11.0 of this policy, then the Risk Characterization must clearly and concisely state the Site Activities and Uses which will

be prohibited.

(a) The assessment of *current* Site Activities and Uses must not consider Activity and Use Restrictions that are not in place or not effective.

(b) The results of the Risk Characterization will not be considered valid unless and until all Activity and Use Restrictions have been recorded and/or registered in the appropriate Registry of Deeds in accordance with Section 11.2.

2.4: Identification of Exposure Points

Exposure points are locations where potential contact between a human or environmental receptor and site contaminants occurs. Procedures for identifying exposure points are as follows:

(1) Potential Exposure Points must be identified during the Risk Characterization process after considering the site and receptor information described in Sections 1.6 through 2.3.

(2) "Hot spots" are considered distinct Exposure Points.

(3) The identification of an Exposure Point must be consistent with the type and method of Risk Characterization which is being performed.

(4) Consideration must be given to the identification of Exposure Points which may be located at a distance from the original source of the release, particularly when the migration of contaminants may result in Exposure Points in addition to those identified under current site conditions.

(5) Examples of Exposure Points include the following:
- (a) an existing public or private water supply;
- (b) a likely future drinking water supply;
- (c) a hot spot of contamination in a neighborhood playground; and
- (d) a volume of subsurface soil at a potential construction site.

2.5: Identification of Exposure Pathways

(1) For each identified receptor at each Exposure Point, the documentation of the Risk Characterization must identify and describe all known and likely Exposure Pathways, based upon the media contaminated and the Site Activities and Uses.

(2) The Exposure Pathways considered must be consistent with the type and method of Risk Characterization which is being performed.

(3) Examples of typical Exposure Pathways include the following:
- (a) ingestion of soil, produce, water, or biota;
- (b) inhalation of air or particulate matter; and
- (c) dermal absorption from water or soil.

2.6: Identification of Exposure Point Concentrations.

(1) An Exposure Point Concentration must be identified and documented for each medium and contaminant that was detected during the site investigation.

(2) Exposure Point Concentrations must be determined or estimated in a manner consistent

with the type and method of Risk Characterization which is being performed.

(3) In determining or estimating the Exposure Point Concentration, the following approach will be utilized:

(a) Method 1 (look up Table use): Site evaluations conducted using the Method 1 risk characterization estimate a reasonable worst case exposure to ensure protectiveness under this streamlined assessment process. Maximum concentrations should be used for Method 1 exposure point concentrations, unless an alternate approach is approved by the Department.

(b) Method 2: Method 2 risk characterizations are based on site specific considerations and require more data than a Method 1 screening evaluation. If sufficient quantity and quality data is available to estimate either the 95th percent upper confidence limit of the arithmetic mean or an arithmetic average exposure point concentrations, these approaches can be used instead of the maximum concentration with NHDES approval.

(c) Method 3: When determining exposure point concentration for Method 3, the objective is to develop sufficient data to identify an arithmetic average concentration which provides an estimate of the concentration contacted by a receptor at the exposure point over the period of exposure.

(d) When developing exposure point concentrations for Method 2 or 3 the use of the maximum concentrations must be considered when conducting:

1. evaluations of acute exposures;
2. evaluations of chemicals associated with lethal or severe human health effects;
3. evaluations of site conditions for which there is insufficient data or other information to adequately characterize the site (e.g., when there is insufficient data to adequately characterize the effects of seasonal variation on groundwater contaminant concentrations); or
4. Imminent Hazard Evaluations (described in Section 5.0).

(e) Assessments conducted using a probabilistic analysis may use a distribution of Exposure Point Concentrations instead of an arithmetic mean, when approved by NHDES, provided that the data are sufficient to provide a reliable distribution and the use of a distribution is consistent with the nature of the evaluation being performed.

(4) Exposure Point Concentrations may be developed using monitoring data gathered during the site investigation or, when appropriate, through the use of fate and transport models acceptable to the Department.

(5) Any mathematical equations or models used to identify Exposure Point Concentrations must be clearly documented.

(6) Below Detection Limit (BDL) data within a contaminated area or zone can be included in an arithmetic average or 95th percent upper confidence limit of the arithmetic mean as half of the detection limit. Alternative statistical approaches to addressing BDL data may be

utilized following consultation with NHDES. BDL values at the perimeter or outside of the contaminated area should not be included in either the arithmetic mean or a 95th percent upper confidence limit of the arithmetic mean exposure point concentration calculation.

3.0: Identification of Site Groundwater and Soil Categories

3.1: Purpose

NHDES has established categories of groundwater and soil for use in the characterization of risk at sites. The Risk Characterization documentation must support the categorization of the groundwater and soils used for a site.

(1) The groundwater and soil categories must be used to determine the applicability of the groundwater and soil standards listed in Section 7.4(5) and Section 7.5(2) when characterizing risks using the methods set forth in this policy[1].

(2) The groundwater categories must be used to identify applicable or suitably analogous standards as described in Section 9.3(3), when Risk Characterization Method 3 is used to characterize risk. Method 3 (described in Section 9.0) employs site-specific exposure assumptions to determine if the Exposure Point Concentrations will exceed the applicable or suitably analogous standards, or if the human health risk limits are exceeded.

(3) Groundwater and soil must be categorized at a site regardless of the Risk Characterization method selected.

(4) The groundwater and soil categories must be considered in determining the need for Activity and Use Restrictions at a site.

3.2: Identification of Applicable Groundwater Categories

(1) New Hampshire's Groundwater Protection Act, RSA 485-C, requires that the groundwater resource in the State must be preserved and protected in order that groundwater may be used for drinking water supply. New Hampshire's Groundwater Protection Rules (Env-Ws 410) establishes as a goal for groundwater quality at all contaminated sites the attainment of the Ambient Groundwater Quality Standards (AGQS). The investigation, remediation and monitoring of groundwater contamination must be performed in accordance with the requirements of Env-Ws 410.

(2) Two categories of groundwater contamination have been established to characterize the risks associated with contaminated groundwater at a site. The groundwater categories are described as GW-1 and GW-2 and are associated with two distinct types of exposures: i.e., its use as drinking water (GW-1); and as a source of indoor air contamination (GW-2). In

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[1] Risk Characterization Method 1 (described in Section 7.0) is the characterization of risk through the use of numerical standards. Risk Characterization Method 2 (described in Section 8.0) is the characterization of risk through the application of numerical standards and allows for *limited* modification of the generic Method 1 standards based upon site-specific information and chemical-specific fate and transport factors. Risk Characterization Method 3 (described in Section 9.0) is the characterization of risk through the application of site-specific methodologies.

addition to these categories, surface water quality violations caused by contaminated groundwater must be addressed.

(3) Groundwater Category GW-1: Under RSA 485-C, the GW-1 category is applicable to all sites. However, one of the following exemptions may apply:

(a) The groundwater is contained within a Groundwater Management Zone (GMZ) as defined by the Groundwater Management Permit and the approved Remedial Action Plan for a site. In this case a temporary exemption to GW-1 standards is provided during the remediation period.;

(b) The contaminants are related to a discharge managed by a Groundwater Discharge Permit;

(c) The contaminants are naturally occurring.

(4) Groundwater Category GW-2: **Revised July 11, 2006**

Groundwater Categories GW-2 is applicable to a site, if groundwater contains volatile chemicals, is located within 30 feet of an existing occupied building or structure, and the average depth to groundwater in that area is 15 feet or less. Category GW-2 groundwater is considered to be a potential source of vapors of contaminants to indoor air. The GW-2 category standards are intended to oprovide guidelinesn when it may be appropriate to examine the indoor air exposure pathway. The GW-1 category is applicable to all sites, including sites where the GW-2 category also applies.

(5) Surface Water: Groundwater shall not contain any contaminant at a concentration such that the natural discharge of groundwater to surface water causes a violation of surface water quality standards (Env-Ws 410.03 and 432). Groundwater quality that fails to meet this performance standard and has caused or is likely to cause a surface water quality standard violation must be addressed under the provisions of a RAP or a Groundwater Management Permit.

3.3 Identification of Applicable Soil Categories

Soil is classified as either category S-1, S-2 or S-3. The site, receptor and exposure information identified in Sections 1.5 through 2.6, considering both the current and reasonably foreseeable Site Activities and Uses identified in Section 2.3, are used in conjunction with the criteria listed below to categorize the soil.

(1) The soil categories are applicable to specific volumes of soil which are described in written and graphic form in the Risk Characterization.

(2) The three soil categories describe a range of the potential for exposure to that soil: Category S-1 soils are associated with the highest potential for exposure, Category S-3 soils have the lowest potential for exposure. While one and only one category is applicable to a specified volume of soil, soils in different areas of a site may be classified in different categories, depending upon their exposure potential.

(3) Figure 2, “NHDES Soil Category Selection Matrix - Human Exposure Potential” in Section 3.3(9) contains a matrix summarizing the criteria used to categorize soil.

(4) For the purpose of soil categorization, the potential for exposure is described by a

qualitative analysis of the accessibility of the soil in combination with the information about the Site Activities and Uses determined pursuant to Section 2.3. The following definitions are used to describe exposure potential for the purposes of categorizing soil:

(a) Frequency of use indicates how often a receptor makes use of, or has access to, the site. Receptor access to and use of the areas around the site are often strong indicators of potential site access and thus should be considered in determining frequency of use for the site under investigation. Frequency of use is described as either "High," "Low" or "Not Present," using the following criteria:

1. Children's frequency of use is characterized as high if:
    a. children reside, attend school or attend day care at the site; or
    b. large numbers of children visit or pass through the site, regardless of any one child's frequency of visitation.
2. Adults' frequency of use is characterized as high when they reside at the site, or when they work at the site on a continuing basis [*i.e.*, full days or shifts of eight or more hours per day on a continuing basis].
3. Children's or adults' frequency of use is characterized as low when they are present at the site, but only as infrequent visitors; or when workers are present at the site for only short periods of time [*i.e.*, less than two hours per day on a continuing basis, or for full days or shifts on a sporadic basis].
4. It must be presumed that children may be present at the site unless it can be demonstrated that access by children age 15 and younger is specifically restricted or that such children are unlikely to be present. Children may then be considered to be "Not Present." Sites which are residential properties must presume the presence of children unless demonstrated otherwise.

(b) Intensity of use describes the nature of the Site Activities and Uses which could potentially result in exposure to the receptor. Intensity of use is described as either "High" or "Low," using the following criteria:

1. Site Activities and Uses which have the potential to disturb soil and thus result in either direct contact with the soil itself or inhalation of soil-derived dust are characterized as high intensity use. Examples of such activities include, gardening, digging, and competitive sports.
2. Passive activities which do not disturb the soil, such as walking, shopping, and birdwatching are characterized as low intensity use.
3. The intensity of use for each identified Site Activity and Use are characterized in the Risk Characterization as either high or low with appropriate justification.

(c) Accessibility of the soil to potential receptors is characterized as either "accessible," "potentially accessible," or "isolated" using the following criteria:

1. Soil is characterized as "accessible" if it is located less than two feet below the surface, and the surface is not completely covered by pavement or other materials that are functionally equivalent to a pavement. For buildings having earthen floors, the floor is considered as the soil surface.
2. Soil is characterized as "potentially accessible" if it is located at a depth between two and fifteen feet below the surface (with or without pavement or other materials that limit access to the soil), or if the soil is located less than two feet from the surface in an area completely paved or functionally similar material.
3. Soil is characterized as "isolated" if it is located at a depth greater than 15

feet below the surface, or if the soil is covered completely by a building or other permanent structure which does not have earthen floors, regardless of depth. Soil located at a depth greater than two feet below the earthen floor of a building or other permanent structure is also characterized as "isolated."

(5) Category S-1. Soil is classified as category S-1 if either:

(a) the soil of concern is accessible, pursuant to Section 3.3(4)(c)(1), and either:

1. the soil is currently used for growing fruits or vegetables for human consumption, or if it is reasonably foreseeable that the soil may be put to such use; or

2. a child's frequency or intensity of use is considered to be high pursuant to Sections 3.3(4)(a) and (b); or

3. an adult's frequency and intensity of use are both considered to be high pursuant to Section 3.3(4)(a) and (b);

(b) or the soil is potentially accessible, pursuant to Sections 3.3(4)(c)(2), and a child's frequency and intensity of use are both considered to be high pursuant to Section 3.3(4)(a) and (b).

(6) Category S-2. Soil is classified as category S-2 if either:

(a) the soil is accessible, pursuant to Section 3.3(4)(c)(1), and either:

1. a child's frequency and intensity of use are both considered to be low pursuant to Section 3.3(4)(a) and (b); or

2. children are not present at the site and either (but not both) the adults' frequency or intensity of use is considered to be high, pursuant to Section 3.3(4)(a) and (b);

(b) or the soil is potentially accessible, pursuant to Section 3.3(4)(c)(2), and either:

1. a child's frequency or intensity of use, but not both, is considered to be high pursuant to Section 3.3(4)(a) and (b); or

2. children are not present at the site and an adult's frequency and intensities of use are both considered to be high pursuant to Section 3.3(4)(a) and (b).

(7) Category S-3. Soil is classified as category S-3 if either:

(a) the soil is accessible, pursuant to Section 3.3(4)(c)(1), and children are not present at the site and an adult's frequency and intensities of use are both considered to be low pursuant to Section 3.3(4)(a) and (b); or

(b) the soil is potentially accessible pursuant to Section 3.3(4)(c)(2), and:

1. a child's frequency and intensity of use are both considered to be low pursuant to Section 3.3(4)(a) and (b); or

2. a demonstration has been made that children are not present at the site, and either an adult's frequency or intensity of use is considered to be low pursuant to Section 3.3(4)(a) and (b); or

(c) the soil is isolated pursuant to Section 3.3(4)(c)(3), regardless of any receptor's frequency or intensity of use.

(8) When uncertainty exists regarding the selection of the appropriate soil category, the soil

category associated with the highest exposure potential (among the soil categories being considered) must be selected.

(9) Figure 2, the “NHDES Soil Category Selection Matrix - Human Exposure Potential” follows:

Figure 2 **(Subsection 3.3(9))**

NHDES SOIL CATEGORY SELECTION MATRIX - HUMAN EXPOSURE POTENTIAL

<table>
<tr><th rowspan="3">ACCESSIBILITY of SOIL HORIZONS</th><th colspan="8">RECEPTOR CHARACTERISTICS</th></tr>
<tr><th colspan="4">CHILDREN PRESENT</th><th colspan="4">ADULTS ONLY PRESENT</th></tr>
<tr><th colspan="2">HIGH FREQUENCY</th><th colspan="2">LOW FREQUENCY</th><th colspan="2">HIGH FREQUENCY</th><th colspan="2">LOW FREQUENCY</th></tr>
<tr><th>High Intensity</th><th>Low Intensity</th><th>High Intensity</th><th>Low Intensity</th><th>High Intensity</th><th>Low Intensity</th><th>High Intensity</th><th>Low Intensity</th></tr>
<tr><td>ACCESSIBLE (SURFICIAL) SOIL
0 <= 2'
(e.g., unpaved)</td><td colspan="3">CATEGORY S-1</td><td>S-2</td><td>S-1</td><td colspan="3">CATEGORY S-2</td></tr>
<tr><td>POTENTIALLY ACCESSIBLE SOIL
2<=15' (unpaved)
or
0 <= 15' (paved, etc.)</td><td></td><td colspan="2">CATEGORY S-2</td><td></td><td>S-2</td><td colspan="3">CATEGORY S-3</td></tr>
</table>

ISOLATED SUB-SURFACE SOILS > 15' or under the footprint of a building or permanent structure without earthen floors. In a structure with earthen floors the soil must be > 2' deep	**CATEGORY S-3**	

4.0: Methods for Characterizing Risk of Harm

4.1: Characterizing Risk of Harm to Human Health and the Environment:

Several approaches may be employed to characterize the risk of harm to human health and the environment. The specific Risk Characterization approach used depends upon the nature of the risk being assessed, the remedial or risk reduction action being performed and the nature of the site.

(1) The evaluation of site conditions to determine if an Imminent Hazard exists is described in Section 5.0 of this policy.

(2) The characterization of the risk of harm to safety is described in Section 6.0 of this policy. A characterization of the risk of harm to safety is required at all sites to determine whether remedial action(s) are necessary to address safety hazards.

(3) One of the following three options is used to characterize the risk of harm to human health and environment and determines the need for a remedial action or to demonstrate that conditions considered protective of human health and the environment have been achieved:

(a) Method 1 Risk Characterization is the characterization of the risk through the use of numerical standards (described in Section 7.0); or

(b) Method 2 Risk Characterization is the characterization of risk through the application of numerical standards supplemented by site-specific information (described in Section 8.0); or

(c) Method 3 Risk Characterization is the characterization of risk through the application of site-specific methodologies (described in Section 9.0).

4.2 Selection of Method to Characterize the Risk of Harm to Human Health and the Environment

The three Methods for Risk Characterization described in Section 4.1(3) have been developed to provide a range of approaches which vary in detail and circumstances of use, each of which provides acceptable levels of protection to human health and the environment. Any of the three Risk Characterization Methods may be employed at a site, subject only to the following limitations:

(1) Method 1 relies upon the use of numerical standards for contaminants in groundwater and soil to characterize risk of harm to human health and the environment. Method 1 Standards for groundwater and soil are listed in Section 7.4(5) and Section 7.5(2) of this policy.

(a) If NHDES determines that contaminants not listed in the Method 1 tables pose a risk of harm to human health and the environment, NHDES may require implementation of one of the following Risk Characterization options:

1. Development of standards under Method 2. Such standards may be used alone or in combination with other Method 1 Standards to characterize risk at

the site. (Note: A combined Method 1 and Method 2 approach is considered a Method 2 Risk Characterization); or

2. Use of Method 3 alone to characterize risk at the site.

(b) If contaminants at the site are present in, or are likely to migrate at potentially significant concentrations to an environmental medium in addition to groundwater and soil (i.e., sediments, surface water, or air) or if environmental receptors may be impacted, then NHDES may request a Method 2 or 3 Risk Characterization be completed to characterize the risks to human health and the environment posed by contaminants at the site.

(2) Method 2 allows the consideration of limited site-specific information to supplement the use of Method 1 Standards for groundwater and soil. (Therefore, the limitations and options described for the use of Method 1 in Section 4.2(1) are also applicable to the use of Method 2.)

(3) Method 3 may be used at any site to characterize the risk of harm to human health and the environment.

5.0: Imminent Hazards

5.1: General

Immediate actions must be taken as necessary to mitigate or eliminate releases, threats of releases, conditions, or practices which present an immediate and substantial threat to human health and the environment. Specific regulations for addressing imminent hazards are contained in Env-Ws 412.05 and 412.06 and Env-Wm 513.02. Site stabilization is also required under RSA 147-F (Brownfields Statute) to address imminent hazards that are created or discovered during remedial activities. NHDES should be contacted for guidance on site stabilization requirements for sites that are participating in the state's Brownfields Program.

5.2: Notification

NHDES must be notified, pursuant to existing state law and statutes, when releases occur and imminent hazards exist.

5.3: Purpose and Scope of Imminent Hazard Evaluations

An Imminent Hazard Evaluation is utilized to determine whether site hazards present either imminent or short term threats to human health and the environment. A decision to conduct an Imminent Hazard Evaluation is based on the location and nature of the contaminants and the Human or Environmental Receptors which may be exposed. An Imminent Hazard Evaluation that is quantitative in nature must be prepared in accordance with Sections 5.4 and 5.5 when requested by the Department or when determined to be necessary by the site owner or person responsible for conducting a remedial action. All Imminent Hazard Evaluations must comply with the Risk Characterization Performance Requirements of Section 1.4 of this policy.

5.4: Exposures to be Considered in Imminent Hazard Evaluations

(1) The focus of an Imminent Hazard Evaluation must be on actual or likely exposures to Human and Environmental Receptors under current site conditions, considering the current use(s) of the site and the surrounding environment.

(2) Hot spots must be the primary, but not exclusive, focus of an Imminent Hazard Evaluation, provided that they are located in areas of actual or likely human exposure under current site conditions.

(3) If a small subset of contaminants are likely to dominate the risk estimates based upon their concentration and toxicity, then the Imminent Hazard Evaluation may be limited to those chemicals.

(4) The Imminent Hazard Evaluation must be conducted in a manner which results in conservative estimates of potential exposures (see Section 2.6.(3)(a)).

(5) The Imminent Hazard Evaluation must clearly identify and explain the basis for exposure parameters chosen for the Risk Characterization.

5.5: Imminent Hazard Risk Characterization and Outcome

In order for an Imminent Hazard to exist, exposures to contaminants must be actually occurring (or likely to occur) under current site conditions and uses. Depending on the type of condition which triggered the need for the Imminent Hazard Evaluation, the Risk Characterization must be conducted in accordance with the following methods:

(1) The characterization of the risk of harm to safety must be consistent with the method described in Section 6.0 of this policy. The conditions at the site pose an Imminent Hazard based on safety concerns if there is a risk to safety (i.e., if a release poses a threat of physical harm or bodily injury to humans) under conditions which actually exist or are about to occur.

(2) The characterization of the risk of harm to human health must consider a potential exposure period that is appropriate considering the toxicity of the chemical(s) at the site, how long exposures are known to have occurred and how long exposures are expected to occur. The conditions at the site pose an Imminent Hazard to human health if:

(a) based on the potential for cancer health effects, the excess lifetime cancer risk for actual or likely exposures is:

1. greater than one-in-ten thousand for short-term exposures; or
2. greater than one-in-one hundred thousand for long-term exposures; or

(b) based on the potential for non-cancer health effects, the Hazard Index for actual or likely exposures is:

1. greater than one; or
2. greater than ten for chemicals for which the Uncertainty Factors and Modifying Factors incorporated in the Reference Dose are, in total, is greater than a factor of ten.

(3) The characterization of the risk of harm to the environment must be consistent with methods described in Section 9.4 (Method 3 Environmental Risk Characterization). The conditions at the site pose an Imminent Hazard if there is visible evidence of stressed biota or if the Risk Characterization demonstrates that significant adverse ecological impacts are likely under current site conditions and will persist if the current conditions were to remain unremediated.

(4) If imminent hazards are determined to exist based on an Imminent Hazard Evaluation, all necessary immediate actions, as well as DES requested stabilization actions, must be undertaken to abate the hazards. A summary report must be issued immediately to the Department that documents the assumptions, risk analysis and measures that will be taken to mitigate or eliminate the identified hazards.

6.0: Characterization of Risk to Safety

The risk to safety posed by a site must be continuously evaluated during the assessment, investigation and remediation of a site to ensure the safe execution of all actions and compliance with all applicable OSHA and state safety standards. Specific procedures for evaluating risks to safety for the purpose of determining whether safety related considerations should trigger remedial actions at a site include the following:

(1) The risk of harm to safety must be characterized based on the data collected pursuant to the investigations and remedial actions being performed and the site, receptor, and exposure information identified in Sections 1.5 through 3.3.

(2) The risk of harm to safety must be characterized by comparing current and reasonably foreseeable conditions at the site and in the surrounding environment to applicable or suitably analogous safety standards.

(3) Safety concerns have been adequately addressed, if the conditions at the site which are related to a release of oil and/or contaminants do not currently and will not in the foreseeable future pose a threat of physical harm or bodily injury to people. Such release-related conditions may include the following:

(a) rusted or corroded drums or containers, open pits, or lagoons;

(b) any threat of fire or explosion, including the presence of explosive vapors resulting from a release of a contaminant; and

(c) uncontained materials which exhibit the characteristics of ignitability, corrosivity, reactivity or described at Env-Wm 403.03 through 403.05.

(4) The risk characterization documentation must clearly state whether or not safety concerns have been adequately addressed.

(5) A site that poses significant safety risks or presents a significant threat of a release, based on the above safety analysis, will not be granted a No Further Action Certificate under the provisions of Section 10.0.

7.0: Method 1 Risk Characterization

7.1: Applicability of Method 1

(1) Method 1 may be used to characterize the risk of harm to human health and the environment at sites where assessments conducted in accordance with Env-Wm 100 through 1000, Env-Ws 412, Env-Ws 410 and this policy have determined that the presence of a contaminant is limited to soil and/or groundwater. NHDES may require a Method 2 or 3 Risk Characterization, if other media are contaminated (such as sediments and surface water), contaminants are detected that do not currently have standards, indoor air quality is impacted or environmental receptors are impacted.

(2) A Method 1 Risk Characterization must be conducted in combination with a separate characterization of the risk of harm to safety, as described in Section 6.0.

7.2: General Approach to Method 1

A Method 1 Risk Characterization compares the conditions at the site to numeric Method 1 Standards. Each list of groundwater and soil standards has been developed by NHDES and NHDHHS considering a defined set of exposures considered to be a conservative estimate of the potential exposures at most sites. The exposures assumed by NHDHHS and NHDES correspond to the groundwater and soil categories are described in Sections 3.2 and 3.3. The Exposure Points and Exposure Point Concentrations must be identified in a manner consistent with those categories, such that the maximum concentrations of contaminants detected in soil and groundwater must be comparable directly to the Method 1 Standards, unless an alternate approach is approved by the Department.

7.3: Method 1 Risk Characterization

Under Method 1, the risk of harm to human health and the environment must be characterized as follows:

(1) The Method 1 Risk Characterization must evaluate each current and reasonably foreseeable Site Activity and Use identified pursuant to Section 2.3.

(2) The groundwater and soil categories determined for the site in Sections 3.2 and 3.3 must be identified and documented.

(3) The Exposure Point(s) in groundwater and soil for all current and reasonably foreseeable Site Activities and Uses must be identified and documented as described in Section 2.4, and:

(a) For groundwater, the Exposure Point(s) must be the wellhead and/or nearest tap of a well screened within the horizontal and vertical distribution of the contaminants in the groundwater. Existing water supply wells and monitoring wells are considered current or potential Exposure Points for a Method 1 Risk Characterization. If

groundwater quality data shows a consistent downward trend or concentrations consistently close to GW-1 standards and is at or below GW-1 standards for all wells for two consecutive rounds, groundwater meets GW-1 standards.

(b) For soil, the Exposure Point(s) must be defined by the horizontal and vertical distribution of the material is soil in combination with the soil applicable category(ies) (i.e., S-1, S-2 and S-3). For a contiguous volume of contaminated soil comprising one or more soil categories as defined in Section 3.3, a separate and distinct Exposure Point must be developed for each soil category.

(4) The Method 1 Standards assume exposure to the concentrations of contaminants under current or reasonably foreseeable future conditions. For the Exposure Point Concentrations to be directly comparable to the Method 1 Standards, they must:

(a) be determined for each contaminant at each Exposure Point as described in Section 2.6; and

(b) be representative of the actual concentration of the contaminants at that Exposure Point, unmodified by other exposure assumptions.

(c) be maximum detected concentrations of contaminants present in the appropriate media, unless an alternate approach is approved by the Department.

(5) The applicable Method 1 Groundwater and Soil Standards must be identified as described in Sections 7.4 and 7.5, and listed in the documentation of the Risk Characterization.

(6) The Exposure Point Concentrations identified in Section 7.3(4) must be compared to all applicable Method 1 Standards identified in Section 7.3(5).

(7) Site conditions are considered to be protective of human health and the environment for the exposure scenarios identified in accordance with Section 7.3(1) if no Exposure Point Concentration is greater than the applicable Method 1 Soil or Groundwater Standard.

(8) The documentation of the Method 1 Risk Characterization must clearly state whether or not a condition that is protective of human health and the environment exists or has been achieved at the site.

(9) Method 1 numbers can be recalculated when toxicological data in IRIS has been updated using the methodology discussed in Appendix A. The risk characterization must clearly document the calculations and assumptions that were made.

7.4: Identification of Applicable Groundwater Standards in Method 1

(1) The groundwater categories (GW-1 and/or GW-2) identified for a site per Section 3.2 determine which column(s) of numerical standards listed in Table 2 may be used to characterize risk posed by contaminants in groundwater.

(a) Groundwater category GW-1 standards address the requirements of Env-Ws 410.03 Groundwater Quality Criteria; Subparagraphs (a) and (b):

1. "[g]roundwater shall be suitable for use as drinking water without treatment" (Env-Ws 410.03(a)); and
2. "[g]roundwater shall not contain any regulated contaminant at a concentration greater than the ambient groundwater quality standards in Env-Ws 410.05" (Env-Ws 410.03(b)).

(b) Groundwater category GW-2 guidelines are intended to determine when the potential exists for migration of volatile contaminants from groundwater to indoor air. If GW-2 guidelines are exceeded the indoor air pathway should be evaluated.

(2) If multiple categories apply to the groundwater at the site, the lowest of the applicable Method 1 Groundwater Standards will be used to characterize the risk of harm posed by the contaminants at the site.

(3) NHDES may consider site-specific information which may allow the site to be divided into separate areas of risk posed by contaminants at the site.

(4) The Groundwater Protection Rules (Env-Ws 410.03) require that groundwater shall not contain any contaminant at a concentration such that the natural discharge of groundwater causes a violation of surface water standards.

(5) The applicability of groundwater standards is independent of the classification of the soil at the site. Table 2 lists the potentially applicable Method 1 Groundwater Standards.

7.5: Identification of Applicable Soil Standards in Method 1

The Method 1 Soil Standards consider both the potential risk of harm resulting from direct exposure to the contaminants in the soil and the potential impacts on the groundwater at the site. The category of soil (S-1, S-2, or S-3) at each Exposure Point determines which Method 1 Soil Standard is applicable. For each listed chemical, the soil standard for each soil category was developed in the following manner:

(1) The Carcinogenic and Noncarcinogenic Direct Contact Risk-based concentration[2] was compared with the Leaching-based concentration[3], where available;

(2) The lowest value from the comparison in Section 7.5(1) was then compared to the Background Concentration[4] and the Practical Quantitation Limit (PQL)[5] for that chemical;

(3) The higher concentration from the comparison in Section 7.5(2) was then selected for

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[2]The methodology for calculating Method 1 Direct Contact Risk-based Concentrations is in Appendix A.

[3]The methodology for calculating Method 1 Leaching-based Concentrations is in Appendix B.

[4]Background Concentrations of Contaminants are described in Section 1.5(4).

[5]Practical Quantitation Limits and the associated analytical method are listed in Appendix C.

comparison with the Ceiling Concentration[6];

(4) The lower value from the comparison in Section 7.5(3) was selected as the Soil Standard for the corresponding soil category;

(5) The Method 1 Soil Standards are listed in Table 3 - “Method 1 Soil Standards”:

Appendix E contains a table listing each soil standard and the calculated human health and leaching derived limits. The table in Appendix E is intended to provide users of this policy an understanding of the methodology that was used to develop the soil standards.

[6]The methodology for determining Ceiling Concentrations is described in Sections 8.4 (8)(a)-(c) and Appendix D.

Revised 7/11/06

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)
Acetone	67-64-1	700	50,000
Acrylonitrile	107-13-1	5	†
Alachor	15972-60-8	2	NA
Aldicarb	116-06-3	3	NA
Aldicarb sulfone	1646-88-4	2	NA
Aldicarb sulfoxide	1646-87-3	4	NA
Aldrin	309-00-2	0.04	0.5
Alkyl benzenes**		50②	†
Allyl chloride	107-05-1	7.4	†
Antimony	7440-36-0	6	NA
Arsenic	7440-38-2	50	NA
Atrazine	1912-24-9	3	†
Barium	7440-39-3	2,000	NA
Benzene	71-43-2	5	2,000
Benzidine	92-87-5	0.8	†
Benzoic Acid	65-85-0	28,000	†
Beryllium	7440-41-7	4	NA
Biphenyl, 1,1-	92-52-4	350	NA
Boron	7440-42-8	620	†
Bromodichloromethane	75-27-4	0.3	NA
Bromoform	75-25-2	5 (4) ④	800
Bromomethane	74-83-9	10	2
Cadmium	7440-43-9	5	NA
Camphor	76-22-2	200	†
Carbofuran	1563-66-2	40	†
Carbon disulfide	75-15-0	7	†
Carbon tetrachloride	56-23-5	5	20
Chlordane	57-74-9	2	NA
Chloroaniline, p-	106-47-8	28	NA
bis-(2-chloroethyl)ether	111-44-4	10	100
bis-(2-chloroisopropyl)ether	39638-32-9	300	400
bis-(chloromethyl)ether	542-88-1	10	†
Chloromethane	74-87-3	3	†
Chlorophenol, 2-	95-57-8	35	NA
Chlorotoluene	95-49-8	100	†
Chromium (Total)	7440-47-3	100	NA
Chromium (III)	16065-83-1	††	NA
Chromium (VI)	18540-29-9	††	NA
Copper	7440-50-8	1300	†
Cyanide	57-12-5	200	NA
2,4-D (Dichlorophenoxyacetic acid, 2,4-)	94-75-7	70	†
Dalapon	75-99-0	200	†
DDD (Dichlorodiphenyl dichloroethane, p,p')	72-54-8	0.1	NA
DDE (Dichlorodiphenyl dichloroethylene, p,p')	72-55-9	0.1	NA
DDT (Dichlorodiphenyl trichloroethane, p,p')	50-29-3	0.1	NA
Dibromochloromethane	124-48-1	0.3	NA

Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)
Dibromochloropropane	96-12-8	0.2	†
Dibutylphthalate	84-74-2	34,000	†
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	600	10,000
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	600	10,000
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	75	30,000
Dichlorobenzidine, 3,3'-	91-94-1	1.3	NA
Dichlorodifluoromethane	75-71-8	1,000	†
Dichloroethane, 1,1-	75-34-3	81	9,000
Dichloroethane, 1,2-	107-06-2	5	20
Dichloroethylene, 1,1-	75-35-4	7	1
Dichloroethylene, cis-1,2-	156-59-2	70	NA
Dichloroethylene, trans-1,2-	156-60-5	100	NA
Dichloromethane (Methylene chloride)	75-09-2	5	50,000
Dichlorophenol, 2,4-	120-83-2	21	NA
Dichloropropane, 1,2-	78-87-5	5	9
Dichloropropene, 1,3-	542-75-6	5 (0.2)④	5
Dieldrin	60-57-1	0.002	NA
Diethyl phthalate	84-66-2	‡	NA
Di(ethylhexyl)adipate	103-23-1	400	†
Di(ethylhexyl)phthalate (bis-(2-ethylhexyl)phthalate)	117-81-7	6	700
Dimethyl phthalate	131-11-3	50,000 ③	NA
Dimethylphenol, 2,4-	105-67-9	140	NA
Dinitrophenol, 2,4-	51-28-5	50 (14)④	NA
Dinitrotoluene, 2,4-	121-14-2	10	NA
Dinoseb	88-85-7	7	†
1,2-Diphenylhydrazine	122-66-7	10	†
Diquat	85-00-7	20	†
Endosulfan	115-29-7	42	NA
Endothall	145-73-3	100	†
Endrin	72-20-8	2	NA
Ethylbenzene	100-41-4	700	30,000
Ethylene dibromide	106-93-4	0.05	3
Ethylene glycol	107-21-1	7,000	†
Fluoride	16984-48-8	4,000	†
Glyphosate	1071-83-6	700	†
Gross alpha radionuclides		15 Pci/L	†
Heptachlor	76-44-8	0.4	NA
Heptachlor epoxide	1024-57-3	0.2	NA
Hexachlorobenzene	118-74-1	1	NA
Hexachlorobutadiene	87-68-3	0.5	1
Hexachlorocyclohexane, alpha	319-84-6	0.006	†
Hexachlorocyclohexane, beta	319-85-7	0.02	†
Hexachlorocyclohexane, gamma	58-89-9	0.02	NA
Hexachlorocyclopentadiene	77-47-4	50	†
Hexachlorodibenzodioxin	34465-46-8	0.0221	†
Hexachloroethane	67-72-1	1.9	10

Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)
Isophorone	78-59-1	100	†
Isopropyl benzene	98-82-8	280	NA
Lead	7439-92-1	15	NA
Mercury	7439-97-6	2	NA
Methoxychlor	72-43-5	40	NA
Methyl ethyl ketone	78-93-3	170	50,000
Methyl isobutyl ketone	108-10-1	350	50,000
Methyl mercury	22967-92-6	‡	NA
Methyl phenol, 2-	95-48-7	350	†
Methyl phenol,4	106-44-5	350	†
Methyl tert butyl ether	1634-04-4	70	50,000
Monochlorobenzene (Chlorobenzene)	108-90-7	100	1,000
Nickel	7440-02-0	100	NA
Nitrate	14797-55-8	10,000	†
Nitrite	14797-65-0	1,000	†
Oxamyl	23135-22-0	200	†
Pentachlorophenol	87-86-5	1	NA
Phenol	108-95-2	4,000	50,000
Picloram	1918-02-1	500	†
Polychlorinated biphenyls (PCBs)	1336-36-3	0.5	NA
Potassium	7440-09-7	35,000	†
Radium 226 and 228	7740-14-4	5 Pci/L	†
Selenium	7782-49-2	50	NA
Silver	7440-22-4	50	NA
Simazine	122-34-9	4	†
Strontium 90	7740-24-6	8 Pci/L	†
Styrene	100-42-5	100	900
Sulfate	14808-79-8	400,000	†
TCDD, 2,3,7,8- (Dioxin)	1746-01-6	0.00003	NA
Tetrachloroethane, 1,1,1,2-	630-20-6	70	6
Tetrachloroethane, 1,1,2,2,-	79-34-5	0.17	20
Tetrachloroethylene	127-18-4	5	3,000
Tetrahydrofuran	109-99-9	154	†
Thallium (thallium chloride)	7440-28-0	2	NA
Toluene	108-88-3	1,000	6,000
Total Coliform	-	CTS/100ml	†
Toxaphene	8001-35-2	3	†
TP, 2,4,5- (Trichlorophenoxyacetic acid, 2,4,5-)	93-76-5	50	†
Trichlorobenzene, 1,3,5-	108-70-3	40	†
Trichlorobenzene, 1,2,4-	120-82-1	70	600
Trichloroethane, 1,1,1-	71-55-6	200	4,000
Trichloroethane, 1,1,2-	79-00-5	5	20,000
Trichloroethylene	79-01-6	5	300
Trichlorofluoromethane	75-69-4	2,000	†
Trichloromethane (Chloroform)	67-66-3	6	400
Trichlorophenol, 2,4,5-	95-95-4	700	NA

Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2① µg/l (ppb)
Trichlorophenol, 2,4,6-	88-06-2	10	40,000
Trichloropropane, 1,2,3-	96-18-4	40	†
Trihalomethanes (total)		6	†
Tritium	10028-17-8	20,000 Pci/L	†
Vinyl chloride	75-01-4	2	2
Xylenes (mixed isomers)	1330-20-7	10,000	6,000
Zinc	7440-66-6	‡	NA
Polynuclear Aromatic Hydrocarbons - Carcinogenic			
Benzo(a)anthracene	56-55-3	10 (0.05)④	NA
Benzo(a)pyrene	50-32-8	10 (0.2)④	NA
Benzo(b)fluoranthene	205-99-2	10 (0.05)④	NA
Benzo(k)fluoranthene	207-08-9	10 (0.5)④	NA
Chrysene	218-01-9	10 (5)④	NA
Dibenzo(a,h)anthracene	53-70-3	10 (0.005)④	NA
Indeno(1,2,3-cd)pyrene	193-39-5	10 (0.05)④	NA
Polynuclear Aromatic Hydrocarbons - Noncarcinogenic			
Acenaphthene	83-32-9	420	NA
Acenaphthylene	208-96-8	420	NA
Anthracene	120-12-7	2,100	NA
Benzo(g,h,i)perylene	191-24-2	210	NA
Fluoranthene	206-44-0	280	NA
Fluorene	86-73-7	280	NA
Methylnaphthalene, 2-	91-57-6	280	10,000
Naphthalene	91-20-3	20	6,000
Phenanthrene	85-01-8	210	NA
Pyrene	129-00-0	210	NA

Endnotes:

① GW-2 concentrations are intended to provide guidance in the evaluation of groundwater quality data where there exists the potential for migration of volatile contaminants from groundwater to indoor air.

② For the purposes of this policy, alkylbenzenes include 1,2,4 trimethyl benzene, 1,3,5 trimethyl benzene, n-propyl benzene, n-butyl benzene, 4-isopropyl toluene, tert-butyl benzene and sec-butyl benzene. NHDES evaluates the risk posed by alkylbenzenes as a group because of the similar structures of these compounds and the lack of toxicological data for all compounds in this class of chemicals. The sum of the total of these compounds is compared to the NH GW-1 standard.

③ Dimethyl pthalate is based on a ceiling limit of 50,000 ppb instead of the calculated value of 70,000 ppb.

④ Standard based on estimated quantitation limits contained in SW 846, Final Update III. December 1996. These standards are subject to change, if improved analytical methods become readily available. The human health risk based number is shown in parenthesis.

† GW-2 groundwater guidelines are not currently available for these chemicals.

‡ New Hampshire Ambient Groundwater Quality Standards (AGQS) are not currently available for these chemicals. Supplemental information for these chemicals will be made available in an addendum to this policy when available.

†† The GW-1 standard for chromium is based on the sum of chromium (III) and (VI).

NA Not Applicable.

Table 2

METHOD 1 GROUNDWATER STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.4(5))

CHEMICAL NAME	CAS No.	NH GW-1 µg/l (ppb)	NH GW-2 Î µg/l (ppb)

Î	GW-2 concentrations are intended to provide guidance in the evaluation of groundwater quality data where there exists the potential for migration of volatile contaminants from groundwater to indoor air.
Ï	For the purposes of this policy, alkylbenzenes include 1,2,4 trimethyl benzene, 1,3,5 trimethyl benzene, n-propyl benzene, n-butyl benzene, 4-isopropyl toluene, tert-butyl benzene and sec-butyl benzene. NH DES evaluates the risk posed by alkylbenzenes as a group because of the similar structures of these compounds and the lack of toxicological data for all compounds in this class of chemicals. The sum of the total of these compounds is compared to the NH GW-1 standard.
Ð	Dimethyl pthalate is based on a ceiling limit of 50,000 ppb instead of the calculated value of 70,000 ppb.
Ñ	Standard based on estimated quantitation limits contained in SW 846, Final Update III. December 1996. These standards are subject to change, if improved analytical methods become readily available. The human health risk based number is shown in parenthesis.
†	GW-2 groundwater guidelines are not currently available for these chemicals.
‡	New Hampshire Ambient Groundwater Quality Standards (AGQS) are not currently available for these chemicals. Supplemental information for these chemicals will be made available in an addendum to this policy when available.
††	The GW-1 standard for chromium is based on the sum of chromium (III) and (VI).
NA	Not Applicable.

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Table 3

METHOD 1 SOIL STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)
Acetone	67-64-1	**9**	**9**	**9**
Acrylonitrile	107-13-1	**0.06**	**0.06**	**0.06**
Aldicarb	116-06-3	**0.04**	**0.04**	**0.04**
Aldicarb sulfone	1646-87-3	w	w	w
Aldicarb sulfoxide	1646-88-4	w	w	w
Aldrin	309-00-2	**0.09**	**0.2**	**1**
Alkylbenzenes[1]		**59**[1]	**59**[1]	**59**[1]
Allyl chloride	107-05-1	**0.6**	**0.6**	**0.6**
Antimony	7440-36-0	**8**	**26**	**26**
Arsenic	7440-38-2	**12**	**12**	**12**
Atrazine	1912-24-9	**0.08**	**0.08**	**0.08**
Barium	7440-39-3	**750**	**2,500**	**3,400**
Benzene	71-43-2	**0.3**	**0.3**	**0.3**

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Table 3

METHOD 1 SOIL STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)
Benzidine	92-87-5	**0.002**	**0.007**	**0.01**
Benzoic acid	65-85-0	**350**	**350**	**350**
Beryllium	7440-41-7	**0.1**	**0.1**	**1**
Biphenyl, 1,1-	92-52-4	**200**	**200**	**200**
Boron	7440-42-8	**1,000**	**2,500**	**5,000**
Bromodichloromethane	75-27-4	**0.01**	**0.01**	**0.01**
Bromoform	75-25-2	**0.1**	**0.1**	**0.1**
Bromomethane	74-83-9	**0.3**	**0.3**	**0.3**
Cadmium	7440-43-9	**32**	**230**	**230**
Camphor	76-22-2	**11**	**11**	**11**
Carbofuran	1563-66-2	**0.6**	**0.6**	**0.6**
Carbon disulfide	75-15-0	**0.4**	**0.4**	**0.4**
Carbon tetrachloride	56-23-5	**6**	**12**	**12**
Chlordane	57-74-9	**0.8**	**2**	**2**
Chloroaniline, p-	106-47-8	**1.3**	**1.3**	**1.3**
bis-(Chloroethyl)ether	111-44-4	**0.7**	**0.7**	**0.7**
bis-(Chloroisopropyl)ether	39638-32-9	**2**	**4**	**9**
Chloromethane	74-87-3	**0.2**	**0.2**	**0.2**
Chlorophenol, 2-	95-57-8	**2**	**2**	**2**
Chlorotoluene, 2 (o)	95-49-8	**30**	**30**	**30**
Chlorotoluene, 4 (p)	106-43-4	**21**	**21**	**21**
Chromium (III)	16065-83-1	**1,000**	**2,500**	**5,000**
Chromium (VI)	18540-29-9	**130**	**460**	**540**
Cyanide	57-12-5	**100**[2]	**500**[2]	**500**[2]
2,4-D (Dichlorophenooxyacetic acid, 2,4-)	94-75-7	**1**	**1**	**1**
Dalapon	75-99-0	**3**	**3**	**3**
DDD (Dichlorodiphenyl dichloroethane, p,p')	72-54-8	**0.7**	**2**	**64**
DDE (Dichlorodiphenyl dichloroethylene, p,p')	72-55-9	**0.7**	**2**	**56**
DDT (Dichlorodiphenyl trichloroethane, p,p')	50-29-3	**0.9**	**3**	**11**
Dibromochloromethane	124-48-1	**0.01**	**0.01**	**0.01**
Dibromochloropropane	96-12-8	**0.01**	**0.01**	**0.01**
Dibutylphthalate	84-74-2	**1,000**	**2,500**	**5,000**
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	**66**	**66**	**66**
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	**45**	**45**	**45**
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	**6**	**9**	**9**
Dichlorobenzidine, 3,3'-	91-94-1	**1.3**	**1.3**	**1.3**
Dichlorodifluoromethane	75-71-8	**1,000**	**2,500**	**5,000**
Dichloroethane, 1,1-	75-34-3	**3**	**3**	**3**
Dichloroethane, 1,2-	107-06-2	**0.08**	**0.08**	**0.08**
Dichloroethylene, 1,1-	75-35-4	**1**	**4**	**14**

Table 3

METHOD 1 SOIL STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)
Dichloroethylene, cis-1,2-	156-59-2	2	2	2
Dichloroethylene, trans-1,2-	156-60-5	9	9	9
Dichloromethane (Methylene chloride)	75-09-2	0.1	0.1	0.1
Dichlorophenol, 2,4-	120-83-2	0.7	0.7	0.7
Dichloropropane, 1,2-	78-87-5	0.1	0.1	0.1
Dichloropropene, 1,3-	542-75-6	1	1	1
Dieldrin	60-57-1	0.06	0.2	3
Diethyl phthalate	84-66-2	1,000	2,500	5,000
Di(ethylhexyl)phthalate (bis(2-ethyl...)	117-81-7	39	110	2,200
Dimethyl phthalate	131-11-3	1,000	1,500	1,500
Dimethylphenol, 2,4-	105-67-9	4	4	4
Dinitrophenol, 2,4-	51-28-5	3.3	3.3	3.3
Dinitrotoluene, 2,4-	121-14-2	0.7	0.7	0.7
Dinoseb	88-85-7	0.3	0.3	0.3
Diphenylhydrazine, 1,2-	122-66-7	0.8	0.8	0.8
Diquat (dibromide)	85-00-7	0.3	0.3	0.3
Endosulfan	115-29-7	45	45	45
Endothall	145-73-3	2	2	2
Endrin	72-20-8	8	54	54
Ethylbenzene	100-41-4	140	140	140
Ethylene dibromide	106-93-4	0.005	0.005	0.005
Ethylene glycol	107-21-1	90	90	90
Fluoride	7782-41-4	w	w	w
Heptachlor	76-44-8	0.2	0.7	9
Heptachlor epoxide	1024-57-3	0.1	0.3	0.5
Hexachlorobenzene	118-74-1	0.7	0.7	7
Hexachlorobutadiene	87-68-3	0.2	0.8	3
Hexachlorocyclohexane, alpha	319-84-6	0.06	0.06	0.06
Hexachlorocyclohexane, beta	319-85-7	0.06	0.06	0.06
Hexachlorocyclohexane, gamma	58-89-9	0.09	0.09	0.09
Hexachlorocyclopentadiene	77-47-4	36	150	710
Hexachlorodibenzodioxin	19408-74-3	w	w	w
Hexachloroethane	67-72-1	0.7	0.7	0.7
Isophorone	78-59-1	2	2	2
Isopropyl benzene	98-82-8	123	123	123
Lead	7439-92-1	400[3]	400[3]	400[3]
Mercury (inorganic)	7439-97-6	1	7	7
Methoxychlor	72-43-5	38	170	170
Methyl ethyl ketone	78-93-3	2	2	2
Methyl isobutyl ketone	108-10-1	10	10	10

Table 3

METHOD 1 SOIL STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)
Methyl mercury	22967-92-6	0.3	3	3
Methyl phenol, 2-	95-48-7	18	18	18
Methyl phenol, 4-	106-44-5	5	5	5
Methyl tert butyl ether	1634-04-4	2	2	2
Monochlorobenzene (Chlorobenzene)	108-90-7	6	6	6
Nickel	7440-02-0	580	2,500	3,900
Oxamyl	23135-22-0	0.4	0.4	0.4
Pentachlorophenol	87-86-5	3.3	3.3	3.3
Phenol	108-95-2	56	56	56
Picloram	1918-02-1	11	11	11
Polychlorinated Biphenyls (PCBs)	1336-36-3	1[4]	1[4]	2
Selenium	7782-49-2	260	2,500	4,200
Silver	7440-22-4	45	200	200
Simazine	122-34-9	0.4	0.4	0.4
Styrene	100-42-5	14	14	14
TCDD, 2,3,7,8- (Dioxin)	1746-01-6	w	w	w
Tetrachloroethane, 1,1,1,2-	630-20-6	2	2	2
Tetrachloroethane, 1,1,2,2,-	79-34-5	0.005	0.005	0.005
Tetrachloroethylene	127-18-4	2	2	2
Tetrahydrofuran	109-99-9	7	7	7
Thallium (thallium chloride)	7440-28-0	10	21	32
Toluene	108-88-3	100	100	100
Total Petroleum Hydrocarbons		10,000	10,000	10,000
Toxaphene	8001-35-2	0.8	0.8	15
TP, 2,4,5- (Trichlorophenoxyacetic acid, 2,4,5-)	93-76-5	6	6	6
Trichlorobenzene, 1,3,5-	108-70-3	27	27	27
Trichlorobenzene, 1,2,4-	120-82-1	15	15	15
Trichloroethane, 1,1,1-	71-55-6	42	42	42
Trichloroethane, 1,1,2-	79-00-5	0.1	0.1	0.1
Trichloroethylene	79-01-6	0.8	0.8	0.8
Trichlorofluoromethane	75-69-4	1,000	2,500	5,000
Trichloromethane (Chloroform)	67-66-3	0.1	0 1	0.1
Trichlorophenol, 2,4,5-	95-95-4	120	120	120
Trichlorophenol, 2,4,6-	88-06-2	0.7	0.7	0.7
Trichloropropane, 1,2,3-	96-18-4	1.4	1.4	1.4
Vinyl chloride	75-01-4	0.4	1	9
Xylenes (mixed isomers)	1330-20-7	500	1,000	1,100
Zinc	7440-66-6	1,000	2,500	5,000
Polynuclear Aromatic Hydrocarbons - Carcinogenic [5]				
Benzo(a)anthracene	56-55-3	0.7	2	40
Benzo(a)pyrene	50-32-8	0.7	0.7	4
Benzo(b)fluoranthene	205-99-2	7	20	400
Benzo(k)fluoranthene	207-08-9	7	20	400
Chrysene	218-01-9	70	200	4,000
Dibenzo(a,h)anthracene	53-70-3	0.7	0.7	4

Table 3

METHOD 1 SOIL STANDARDS

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)
Indeno(1,2,3-cd)pyrene	193-39-5	**0.7**	**2**	**40**
Polynuclear Aromatic Hydrocarbons - Noncarcinogenic				
Acenaphthene	83-32-9	**270**	**270**	**270**
Acenaphthylene	208-96-8	**300**	**300**	**300**
Anthracene	120-12-7	**1,000**	**1,700**	**1,700**
Fluoranthene	206-44-0	**810**	**2,500**	**5,000**
Fluorene	86-73-7	**510**	**510**	**510**
Methylnaphthalene, 2-	91-57-6	**150**	**150**	**150**
Naphthalene	91-20-3	**5**	**5**	**5**
Benzo(g,h,i)perylene[6]	191-24-2	**Total of three less than 480**	**Total of three less than 2,400**	**Total of three less than 5,000**
Phenanthrene[6]	85-01-8			
Pyrene[6]	129-00-0			

***Endnotes:**

Column (1):	Chemical Name.
Column (2):	Chemical Abstract Service (CAS) Number.
Column (3):	Method 1 Category S-1 Soil Standard.
Column (4):	Method 1 Category S-2 Soil Standard.
Column (5):	Method 1 Category S-3 Soil Standard.
NOTES: 1)	For the purposes of this policy, alkylbenzenes include 1,2,4 trimethyl benzene, 1,3,5 trimethyl benzene, n-propyl benzene, n-butyl benzene, 4-isopropyl toluene, tert-butyl benzene and sec-butyl benzene. NH DES evaluates the risk posed by alkylbenzenes as a group because of the similar structures of these compounds and the lack of toxicological data for all compounds in this class of chemicals. The sum of the total of these compounds is compared to the NH S-1, NH S-2 and NH S-3 standards.
2)	Cyanide standards were developed using free cyanide toxicity and physical characteristics. Complexed cyanide or other cyanide species can be addressed via Method 2 or 3 Risk Characterization methodologies.
3)	A screening level of 400 mg/kg has been set for lead based on EPA's "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities" (U.S. EPA, 1994). Background levels of lead are frequently elevated in older towns and cities, due to auto exhaust, lead paint and other sources. Levels between 400 and 1000 should be evaluated to determine whether high background levels will preclude significant overall area risk reduction by addressing site lead contaminant levels. Massachusetts DEP issued a Urban Fill "Background" Levels Discussion Document on 6/27/1996 that contains a database of up to 873 sample results for PAHs and metals. A statistical analysis of the concentration distribution of these contaminants is presented in this document and may be useful in conjuction with site specific sampling results to evaluate the probability of high urban background levels levels of metals being present.
4)	The S-1 and S-2 PCB number is based on EPA's August 1990 "Guidance on Remedial Actions for Superfund Sites with PCB Contamination" for residential areas.
5)	Standards for carcinogenic PAHs were calculated using the potency factors developed by EPA, based on equivalency to Benzo(a)pyrene.
6)	Method 1 soil standards for Benzo(g,h,i) perylene, Phenanthrene and Pyrene are derived by adding the concentrations of each of these three compounds and comparing the total value to the appropriate value in column 3, 4 or 5.
w	Standards were not developed for this contaminant because the necessary physical property information was not available to run the leaching model or because of questions related to PQLs.

8.0: Method 2 Risk Characterization

8.1 Applicability of Method 2

Method 2 may be used to characterize the risk of harm to human health and the environment at sites where site investigations conducted in accordance with Env-Wm 100 through 1000, Env-Ws 412, Env-Ws 410, the VPC Policy, and this policy have determined that the release of contaminants is limited to soil and/or groundwater. A Method 2 Risk Characterization must be conducted in combination with a separate characterization of the risk

of harm to safety, as described in Section 6.0.

8.2 General Approach to Method 2

A Method 2 Risk Characterization supplements and modifies the Method 1 Standards with site-and chemical-specific information. For the purposes of this policy, "Method 2 Standards" must refer to the Method 1 Standards which have been modified to address site-specific conditions as described in Section 8.2. Site conditions are then compared to such Method 2 Standards, in the same manner that Method 1 Standards are used under Section 7.3, to characterize the risk of harm to human health and the environment.

(1) Method 1 GW-1 Standards, listed in Section 7.4(5), must not be modified in Method 2. If GW-1 standards are exceeded, a groundwater management permit is required and all relevant portions of Env-Ws 410 (e.g., treatment, removal or containment of source areas and the development of a remedial action plan) must be addressed.

(2) The component of the Method 1 Soil Standards which is protective of direct contact exposures to the soil must not be modified in Method 2. These standards are listed in the table in Appendix E, columns (6), (7) and (8).

(3) The following information may be used under Method 2 to modify the Method 1 Standards:

(a) Site-specific information may be used to either modify the Method 1 GW-2 Guidelines, which model potential volatilization of contaminants to indoor air, or demonstrate that such vapor infiltration will not occur. The incorporation of such site-specific information will result in Method 2 GW-2 Guidelines or a determination that one or more of the Method 1 GW-2 Guidelines are not applicable at this site. These site-specific modifications are described in Section 8.6.

(b) Site-specific information may be used to either modify the leaching component of the Method 1 Soil Standards or demonstrate that a contaminant will not leach to groundwater. The Method 2 Soil Standard cannot be used to predict the performance of an impermeable cap or barrier in preventing the soil acting as a source of groundwater contamination. The incorporation of such site-specific information will result in Method 2 Soil Standards or a determination that the leaching component of one or more of the Method 1 soil standard are not applicable. These site-specific modifications are described in Section 8.5.

(c) Method 2 Groundwater and Soil Standards may be developed for chemicals for which Method 1 Standards have not been adopted by NHDES. This process is described in Sections 8.3 and 8.4.

(d) Exposure Point concentrations can be calculated under Method 2 using either the 95th percent upper confidence limit of the arithmetic mean or an arithmetic average, when sufficient data are available and NHDES approval is obtained.

(4) Method 1 Standards may be used in combination with one or more Method 2 Standards. A Risk Characterization which uses a combination of Method 1 and 2 Standards is considered a Method 2 Risk Characterization.

(5) The Method 2 Standards developed and used or relied upon must be listed and suitably documented.

8.3: Derivation of Additional Method 1 Groundwater Standards for Use in Method 2.

If a Method 1 Groundwater Standard has not been adopted by NHDES, a Method 2 Standard may be developed for that contaminant on the basis of the following assumptions and procedures:

(1) A site-specific background concentration in groundwater must be identified for the contaminant.

(2) GW-1 Standards must be calculated as follows:

(a) Based on non-cancer health risk, a concentration in drinking water of the petroleum and/or hazardous substance associated with 20% of a Reference Dose must be identified using the following equation:

$$[C] = (RfD \times 7{,}000)/RAF_{oral}$$

Where: [C] = the concentration of the contaminant being derived, in units: µg/L (ppb)
RfD = the USEPA derived Reference Dose, in units: mg/(kg * d)
7,000 = (0.2 * 70 kg * 1000 µg/mg)/(2 L/d)
RAF_{oral} = the Relative Absorption Factor applicable for oral exposures dimensionless.

(b) A concentration of the contaminant associated with an Excess Lifetime Cancer Risk equal to one-in-one million must be identified using the following equation:

$$[C] = 0.035/(CSF * RAF_{oral})$$

Where: [C] = the concentration of the contaminant being derived, in units: µg/L (ppb)
0.035 = $(10^{-6} * 70 \text{ kg} * 10^{3} \text{ µg/mg})/(2 \text{ L/d})$
CSF = the USEPA derived oral Carcinogenic Slope Factor, in units: $(mg/(kg * d))^{-1}$
RAF_{oral} = the Relative Absorption Factor applicable for oral exposure, dimensionless.

(c) The concentration in water of the contaminant at which 50% of the population can detect its odor is identified, if available.

(d) The lowest non-zero concentration estimated in Sections 8.3(2)(a), (b), and (c) is identified as the risk-based concentration for the contaminant of concern;

(e) The site-specific groundwater background concentration identified for the contaminant in Section 8.3(1) is considered;

(f) The Practical Quantitation Limit (PQL) applicable to the contaminant using an appropriately sensitive analytical method for quantifying the concentration of the contaminant in water must be identified.

(g) The highest of the three concentrations identified in Sections 8.3(2)(d), (e) and (f) is adopted as the Method 2 GW-1 Standard for that contaminant.

(3) GW-2 Guidelines must be determined as follows: **Revised July 11, 2006**

(a) A risk-based indoor air concentration must be identified (i.e., when sufficient information exists) by choosing the lower non-zero value from the following:

1. A concentration equal to 20% of a Reference Concentration (RfC) published by the USEPA, or an analogous allowable concentration.
2. An indoor air concentration associated with an Excess Lifetime Cancer Risk of one-in-one million, using the following equation:

$$[C]air = 10^{-6} \div Ur_{air}$$

Where: [C]air = The calculated indoor air concentration. In units of: µg/cubic meter.
10^{-6} = A one-in-one-million Excess Lifetime Cancer Risk (dimensionless)
Ur_{air} = The Unit Risk in air for the chemical, published by USEPA. In units of: $(\mu g/\text{cubic meter})^{-1}$

3. The concentration in air of the contaminant at which 50% of the population can detect its odor is identified, if available.

(b) A background indoor air concentration for the chemical must be identified and compared to the risk-based concentration calculated in Section 8.3(2)(a). The higher of the two values must be chosen as the target indoor air concentration.

(c) A groundwater contaminant concentration is calculated with this equation:

$$[C]gw = [C]air \div (\text{"} * d * H * CF)$$

Where: [C]gw = The calculated GW-2 Guideline, in units of: µg/liter (ppb).
[C]air = The target indoor air concentration identified in Section 8.3(2)(b). (Units=µg/cubic meter).
" = An attenuation factor equal to 0.0005. Dimensionless.
d = An applied dilution factor equal to 0.1. Dimensionless.
H = The Henry's Law Constant for the chemical. Dimensionless.
CF = Units Conversion Factor, 1000 l/m^3.

(d) The site specific groundwater background concentration must be identified for the contaminant in Section 8.3(1) is considered;

(e) the Practical Quantitation Limit (PQL) applicable to the contaminant using an appropriately sensitive analytical method for quantifying the concentration of the contaminant in water must be identified;

(f) the highest of the three concentrations identified in Section 8.3(2)(c), (d) and (e) must be adopted as the Method 2 GW-2 Guideline for that contaminant.

(4) Any of the Method 2 groundwater standards calculated in Sections 8.3(2) through (4) must be adjusted to a ceiling concentration of 50,000 µg/liter (ppb) if the calculated value is greater than 50,000 µg/liter (ppb);

(5) Any of the Method 2 groundwater standards calculated in 8.3(2) through (5) must be adjusted to be equal to ½ of the solubility (in µg/liter at 25EC) in water of the contaminant if the calculated value is greater than the solubility of that chemical.

8.4: Derivation of Additional Method 1 Soil Standards for Use in Method 2.

If a Method 1 Soil Standard has not been adopted by NHDES, a Method 2 Standard for a contaminant may be developed on the basis of the following assumptions and procedures:

(1) Based upon non-cancer health risk, a concentration equal to the product of the Reference Dose multiplied by Relative Source Contribution Factor (RSCF) is developed using the following equations specific to each soil category.

Where: [C] = the concentration of the contaminant being derived, units = mg/kg (ppm)
RfD = the chronic or subchronic USEPA derived Reference Dose for the contaminant, units = mg/(kg day)
RAF_{oral} = the Relative Absorption Factor applicable for oral exposures, dimensionless
RAF_{dermal} = the Relative Absorption Factor applicable for dermal exposures, dimensionless
CF = 10^6 mg/kg conversion factor
Other numerical values = Average Daily Exposure to the soil of concern by the oral or dermal pathway. In units: $mg_{soil}/(Kg_{bw}*day)$

(a) S-1 Standards: The concentration of the contaminant must be derived using the following equation:

$$[C] = (RfD_{chronic} \times RSCF \times CF)/((RAF_{oral} \times 5.16) + (RAF_{dermal} \times 67.87))$$

Where: RSCF = Relative Source Contribution Factor. In the absence of any relevant chemical-specific RSCF value provided in USEPA reports or guidance documents, DHHS-BHRA recommends using a value of 0.2. If RSCFs are available for different age categories, the RSCF that most closely pertains to a young child, age 2 to 6 years old, should be selected.

(b) S-2 Standards: The concentration of the contaminant is derived using the lower result from the following equations:

$$[C] = (RfD_{chronic} \times RSCF \times CF)/((RAF_{oral} \times 0.57) + (RAF_{dermal} \times 17.74))$$

Where: RSCF = Relative Source Contribution Factor. In the absence of any relevant chemical-specific RSCF value provided in USEPA reports or guidance documents, DHHS-BHRA recommends using a value of 0.2. If RSCFs are available for different age categories, the RSCF that pertains to an adult should be selected.

(c) S-3 Standards: the concentration of the contaminant is derived using the following equation:

$$[C] = (RfD_{subchronic} \times RSCF \times CF)/((RAF_{oral} \times 4.67) + (RAF_{dermal} \times 30.17))$$

Where: RSCF = Relative Source Contribution Factor. In the absence of any relevant chemical-specific RSCF value provided in USEPA reports or guidance documents, DHHS-BHRA recommends using a value of 0.2. If RSCFs are available for different age categories, the RSCF that pertains to an adult should be selected. In the case where EPA has not established a subchronic RfD but has established a chronic RfD, the latter value may be used. The resulting S-3 value is then compared with the S-2 value and the higher of the two is selected as the S-3 direct contact standard.

(2) A concentration of the contaminant associated with an Excess Lifetime Cancer Risk equal to one-in-one million must be identified using equations specific to each soil category;

Where: [C] = the concentration of the contaminant being derived, in units: mg/kg (ppm)

CSF = the USEPA derived oral Carcinogenic Slope Factor, in units: $(mg/(kg*day))^{-1}$
RAF_{oral} = the Relative Absorption Factor applicable for oral exposures, dimensionless
RAF_{dermal} = the Relative Absorption Factor applicable for dermal exposures, dimensionless
CF = 10^6 mg/kg conversion factor

(a) S-1 Standards: The concentration of the contaminant must be derived using the following equation:

$$[C] = (1x10^{-6} \text{ x } CF)/(CSF \text{ x } ((RAF_{oral} \text{ x } 0.659) + (RAF_{dermal} \text{ x } 16.99)))$$

(b) S-2 Standards: The concentration of the contaminant must be derived using the following equation:

$$[C] = (1x10^{-6} \text{ x } CF)/(CSF \text{ x } ((RAF_{oral} \text{ x } 0.204) + (RAF_{dermal} \text{ x } 6.33)))$$

(c) S-3 Standards: The concentration of the contaminant must be derived using the following equation:

$$[C] = (1x10^{-6} \text{ x } CF)/(CSF \text{ x } ((RAF_{oral} \text{ x } 0.022) + (RAF_{dermal} \text{ x } 0.144)))$$

(3) Considering the GW-1 standards for groundwater and an acceptable leaching model or test method as discussed in Section 8.5, a concentration of the contaminant in soil which will not result in groundwater concentrations of the contaminant greater than the applicable groundwater standard must be identified.

(4) For each combination of soil and groundwater categories, the lowest non-zero concentration estimated in Sections 8.4(1) through (3) must be the risk-based concentration for the contaminant of concern.

(5) A site-specific background concentration for the contaminant in soil must be identified for consideration as described in Section 8.4(7).

(6) The Practical Quantitation Limit (PQL) applicable to the contaminant using an appropriately sensitive analytical method for quantifying the concentration of the chemical in soil must be identified for consideration as described in Section 8.4(7).

(7) For each combination of the soil and groundwater categories, the highest of the three concentrations identified in Sections 8.4(4) through (6) must be adopted as the Method 2 soil standard for that combination of soil and groundwater categories.

(8) Method 2 soil standards identified in Section 8.4(7) must be adjusted to a Ceiling Concentration if the calculated concentration for a chemical is greater than its Ceiling Concentration. The Ceiling Concentration (which serves to limit excessive residual concentrations and minimize degradation of soil as a general resource) is based upon the "Odor Index" of the chemical. For the purposes of this policy, the Odor Index is the ratio of the chemical’s vapor pressure and 50% odor recognition level (odor threshold):

$$\text{Odor Index} = VP \div ORT_{50\%}$$

Where: VP = Vapor Pressure of a contaminant, in units of Torr, measured between 20< and 30< Celsius.

$ORT_{50\%}$ = The concentration of the contaminant at which 50% of the general population would recognize its odor. In units: parts per million (ppm).

(a) S-1 Standards:

1. Chemicals having a Vapor Pressure greater than or equal to 1, in units of Torr, measured between 20< and 30< Celsius or an Odor Index greater than or equal to 100 must be assigned a ceiling concentration of 100 mg/kg (ppm).
2. Chemicals having an Odor Index greater than or equal to one but less than 100 must be assigned a ceiling concentration of 500 mg/kg (ppm).
3. For chemicals having an Odor Index less than one or for which there is insufficient data to calculate an Odor Index, the assigned ceiling concentration must be 1,000 mg/kg (ppm).

(b) S-2 Standards:

1. Chemicals having a Vapor Pressure greater than or equal to 1, in units of Torr, measured between 20< and 30< Celsius or an Odor Index greater than or equal to 100 must be assigned a ceiling concentration of 500 mg/kg (ppm).
2. Chemicals having an Odor Index greater than or equal to one but less than 100 must be assigned a ceiling concentration of 1,000 mg/kg (ppm).
3. For chemicals having an Odor Index less than one or for which there is insufficient data to calculate an Odor Index, the assigned ceiling concentration must be 2,500 mg/kg (ppm).

(c) S-3 Standards:

1. Chemicals having a Vapor Pressure greater than or equal to 1, in units of Torr, measured between 20< and 30< Celsius or an Odor Index greater than or equal to 100 must be assigned a ceiling concentration of 1,000 mg/kg (ppm).
2. Chemicals having an Odor Index greater than or equal to one but less than 100 must be assigned a ceiling concentration of 2,500 mg/kg (ppm).
3. Chemicals having an Odor Index less than one, or there is insufficient data to calculate an Odor Index, the assigned ceiling concentration is 5,000 mg/kg.

8.5: Determination of Method 2 Soil Standards Considering Leaching Potential

Method 1 Soil Standards consider both the risks associated with direct contact with the contaminated soil and the potential for the contaminant to leach to groundwater. The leaching component of the Method 1 Soil Standards can be modified or eliminated in Method 2 considering site-specific information. The direct contact-exposure component of the standard cannot be adjusted in this Method.

(1) The development of alternative leaching-based soil concentrations or the determination that leaching-based concentrations are not applicable must be based upon information which is scientifically justified and completely documented.

(2) Demonstrations that the leaching-based component of the Method 1 soil standards is not applicable may be made on a chemical-by-chemical basis or for the site as a whole, depending upon the information relevant to that determination.

(3) Groundwater monitoring results may be used to demonstrate that soil contamination is not and will not result in groundwater concentrations greater than the applicable Method 1 or 2 Groundwater Standards. The duration of required monitoring must depend on the source mass, the mobility of the contaminant, and subsurface conditions. NHDES may request that the following methods be used in addition to groundwater monitoring to demonstrate that the concentrations of contaminants in soil at the site now and in the foreseeable future will result in compliance with all applicable Method 1 or 2 Groundwater Standards:

(a) transport and fate modeling that incorporates site-specific information on source mass and subsurface hydrogeological conditions; and/or

(b) laboratory tests that demonstrate, under site conditions, the contaminant in the soil will not leach to groundwater at levels which exceed the applicable Method 1 or Method 2 Groundwater Standards.

(4) For each combination of soil categories, the lower of the following is the applicable Method 2 Soil Standard for the contaminant:

(a) The leaching-based soil concentration identified in Section 8.5(2), and

(b) The direct contact exposure-based concentration specific to the soil category, listed in the table in Appendix E, columns (6), (7) and (8). The direct contact standard is applicable when it is determined that the leaching-based component of the Method 1 standard is not applicable per Section 8.5(2).

8.6: Determination of Method 2 GW-2 Guidelines.

(1) Method 1 GW-2 Guideline(s) consider the potential for contaminants to volatilize from the groundwater and migrate to indoor air. These standards may be modified under Method 2, or a determination may be made that one or more GW-2 standards are not applicable, based upon site-specific conditions. Modifications of a standard will result in a proposed Method 2 GW-2 Guideline(s). Proposed Method 2 standards or the determination that one or more GW-2 standards are not applicable must be scientifically justified and sufficiently documented to demonstrate that the Risk Characterization Performance Requirements, described in Section 1.4 have been met.

(2) A Method 2 GW-2 Guideline(s) must be protective of migration of contaminants into indoor air. The presence of contaminants in the groundwater at the proposed Method 2 GW-2 Guideline(s) below or near a building must not result in indoor air concentrations which pose a significant risk of harm to human health or the environment. The Method 2 GW-2 Guideline(s) may be greater or less than the corresponding Method 1 GW-2 Guideline(s), or it may be determined that the Method 1 Standard is not applicable, based upon site-specific conditions. The development of such standards must be documented by:

(a) transport and fate modeling that incorporates site-specific information on source, hydrogeological, and building conditions, and which demonstrates that the contaminant in the soil will not infiltrate to indoor air and result in significant risk of harm to human health or the environment; and/or

(b) soil gas characterization data, indoor air characterization data, and other information and data resulting from field investigation conducted at and proximate to the site.

8.7: Method 2 Risk Characterization.

(1) When conducting a Method 2 Risk Characterization, the risk of harm to human health and the environment must be characterized using the methodology described in Section 7.0 (Risk Characterization Method 1), and any applicable Method 1 Standards in combination with one or more Method 2 Standards identified pursuant to Section 8.0.

(2) A Method 2 Risk Characterization must be conducted in combination with a separate characterization of the risk of harm to safety, as described in Section 6.0.

(3) A condition that is protective of human health and the environment for the applicable Site Activity and Uses identified in accordance with Section 2.3 exists or has been achieved if no Exposure Point Concentration is greater than the applicable Method 1 and Method 2 Soil or Groundwater Standard.

(4) The documentation of the Method 2 Risk Characterization must clearly state whether or not a condition that is protective of human health and the environment exists or has been achieved at the site.

9.0: Method 3 Risk Characterization

9.1 Applicability of Method 3

Method 3 may be used to characterize the risk of harm to human health and the environment for any site. In a Method 3 Risk Characterization, the risks of harm to human health and the environment are evaluated separately. Method 3 Risk Characterizations use detailed site-specific information and methodologies. Due to the complexity and expense of a Method 3 Risk Characterization, NHDES recommends that the scope of work for a Method 3 Risk Characterization be approved by NHDHHS and NHDES prior to performing the work.

9.2: General Approach to Method 3

Method 3 relies upon detailed information about the site, the contaminant, and potential exposures to Human and Environmental Receptors under all current and reasonably foreseeable Site Activities and Uses to characterize the risk of harm. The scope and level of effort for the Method 3 Risk Characterization must reflect the site-specific nature of this Method, and the information used to characterize the risk must be sufficiently documented to demonstrate that the Risk Characterization Performance Requirements, described in Section 1.4, have been met.

(1) The Method 3 Risk Characterization must be performed in a manner consistent with scientifically acceptable risk assessment practices, and consider guidance published by NHDHHS and USEPA. Regardless of the Method 3 Risk Characterization results, if GW-1 standards are exceeded, a groundwater management permit is required and all relevant portions of Env-Ws 410 (e.g., treatment, removal or containment of source areas and the development of a remedial action plan) must be addressed.

(2) In performing a Method 3 Risk Characterization, the objective must be to provide a conservative estimate of the impact that the contaminant may have on the Human and Environmental Receptors at the site and in the surrounding environment.

(3) This Risk Characterization process makes use of existing standards, Upper Concentration Limits in Soil, quantitative estimates of cancer and noncancer health risks, and both quantitative and qualitative evaluations of risk to the environment to determine the need for a remedial action or to demonstrate a condition that is protective of human health and the environment either exists or has been achieved.

(a) The Method 3 characterization of the risk of harm to human health is described in Section 9.3.

(b) The Method 3 characterization of the risk of harm to the environment is described in Section 9.4.

(c) The list of Upper Concentration Limits in Soil is in Section 9.5(8).

(4) The risk of harm to safety must also be characterized, as described in Section 6.0.

9.3: Method 3 Human Health Risk Characterization.

Under Method 3, the risk of harm to human health must be characterized for all current and reasonably foreseeable Site Activities and Uses identified in Section 2.3, as follows:

(1) The site, receptor and exposure information described in Sections 1.5 though 2.6 must be identified and documented.

(2) The groundwater and soil categories applicable to the site must be identified and documented, as described in Section 3.0. The groundwater and soil categories are considered as general indicators of exposure potential in a Method 3 evaluation.

(3) All applicable or suitably analogous human health standards must be identified in the documentation of the Method 3 Risk Characterization. The Method 1 Soil Standards listed in Section 7.0 are not considered applicable or suitably analogous, as those standards represent an alternative approach to Method 3. The list of potentially applicable or suitably analogous standards includes the following:

(a) New Hampshire Drinking Water Quality Standards promulgated in Env-Ws 315 through 317, which are considered applicable to all groundwater except where exempted pursuant to Env-Ws 410.04;

(b) New Hampshire Air Quality Standards promulgated in Rules Governing the Control of Air Pollution Env-A 100 through 1700, and

(c) New Hampshire Surface Water Quality Standards promulgated in Env-Ws 432.03.

(4) The frequency, duration and intensity of exposure to each contaminant at the site for each receptor at each Exposure Point must be evaluated and documented, considering the current and reasonably foreseeable Site Activities and Uses identified for the disposal site. The magnitude of each receptor's total exposure to the contamination at the site is calculated in a manner which provides a conservative estimate of the potential exposures. NHDES and NHDHHS must approve work plans for assessments conducted using a probabilistic analysis.

(5) For each identified Human Receptor, cumulative cancer risks and cumulative non-cancer risks must be calculated.

(a) Chemical-specific toxicity information used to estimate the cancer and non-cancer risks must be identified and documented, and the selection of this information must take into account guidance published by NHDHHS. Primary consideration must be given to information developed by the USEPA for the purpose of conducting such risk assessments. Examples of such toxicity information include the following:

1. Reference Doses and Reference Concentrations; and
2. Carcinogenic Slope Factors and Unit Risks values.

(b) For receptors who may be exposed to mixtures of contaminants or through multiple Exposure Pathways at the site, the cumulative risk must reflect those exposures. Risk estimates are presumed to be additive unless an alternative mechanism is demonstrated to be appropriate.

(c) Risk calculations performed using a probabilistic analysis must identify the cumulative cancer and non-cancer risks associated with the 95th percentile estimate of exposure.

(6) The Cumulative Receptor Cancer Risk must be compared to a Cumulative Cancer Risk Limit which is an Excess Lifetime Cancer Risk equal to one-in-one hundred thousand. Cumulative Receptor Non-cancer Risk must be compared to a Cumulative Non-cancer Risk Limit which is a Hazard Index equal to one. Estimated Exposure Point Concentrations must be compared to any applicable or suitably analogous standards.

(7) A condition that is protective of harm to human health for the applicable Site Activity and Uses identified in accordance with Section 2.3 exists or has been achieved if:

(a) no Exposure Point Concentration of a contaminant is greater than an applicable or suitably analogous human health standard;

(b) no Cumulative Receptor Cancer Risk calculated is greater than the Cumulative Cancer Risk Limit; and

(c) no Cumulative Receptor Non-cancer Risk is greater than the Cumulative Receptor Non-cancer Risk Limit.

(8) Method 3 human health Risk Characterization documentation must clearly state whether or not a condition that is protective of human health exists or has been achieved, based upon the criteria described in Section 9.3(7).

(9) All mathematical equations used to calculate cumulative receptor cancer and non-cancer risks must be clearly presented and documented.

9.4: Method 3 Environmental Risk Characterization

The characterization of risk of harm to the environment must be conducted for all current and reasonably foreseeable Site Activities and Uses identified in Section 2.3. Characterization of the risk of harm to the environment must include an assessment of chemical data, potential contaminant migration pathways, and an evaluation of biota and habitats at and in the immediate vicinity of the site, as described in Section 9.4(2), as well as through the application of Upper Concentration Limits, as described in Section 9.4(5).

(1) A Method 3 characterization of the risk of harm to the environment must be based on the site, receptor and exposure information identified in Sections 1.5 through 2.6, as well as any relevant data collected during the remedial investigations.

(2) The risk of harm to the site biota and habitats is characterized by evaluating ecological parameters using a two-stage approach. In Stage I, the objective is to identify and document conditions which do not warrant a Stage II Risk Characterization, either because of the absence of a potentially significant exposure pathway or because environmental harm is readily apparent and therefore additional assessment would be redundant. If a potentially significant exposure pathway is indicated by the available information per Sections 9.4(3)(a) and 9.4(3)(c), then a Stage II Environmental Risk Characterization is required to characterize the risks posed by those exposures.

(a) A Stage I Environmental Screening must be performed as described in Section 9.4(3) for all sites evaluated using Risk Characterization Method 3, and for those sites evaluated using a Method 3 Environmental Risk Characterization in combination with Method 1 or Method 2.

(b) Following a Stage I Environmental Screening and based upon the criteria described in Section 9.4(3), it may be concluded that:

1. A Stage II Environmental Risk Characterization is <u>not</u> required because there are no complete exposure pathways that could result in potentially significant exposures, and a condition that is protective of harm to site biota and habitats clearly exists (Section 9.4(3)(a)); or

2. A Stage II Environmental Risk Characterization is <u>not</u> required because, for each contaminated medium, harm is readily apparent; therefore a condition

protective of harm to the site biota and habitats clearly does not exist, and a Stage II Environmental Risk Characterization would be redundant (Section 9.4(3)(b)); or

3. A Stage II Environmental Risk Characterization is required because, for one or more contaminated media, there is not enough information to determine whether or not a condition that is protective of harm exists, and therefore those media are considered to present "potentially significant exposures" (Section 9.4(3)(c)).

(c) The scope and nature of the Stage II Environmental Risk Characterization must depend on the nature of the site, the Environmental Receptors affected or potentially affected, and the Stage I Environmental Screening criteria which indicated the need for the Stage II Environmental Risk Characterization.

(3) Stage I Environmental Screening. Exposures of site biota and habitats must be characterized by the Stage I Environmental Screening as follows:

(a) Available evidence must be evaluated to determine whether there is current or potential future exposure of Environmental Receptors to contamination at or from the site. Sources of such evidence must include historical records, site data, field observations, statements by present and past residents or employees, and any other relevant source.

1. Evidence of current or potential exposure must include, but is not limited to:

a. Current or past visible physical evidence that contaminants at or from the site have come to be located in surface soil, surface water, sediment or wetlands. Examples of such evidence include the presence of sheens from contaminants, non-aqueous phase liquids, oil, tar or other solid or semi-solid contaminant in surface soil, surface water, sediment or wetlands;

b. Records or other evidence of current or past impacts of contaminants from the site on wildlife, fish, shellfish or other aquatic biota. Examples of such impacts include fish kills and abiotic conditions;

c. Analytical data indicating the presence of contaminants attributable to the site in question in surface water or sediment (including wetlands);

d. The potential for the transport of contaminants in the groundwater or surface runoff to such receptors as surface water or sediments (including wetlands) identified as Environmental Receptors; or

e. The presence of contaminants at the site within two feet of the ground surface and the potential for such contamination to result in exposure to wildlife.

2. If no current or potential future exposure is identified, then a condition that is protective of the environment exists or has been achieved, and a Stage II Environmental Risk Characterization is *not* required.

(b) If a current or potential future exposure of Environmental Receptors to contamination at or from the site is identified, then for each such exposure, site conditions must be evaluated to determine whether significant environmental harm is "readily apparent."

1. The following criteria represent "readily apparent harm":

a. the visual evidence of stressed biota attributable to the release at the

site, including, without limitation, fish kills or abiotic conditions;

b. the existence of contaminants attributable to the site in concentrations which exceed New Hampshire Surface Water Quality Standards, Env-Ws 432.03, which include USEPA Ambient Water Quality Criteria;

c. the visible presence of oil, tar, or other non-aqueous phase contaminants in soil over an area equal to or greater than two acres, or over an area equal to or greater than 1,000 square feet in sediment; and,

d. the presence of oil, tar or non-aqueous phase liquids (NAPLs) discharging to surface waters.

If any of these conditions exist, then there is sufficient evidence to conclude that a remedial action plan is required and a Stage II Environmental Risk Characterization would be redundant and is *not* required.

2. If any exposure pathway is associated with readily apparent harm, then a condition that is protective the environment does not exist, and a Stage II Environmental Risk Characterization is not required to make that determination.

(c) Each current and potential future Exposure Pathway identified in Section 9.4(3)(a) must be evaluated using available information, to determine whether it could result in potentially significant exposure.

1. Any potential exposure identified in Section 9.4(3)(a) is considered a "potentially significant exposure" unless it can be ruled out as such using an effects-based screening approach. The Stage I effects-based screening must be conducted in a manner consistent with scientifically acceptable risk assessment practices, and must take into consideration guidance and screening criteria published by NHDES or USEPA. Examples of screening criteria include:

a. USEPA Ambient Water Quality Criteria and New Hampshire Surface Water Standards promulgated in Env-Ws 432.03;

b. concentrations reported in the scientific literature to be associated, or potentially associated, with toxic, teratogenic and mutagenic effects;

c. site size and location criteria which may be identified by NHDES;

d. EPA's Sediment Quality Criteria and Benchmarks and NOAA and OMOE sediment guidelines

2. If, through the application of the screening criteria identified in Section 9.4(3)(c)1, an environmental medium (such as soil, sediment or surface water) can be screened out as a source of "potentially significant exposures," then a Stage II Environmental Risk Characterization is *not* required for any exposure pathway for which that medium is the contaminant source.

3. If current or potential future exposures to any media are not ruled out in Stage I Screening, those exposures may be considered to be "potentially significant exposures," and NHDES may require a Stage II Environmental Risk Characterization to determine whether a condition of that is protective of the environment exists. A remedial action plan would be required instead of a Stage II Environmental Risk Characterization, if "readily apparent harm" is present as defined in Section 9.4 (3)(b)1.

(4) Stage II Environmental Risk Characterization: A Stage II Environmental Risk Characterization is used to determine whether there is an indication of the potential for ecological harm and/or evidence of ecological harm.

(a) The Stage II Environmental Risk Characterization must be conducted under the supervision of an individual trained and knowledgeable in ecological studies. The evaluation must take into account relevant accepted guidance and methods, including the following:

1. literature reviews to obtain relevant dose/response information, tissue concentrations and/or environmental concentrations associated with adverse ecological effects;
2. field studies to evaluate adverse impacts on receptor populations and communities exposed to contaminants at or from the site;
3. toxicity tests to evaluate the effects of contaminated media on the survival, growth, reproduction and metabolism of the test organisms.

(b) The Stage II Environmental Risk Characterization must include, but is not limited to, the following steps:

1. Problem Formulation. The first phase of the assessment must establish the goals, scope and focus of the Stage II Environmental Risk Characterization. Preliminary characterization of exposure and effects must be conducted, and both assessment and measurement endpoints must be identified. The relevance of the measurement endpoints to the assessment endpoints selected must be described and justified.
    a. Population impacts must be evaluated by focusing on the likely or potentially exposed population rather than the general regional population.
    b. The evaluation must focus on ecological effects in the scale of the site.
2. Analysis. The second phase of the risk assessment must characterize actual and potential environmental exposures and associated ecological effects.
3. Risk Characterization. In the final phase of the risk assessment, the results of the environmental exposure and effects analysis must be used to evaluate the likelihood of adverse ecological effects. The documentation of the Risk Characterization must include a summary of assumptions, scientific uncertainties, strengths and weaknesses of the analyses, and justification of conclusions reached concerning the ecological significance of the risks.

(c) The Stage II Environmental Risk Characterization may also include the development of an environmental risk-based guideline for a contaminant for which no environmental standard exists, and to the extent sufficient information concerning the environmental risks posed by the contaminant is available. Such guidelines must be developed in a manner consistent with scientifically acceptable practices, taking into account guidance published by NHDES or the U.S. Environmental Protection Agency, and information from the scientific literature, laboratory studies or field studies.

(d) Conclusions. A condition considered to be protective of the environment has been achieved, if:

1. there is no physical evidence of a continuing release of a contaminant at or from the site to surface waters and wetlands which significantly affect Environmental Receptors; and
2. there is no evidence of biologically significant harm (at the subpopulation, community, or system-wide level) known or believed to be associated with

current or reasonably foreseeable future exposure of wildlife, fish, shellfish or other aquatic biota to a contaminant at or from the site; and

3. concentrations of contaminants at or from the site do not and are not likely to exceed any applicable or suitably analogous environmental standards which have been formally promulgated, including New Hampshire's Surface Water Quality Standards, Env-Ws 432.03, at current and reasonably foreseeable Exposure Points; and

4. there is no indication of the potential for biologically significant harm (at the subpopulation, community, or system-wide level), currently or for the reasonably foreseeable future, to Environmental Receptors considering their potential exposures to a contaminant and the toxicity of the contaminant.

(5) The risk of harm to the environment must also be characterized by comparing the concentration of each contaminant to the Upper Concentration Limits in Soil as described in Section 9.5.

(6) The documentation of the Method 3 Environmental Risk Characterization must clearly state whether or not a condition that is protective of harm to environmental resources, biota and habitats exists or has been achieved at the site.

9.5: Method 3 Upper Concentration Limits in Soil

(1) Upper Concentration Limits in soil are concentrations of contaminants which, if exceeded, indicate the potential for significant risk of harm to the environment under current and future conditions.

(2) The risk of harm to the environment must also be characterized by comparing the arithmetic mean of the concentration of the chemical in soil to the Upper Concentration Limits listed in Table 4 of Section 9.5(8).

(3) If one or more "hot spots" have been identified at the site pursuant to Section 2.4(2), then the maximum or 95th percent upper confidence limit of the arithmetic mean concentrations within each hot spot must also be compared to the Upper Concentration Limits.

(4) Upper Concentration Limits are not applicable to soil contaminants which have been permanently immobilized or fixated or contained by an engineered system as part of a NHDES approved remedial action. Upper concentration limits can also be exceeded during the implementation of a NHDES approved remedial action plan.

(5) Activity and Use Restrictions for management of the exposure to the contaminated soils is not an appropriate method for complying with Upper Concentration Limits.

(6) A site is not eligible for a Certificate of No Further Action, if the Upper Concentration Limits are exceeded.

(7) Table 4 lists the Upper Concentration Limits in Soil:

Table 4

METHOD 3: UPPER CONCENTRATION LIMITS IN SOIL

NHDES Risk Characterization and Management Policy (Section 9.5(6))

CHEMICAL NAME	CAS No.	UCLs in Soil ug/g (ppm)
Acetone	67-64-1	10,000
Acrylonitrile	107-64-1	660
Aldicarb	116-06-3	1,800
Aldicarb sulfone	1646-87-3	1,800
Aldicarb sulfoxide	1646-88-4	1,800
Aldrin	309-00-2	10
Alkyl benzenes		2,500
Allyl chloride	107-05-1	100
Antimony	7440-36-0	260
Arsenic	7440-38-2	120
Atrazine	1912-24-9	6,300
Barium	7440-38-2	10,000
Benzene	71-43-2	10,000
Benzidine	92-87-5	1
Benzoic acid	65-85-0	10,000
Beryllium	7440-41-7	10
Biphenyl, 1,1-	92-52-4	10,000
Boron	7440-42-8	10,000
Bromodichloromethane	75-27-4	4,100
Bromoform	75-25-2	10,000
Bromomethane	74-83-9	2,200
Cadmium	7440-43-9	2,300
Camphor	76-22-2	10,000
Carbofuran	1563-66-2	9,100
Carbon disulfide	75-15-0	10,000
Carbon tetrachloride	56-23-5	240
Chlordane	57-74-9	20
Chloroaniline, p-	106-47-8	4,000
bis(2-chloroethyl)ether	111-44-4	100
bis(2-chloroisopropyl)ether	39638-32-9	1,500
Chloromethane	74-87-3	10,000
Chlorophenol, 2-	95-57-8	10,000
Chlorotoluene, 2 (o)	95-49-8	10,000
Chlorotoluene, 4 (p)	106-43-4	10,000
Chromium (III)	16065-83-1	10,000
Chromium (VI)	18540-29-9	5,400
Cyanide	57-12-5	10,000
2,4-D	94-75-7	10,000
Dalapon	75-99-0	10,000
DDD (Dichlorodiphenyl dichloroethane, p,p')	72-54-8	640
DDE (Dichlorodiphenyl dichloroethylene, p,p')	72-55-9	560
DDT (Dichlorodiphenyl trichloroethane, p,p')	50-29-3	110
Dibromochloromethane	124-48-1	2,200

Table 4

METHOD 3: UPPER CONCENTRATION LIMITS IN SOIL

NHDES Risk Characterization and Management Policy (Section 9.5(6))

CHEMICAL NAME	CAS No.	UCLs in Soil ug/g (ppm)
Dibromochloropropane		220
Dibutylphthlate	84-74-2	10,000
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	10,000
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	10,000
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	5,600
Dichlorobenzidine, 3,3'-	91-94-1	520
Dichlorodifluoromethane	75-71-8	10,000
Dichloroethane, 1,1-	75-34-3	10,000
Dichloroethane, 1,2-	107-06-2	3,700
Dichloroethylene, 1,1-	75-35-4	590
Dichloroethylene, cis-1,2-	156-59-2	10,000
Dichloroethylene, trans-1,2-	156-60-5	10,000
Dichloromethane (Methylene chloride)	75-09-2	10,000
Dichlorophenol, 2,4-	120-83-2	2,200
Dichloropropane, 1,2-	78-87-5	5,300
Dichloropropene, 1,3-	542-75-6	120
Dieldrin	60-57-1	30
Diethyl phthalate	84-66-2	10,000
Diethylhexyl)phthalate (bis(2-ethylhexyl)phthalate)	117-81-7	10,000
Dimethyl phthalate	131-11-3	10,000
Dimethylphenol, 2,4-	105-67-9	10,000
Dinitrophenol, 2,4-	51-28-5	1,500
Dinitrotoluene, 2,4-	121-14-2	450
Dinoseb	88-85-7	620
Diphenylhydrazine, 1,2-	122-66-7	470
Diquat (dibromide)	85-00-7	4,000
Endosulfan	115-29-7	10,000
Endothall	145-73-3	10,000
Endrin	72-20-8	540
Ethylbenzene	100-41-4	10,000
Ethylene dibromide	106-93-4	4
Ethylene glycol	107-21-1	10,000
Fluoride	16984-48-8	10,000
Heptachlor	76-44-8	90
Heptachlor epoxide	1024-57-3	5
Hexachlorobenzene	118-74-1	70
Hexachlorobutadiene	87-68-3	30
Hexachlorocyclohexane, alpha	319-84-6	40
Hexachlorocyclohexane, beta	319-85-7	140
Hexachlorocyclohexane, gamma; (Lindane)	58-89-9	70
Hexachlorocyclopentadiene	77-47-4	7,100
Hexachlorodibenzodioxin	34465-46-8	w
Hexachloroethane	67-72-1	100

Table 4

METHOD 3: UPPER CONCENTRATION LIMITS IN SOIL

NHDES Risk Characterization and Management Policy (Section 9.5(6))

CHEMICAL NAME	CAS No.	UCLs in Soil ug/g (ppm)
Isophorone	78-59-1	10,000
Isopropyl benzene	98-82-8	10,000
Lead	7439-92-1	4,000
Mercury (inorganic)	7439-97-6	70
Methoxychlor	72-43-5	1,700
Methyl ethyl ketone	78-93-3	10,000
Methyl isobutyl ketone	108-10-1	10,000
Methyl mercury	22967-92-6	30
Methyl phenol, 2-	95-48-7	3,700
Methyl phenol, 4-	106-44-5	370
Methyl tert butyl ether	1634-04-4	10,000
Monochlorobenzene (Chlorobenzene)	108-90-7	10,000
Nickel	7440-02-0	10,000
Oxamyl	23135-22-0	10,000
Pentachlorophenol	87-86-5	2,100
Phenol	108-95-2	10,000
Picloram	1918-02-1	10,000
Polychlorinated Biphenyls (PCBs)	1336-36-3	20
Selenium	7782-49-2	10,000
Silver	7440-22-4	2,000
Simazine	122-34-9	910
Styrene	100-42-5	10,000
TCDD, 2,3,7,8- (Dioxin)	1746-01-6	.003
Tetrachloroethane, 1,1,1,2-	630-20-6	610
Tetrachloroethane, 1,1,2,2,-	79-34-5	690
Tetrachloroethylene	127-18-4	6,900
Tetrahydrofuran	109-99-9	10,000
Thallium (thallium chloride)	7440-28-0	320
Toluene	108-88-3	10,000
Toxaphene	8001-35-2	150
TP, 2,4,5- (Silvex)	93-72-1	10,000
Trichlorobenzene, 1,3,5-	108-70-3	1,300
Trichlorobenzene, 1,2,4-	120-82-1	2,100
Trichloroethane, 1,1,1-	71-55-6	10,000
Trichloroethane, 1,1,2-	79-00-5	1,000
Trichloroethylene	79-01-6	10,000
Trichlorofluoromethane	75-69-4	10,000
Trichloromethane (Chloroform)	67-66-3	3,600
Trichlorophenol, 2,4,5-	95-95-4	10,000
Trichlorophenol, 2,4,6-	88-06-2	10,000
Trichloropropane, 1,2,3-	96-18-4	9,200
Tritium	10028-17-8	w
Vinyl chloride	75-01-4	190

Table 4

METHOD 3: UPPER CONCENTRATION LIMITS IN SOIL

NHDES Risk Characterization and Management Policy (Section 9.5(6))

CHEMICAL NAME	CAS No.	UCLs in Soil ug/g (ppm)
Xylenes (mixed isomers)	1330-20-7	10,000
Zinc	7440-66-6	10,000
Polynuclear Aromatic Hydrocarbons - Carcinogenic		
Benzo(a)anthracene	56-55-3	400
Benzo(a)pyrene	50-32-8	40
Benzo(b)fluoranthene	205-99-2	4,000
Benzo(k)fluoranthene	207-08-9	4,000
Chrysene	218-01-9	10,000
Dibenzo(a,h)anthracene	53-70-3	40
Indeno(1,2,3-cd)pyrene	193-39-5	400
Polynuclear Aromatic Hydrocarbons - Noncarcinogenic		
Acenaphthene	83-32-9	10,000
Acenaphthylene	208-96-8	10,000
Anthracene	120-12-7	10,000
Benzo(g,h,i)perylene	191-24-2	10,000
Fluoranthene	206-44-0	10,000
Fluorene	86-73-7	10,000
Methylnaphthalene, 2-	91-57-6	10,000
Naphthalene	91-20-3	10,000
Benzo(g,h,i)perylene	191-24-2	10,000
Phenanthrene	85-01-8	10,000
Pyrene	129-00-0	10,000

Notes: w Upper Concentration Limits are currently unavailable for these contaminants.

10.0: Remedial Action Completion

10.1: Purpose

This Section establishes requirements and procedures for: 1) determining when remedial actions are completed, and 2) documenting the activities and information necessary to support a Certificate of Completion or a Certificate of No Further Action.

10.2: General Provisions for Completion of Remedial Actions and Site Closure

(1) NHDES has the statutory authority under RSA 147-F to issue two types of certificates to document that certain stages of the remedial action process have been completed.

(a) A Certificate of Completion is issued when the active components of the RAP have been completed and the performance standards specified in the RAP and/or the Groundwater Management Permit have been achieved. A RAP Completion Report must accompany the request for issuance of a Certificate of Completion and must meet the requirements of Section 10.5.

(b) A Certificate of No Further Action is issued when the site does not require significant additional oversight by NHDES, the RAP has been completed and the Groundwater Management Permit has been terminated. A request for a Certificate of No Further Action must meet the requirements specified in Section 10.6.

(2) Remedial actions must be completed in accordance with the requirements of an approved RAP (Env-Ws 410.23), this section and schedules approved by NHDES. If the remedial action does not achieve the performance standards contained in the RAP and the Groundwater Management Permit, a modified RAP will be implemented in accordance with NHDES approved schedules, this section and applicable state rules and regulations.

(3) At all sites where groundwater quality exceeds GW-1 standards, the following actions must be taken prior to Completion of a remedial action:

(a) If a source area is present, the source must be either treated, removed or contained. Additionally, the dissolved portion of the plume must be evaluated against the criteria listed in Env-Ws 410.24 to determine:

1. if active treatment of groundwater is required to restore groundwater quality or contain groundwater contamination; or
2. if groundwater quality may be restored by natural attenuation to AGQS.

(b) Groundwater exceeding GW-1 standards must be contained within a Groundwater Management Zone (GMZ) delineated and established in accordance with Env-Ws 410.

(c) A Groundwater Management Permit must be obtained to monitor groundwater quality within and at the boundary of the GMZ.

10.3: Certificate of Completion

(1) A Certificate of Completion certifies that:

(a) the activities specified in an approved RAP have been completed and the performance standards specified in the RAP and Groundwater Management Permit have been achieved;

(b) any necessary Activity and Use Restrictions have been implemented;

(c) any monitoring requirements are being met; and

(d) all fees and costs due under RSA 147-F have been paid.

(2) A Certificate of Partial Cleanup can be provided prior to the issuance of a Certificate of completion at the discretion of the NHDES. The purpose of a Certificate of Partial Cleanup is to document that substantial progress has been made toward the implementation of a RAP. Examples of remedial action milestones that might qualify for a Certificate of Partial Cleanup are as follows:

(a) the completion of a key phase of activity (e.g., source removal);
(b) the completion of the remedial action at a key portion of the site;
(c) the implementation of any necessary Activity and Use Restrictions.

10.4: Certificate of No Further Action

(1) A Certificate of No Further Action certifies that:

(a) no further investigation, remediation or other actions are required;
(b) any necessary Activity and Use Restrictions have been implemented or no further Activity and Use Restrictions are required;
(c) any monitoring requirements necessary to implement an Activity and Use Restriction are being met or no monitoring requirements are required; and
(d) all fees and costs due under RSA 147-F have been paid.

(2) A Certificate of No Further Action is issued for sites where remedial actions, site investigations, risk characterization or monitoring activities have determined that:

(a) The sole source of a site's risk is due to contaminated groundwater migrating from an upgradient property (see R.S.A Chapter 266 or SB 532 for additional details); or
(b) Sources of on-site contamination have been sufficiently addressed to conclude that:

(1) Sources of contamination which could result in an increase in concentrations of contaminants in an environmental medium, either as a consequence of a direct discharge or through inter-media transfer of contamination, do not exist (Note: The downgradient leading edge of a plume of one or more contaminants dissolved in and migrating with groundwater is not, in and of itself, considered a source of contamination);

(c) contaminant concentrations in soil are below the applicable Soil Standards (Method 1, 2 or 3 standards developed for the site) or exposure to contaminated soil is managed by a NHDES approved Activity and Use Restriction; and
(d) contaminant concentrations in groundwater are in compliance with GW-1 standards and any existing groundwater management permit terminated.

10.5: Content of Completion Reports for Certificates of Partial Completion and Completion

(1) A Completion Report for a Certificate of Completion or Certificate of Partial Completion must include, at a minimum, the following:

(a) the site name, address and NHDES Site Number(s);
(b) for response actions where a threat of release has been abated, the Method(s) (Methods 1, 2, or 3) used to characterize the risk of harm posed by the site to human health and the environment;
(c) the relationship of the requested certificate to any other certificate that has been filed for the site or portion thereof, if applicable, together with a statement as to whether any additional remedial actions are needed for any other portions of the site;
(d) when the active components of an approved RAP have not achieved applicable Soil and Groundwater Standards, a discussion must be provided on how compliance with the standards will be achieved (e.g., natural attenuation and Activity and Use

Restrictions) and demonstrated (e.g., plans for future groundwater monitoring and/or soil sampling).

(e) a discussion of an Activity and Use Restriction implemented at the site.

(2) Except where previously submitted, all documentation, plans and/or reports necessary to support the Completion Report must be submitted to NHDES and must include the following:

(a) a clear and accurate description of the location of the site or the location and boundaries of the site or portion of the site to which the Completion Report applies. Such description must reference, to the extent practicable, the location of the site, and location and boundaries of the site or portion thereof relative to permanent or semi-permanent landmarks, and/or surveyed boundaries;

(b) a demonstration that all uncontrolled sources have been eliminated or controlled;

(c) information supporting the conclusion that no substantial hazards remain at the site;

(d) a copy of any and all Activity and Use Restrictions which have been implemented;

(e) a description of any operation, maintenance, and/or monitoring that will be required to confirm and/or maintain those conditions at the site upon which the remedial action is based; and

(3) For all remedial actions where applicable Soil and Groundwater Standards have not been achieved the Completion Report must include the following:

(a) a modified remedial action plan, if additional active remedial measures are required;

(b) a description of any additional steps that will be taken, including monitoring and Activity and Use Restrictions, to ensure site conditions that are protective to human health and the environment.

(c) a periodic evaluation of the remedial action must be conducted in accordance with a schedule approved by NHDES until such time that a Certificate of No Further Action has been attained.

10.6: Content of Request for a Certificate of No Further Action

(1) A Request for a Certificate of No Further Action must include, at a minimum, the following:

(a) the site name, address and NHDES Site Number(s);

(b) Method(s) (Methods 1, 2, or 3) used to characterize the risk of harm posed by the site to human health and the environment;

(c) A summary of the most recent groundwater and soil quality results and a comparison of the results to applicable Soil and Groundwater standards (Method 1,2 or 3 standards derived for the site);

(d) for a site where a remedial action was conducted, information supporting the conclusion that the response actions have achieved applicable Soil and Groundwater Standards;

(e) indication as to whether the Request for a Certificate of No Further Action is based upon the implementation of an Activity and Use Restriction, and if so, the type of Activity and Use Restriction implemented at the site.

(f) the relationship of the Request for a Certificate of No Further Action to any Certificate of Completion that has been filed for the site or portion thereof, if applicable, together with a statement as to whether any additional response actions are needed for any other portions of the site;

(2) Except where previously submitted, supporting documentation, plans and/or reports necessary to support the Request for a Certificate of No Further Action must be submitted to NHDES and must include the following:

(a) a clear and accurate description of the location of the site or the location and boundaries of the site or portion of the site to which the Request for a Certificate of No Further Action applies. Such description must reference, to the extent practicable, the location of the site, and location and boundaries of the site or portion thereof relative to permanent or semi-permanent landmarks, and/or surveyed boundaries;

(b) a copy of any and all Activity and Use Restrictions which have been implemented; and

(c) a description of any monitoring that will be required to confirm and/or maintain those conditions at the site upon which the Request for a Certificate of No Further Action is based.

11.0: Activity and Use Restrictions

Sections 11.0 through 11.5 are cited collectively as the Activity and Use Restrictions Section.

11.1: Application of Activity and Use Restrictions

(1) The purpose of an Activity and Use Restriction is to narrow the scope of exposure assumptions used to characterize risks to human health from a release pursuant to Sections 1.0 to 10.0 by specifying activities and uses that will be prohibited and allowed at the site in the future. Activity and Use Restrictions are intended to ensure that proposed changes in the use of a site are evaluated for any increased exposure to remaining contamination. This section establishes criteria for determining when an Activity and Use Restriction must be used, when one cannot be used, and when one may be a factor to be considered in appropriately characterizing soil and groundwater at a site.

(2) Activity and Use Restrictions are required:

(a) at all sites or portions of sites for which the Risk Characterization depends upon the restriction of Site Activities and Uses to achieve or maintain protection of human health and/or environment including:

1. any site for which a Risk Characterization is based on Method 1 or 2 Soil Standards and the Exposure Point Concentrations of contaminants exceed the S-1 standards but meet applicable S-2 or S-3 standards; and
2. any site where a Method 3 Risk Characterization relies on reduced exposure potential due to the assumption of limited site use; and

(b) at all sites for which the Risk Characterization relies upon Exposure Pathway elimination measures to prevent exposure to levels of contamination that would otherwise pose a significant risk of harm to human health or the environment.

(3) A Groundwater Management Zone that has been established and is being monitored under the provisions of a Groundwater Management Permit is the appropriate Activity and Use Restriction for groundwater at a site that contains contaminant concentrations in groundwater that exceed AGQS. No additional requirements for contaminated groundwater above and beyond the provisions of Env-Ws 410 are required to implement this type of Activity and Use Restriction under the provisions of this section.

(4) Activity and Use Restrictions:

(a) must provide notice to holders of any interest(s) in a property or a portion thereof (including without limitation, owners, lessees, tenants, mortgagees, and holders of easement rights) of the existence and location of contamination at such property and the Activity and Use Restrictions that have been implemented in response thereto; and

(b) establish a duty to evaluate risks associated with proposed changes in Site Activities and Uses on the subject property that could increase the risk of harm to human health or the environment and to perform additional response actions prior to any such change in Site Activities and Uses.

(5) Any Activity and Use Restrictions applied at a site pursuant to this policy must be instituted and maintained in accordance with the relevant requirements of NHDES.

11.2: Implementation of Activity and Use Restrictions

Activity and Use Restrictions imposed pursuant to this policy must be implemented and

adhered to by the owner and holders of interest(s) in the property and/or a license to use the property subject to the Activity and Use Restriction, and person(s) conducting response actions at the site in accordance with the procedures established in this policy.

(1) Contents of an Activity and Use Restrictions Proposal

A request for Activity and Use Restrictions must contain the following information:

(a) a description of the property and site, including:

1. the location of the property and its street address;
2. a metes and bounds description of the property that is subject to the Activity and Use Restrictions; and
    a. a recordable or registerable plan of such property prepared by a New Hampshire Registered Land Surveyor or a New Hampshire Registered Professional Engineer; or
    b. a reference to a survey plan of such property that has been recorded and/or registered;
3. if the area subject to the Activity and Use Restrictions (i.e., "the Restricted Area") comprises only a portion of the property, a metes and bounds description of the Restricted Area; and
    a. a recordable or registerable plan of the Restricted Area prepared by a New Hampshire Registered Land Surveyor or a New Hampshire Registered Professional Engineer; or
    b. a reference to a survey plan of the Restricted Area that has been recorded and/or registered. If the entire property is to be restricted then a separate plan for the Restricted Area need not be included; and
4. a sketch plan showing the location of the Restricted Area in relation to the boundaries of the site to the extent that the boundaries of the site have been established;

(b) name(s) of the property owner(s) and, for Brownfields Program participants (RSA 147-F) that do not own the property, the relationship to the owner;

(c) the site name and NHDES Site Number(s);

(d) the time period during which the Activity and Use Restrictions must be in place;

(e) a precise description of the Site Activities and Uses which must be prohibited on the property such as:

1. construction or placement of buildings, utilities, roadways, parking lots or other structures;
2. excavating, dredging or otherwise removing sediments, soils, loam, peat, sand, gravel, rock or other mineral substance;
3. planting, removal or destruction of trees, shrubs, or other vegetation;
4. using a private well to supply groundwater for human consumption;
5. use of the property as a park, playground or school; or
6. other Site Activities and Uses which would likely result in significant risk or a substantial hazard from exposures to contaminants if the Site Activity and Use were to take place on the property;

(f) a precise description of the measures which will be taken to ensure compliance with restrictions. Such obligations may include the continued proper operation of remedial actions, specific procedures governing excavation activities to protect workers and site neighbors, and the erection and maintenance of fences to prohibit access of unauthorized persons to the site;

(g) a precise description of Site Activities and Uses which are permitted on the subject property, including without limitation specific provisions for purposes of maintenance, alteration, or repair of utilities, or specific types of land uses and how the restrictions

will eliminate the site's risks to human health and the environment;

(h) procedures to be followed when an emergency requires immediate excavation of contaminated soil to repair utility lines or other infrastructure on the site, or to respond to other types of emergencies (*e.g.*, fire or floods) that may result in a significant risk of harm from exposure to contaminants at the site, including:

1. notifying NHDES of such emergency condition;
2. limiting disturbance of contaminated media to the minimum reasonably necessary to adequately respond to the emergency; and
3. undertaking specified precautions to reduce exposure of workers and neighbors of the site, to contaminated media (*e.g.*, the need for specific types of protective clothing for workers conducting the excavation, and procedures for minimizing the liberation of contaminated dust); and
4. engaging the services of an environmental consulting firm to prepare or supervise preparation and implementation of a written plan for restoring the site to a condition consistent with the Activity and Use Restrictions, and to review and evaluate response actions to ensure minimal disturbance of contaminated media;

(i) an acknowledgment that the Activity and Use Restrictions shall run with the land, in accordance with RSA 147-E:16(II) and an analysis of the long-term feasibility of maintaining such use restrictions;

(j) an agreement to incorporate either in full or by reference the Activity and Use Restrictions into all deeds, easements, mortgages, leases, licenses, occupancy agreements, or any other instruments conveying an interest in and/or a right to use the property. The proposed deed language should be submitted to NHDES with the Activity and Use Restriction proposal;

(k) the procedures for amending and releasing the Activity and Use Restrictions;

(l) title reference by which the property owner(s) acquired title to the property; and

(m) the notarized signature(s) of the property owner(s).

(2) Recording/Registering Activity and Use Restrictions

(a) The Activity and Use Restrictions shall be recorded in a format approved by NHDES at the appropriate Registry of Deeds and/or Land Registration Office within 30 days of the applicant's receipt of approval of the Activity and Use Restriction proposal from NHDES. A certified Registry copy of the Activity and Use Restrictions bearing the book and page/instrument number and/or document number shall be submitted to NHDES within 30 days of its date of recordation and/or registration.

(3) Approvals of Requests for Activity and Use Restrictions

(a) For each application for an Activity and Use Restrictions, NHDES must prepare a statement specifying that the request is approvable, or, as appropriate, a statement describing the basis for disapproving the request.

(b) Activity and Use Restrictions that are approved by NHDES become effective upon recordation.

11.3: Modifications of Activity and Use Restrictions

(1) Any modification of an Activity and Use Restriction must be approved by NHDES before the change in activity or use is implemented.

(2) Additional remedial actions required to maintain Soil and Groundwater Standards, or to eliminate a substantial hazard, for the contemplated changes in Site Activities and/or Uses must

be completed before the new or altered activities commence.

(3) An Activity and Use Restriction must be modified when necessary to meet the objectives of the Activity and Use Restriction (e.g., either to maintain Soil and Groundwater Standards, or to eliminate a substantial hazard for the new or altered Site Activities and Uses). NHDES must approve any modification to an Activity and Use Restriction.

(4) An Activity and Use Restriction may also be modified to expand or reduce the list(s) of prohibited and/or permitted Site Activities and Uses, and obligations and/or conditions listed therein based on changed circumstances or other grounds.

(5) Activity and Use Restrictions must be amended in accordance with the following:

(a) the proposed modification must be submitted to NHDES in the form required by Section 11.2 (1);

(b) the modification shall be recorded at the appropriate Registry(ies) of Deeds and/or Land Registration Office(s) within 30 days of owner's receipt of NHDES approval; and

(c) a certified Registry copy of the modified Activity and Use Restrictions bearing the book and page/instrument numbers and/or document number must be submitted to NHDES within 30 days of its date of recordation and/or registration.

11.4: Release of Activity and Use Restrictions

(1) In cases where, as a result of additional response actions conducted at a site or a portion of a site, an Activity and Use Restriction is no longer necessary to maintain the protection of human health and the environment, or to eliminate a substantial hazard, such Activity and Use Restriction must be released or terminated pursuant to the procedures described below.

(2) A Notice of Activity and Use Restriction may be terminated in accordance with the following procedures:

(a) a request must be submitted to NHDES to terminate the Activity and Use Restriction the request which includes an explanation as to why the Activity and Use Restriction is no longer necessary to maintain the protection of human health and the environment;

(b) upon approval of the request by NHDES, the termination must be prepared, recorded and/or registered by the property owner at the appropriate Registry of Deeds and/or Land Registration Office. Such amendment must also be marginally referenced on the deed for the subject property;

(c) a certified Registry copy of the termination bearing the book and page/instrument numbers and/or document number must be submitted to NHDES within 30 days of its date of recordation and/or registration; and

(d) supporting documentation reflecting any changes to the site’s Risk Characterization as the result of additional remedial actions and the termination of the Notice of Activity and Use Restriction must be submitted to NHDES.

11.5: Checklist for AUR

(1) Figure 3 contains a checklist for the completion of an AUR.

APPENDICES

APPENDIX A: **Methodologies for Calculating Direct Contact Risk-based Soil Standards**

APPENDIX B: **Methodologies for Calculating Leaching-based Soil Standards**

APPENDIX C: **Selection of Practical Quantitation Limits For Method 1 Chemicals**

APPENDIX D: **Methodology for the Determination of Ceiling Concentrations**

APPENDIX E: **Soil Standard Selection Methodology Summary Table**

APPENDIX A

METHODOLOGY USED TO DEVELOP SOIL STANDARDS BASED ON DIRECT CONTACT RISK TO HUMAN HEALTH

Appendix A

Methodologies for Calculating Direct Contact Risk-Based Soil Concentrations

A.1.1 Purpose: This appendix provides the rationale for the methodology used to derive direct contact risk-based soil concentrations (or DCRB concentrations) that are considered protective of certain land uses which correspond to different levels of human exposure potential described in Chapter 3 of this policy. The objective is to determine allowable concentrations of chemicals in soil that are not anticipated to pose an unacceptable risk to people who are exposed to such chemicals by coming in contact with the soils. These levels are derived taking into account exposures that may result from combined incidental ingestion and dermal exposure.

These DCRB concentrations do not take into account potential exposure via inhalation. These values also do not take into account potential indirect-exposure route pathways, such as modeling the migration of persistent pollutants via runoff to nearby surface water bodies and possible bioaccumulation up the food chain. This latter pathway may be particularly important for contaminants that are known to persist in the environment and have properties favorable for bioaccumulation (e.g., hydrophobic chemicals such as dioxin, PCBs, DDT, and other select pesticides).

A.1.2 General Approach: Section 8.4 of this policy provides equations, in their most simplified form, that can be used to derive additional Method 1 soil standards for use in Method 2. Each soil category is associated with a range of potential exposure conditions which are determined taking into account varying degrees of frequency and intensity of usage, as well as accessibility. These three different human exposure soil categories (S-1, S-2, and S-3) are intended to describe a range of potential exposure situations that are commonly found at different sites. Derivation of each DCRB concentration shares a common methodology which is provided in this appendix. Each DCRB concentration is derived by incorporating standard toxicity information and basic risk assessment principles.

Regarding non-carcinogenic effects, a DCRB is calculated as a dose that is equal to 20% (or other appropriately derived chemical-specific relative source contribution factor) of an allowable daily intake derived based on a non-carcinogenic toxic endpoint. For chemicals classified by EPA as group C, or possible human carcinogens, the NH DHHS used an additional uncertainty factor of 10 to allow for protection against possible carcinogenic effects.

For carcinogenic chemicals that have an available EPA-derived cancer potency factor (CPF), the DCRB is set at a risk level protective of an excess lifetime cancer risk of one-in-one million. For chemicals that have both an RfD and a CPF, it is recommended that a DCRB be calculated for both the carcinogenic and non-carcinogenic hazards and the lower of these two values be adopted as the DCRB concentration.

A.2.1 Risk Assessment Equations:

The equation used to calculate a DCRB concentration protective of non-carcinogenic risks associated with direct contact with contaminated surface soils is given as follows:

$$\text{Chemical Conc.}_{soil}\ (\text{mg/kg}) = \frac{RSCF_i * RfD * CF}{[(IR_i * RAF_o) + (SA_i * AF * RAF_d)] * [(EF * ED)/(AT * Bw_i)] \times UF_{grp_c}}$$

The equation used to calculate a DCRB concentration protective against a predetermined *de minimus* carcinogenic risk posed by direct contact with contaminated surface soils is given as follows:

$$Conc._{soil} = \frac{ELCR * CF}{CPF * [\{3\ (IR_i * EF * ED_i * RAF_{o,i} / AT * BW_i)\} + \{3\ (SA_i * EF * ED * AF * RAF_d / AT * BW_i)\}]}$$

Where:

$Conc_{soil}$ = Risk-based (non-cancer or cancer risk) concentration in soil for the chemical, in units: mg/kg.

$RSCF_i$ = Relative Source Contribution Factor, used to take into account possible exposures from other sources besides soil. In the absence of any relevant chemical-specific RSCF values provided in U.S. EPA reports or guidance documents, DHHS-BHRA recommends using a value of 0.2. When age-specific RSCFs are available DHHS-BHRA recommends using a value that pertains to age category that most closely represents the ith age category.

RfD = Oral Reference Dose or substitute toxicity value identified for the chemical, in units: mg/kg/day.

CF = Units Conversion Factor: 10^6 mg/kg.

IR_i = Daily soil ingestion rate that applies to the ith age category and to the specific intensity of land use, in units: mg of soil/day.

RAF = Relative Absorption Factors for soil ingestion or dermal contact. Dimensionless.

SA_i = Skin surface area available for soil contact for the ith age category and exposure category of concern , in units: cm^2.

AF = Soil-to-Skin Adherence Factor, in units: mg/cm^2

EF = Exposure Frequency applicable to exposure category of concern, in units: days/year.

ED_i = Exposure Duration for the ith age group and exposure category of concern, in units: years.

AT = Pathway-specific period of exposure for non-carcinogenic effects (i.e., ED * 365 days), and 70-year lifetime for carcinogenic effects (i.e., 70 years * 365 days/year). Expressed in units: days.

BW_i = Body Weight that applies to the ith age category, in units: kg.

ELCR = Target Excess Lifetime Cancer Risk: 1×10^{-6} (dimensionless).

CPF	=	Oral Cancer Potency Factor for the chemical being evaluated. In units of: $(mg/kg/day)^{-1}$
UF_{grp_c}	=	For Group C chemicals, only, a UF of 10 to account for possible carcinogenicity.

Definition of subscript "i". Some of the assumed exposure assumptions are age-specific, including body weights, incidental soil ingestion rates, skin surface areas available for soil contact, and exposure durations. When i = 1, each of these values are set equal to those representative of a young child ages 2 - 6 years. When i = 2, each of these values are set equal to those representative of an older aged child, 7 - 16 years of age. When i = 3, each of these values is set equal to those representative of an adult.

Representative Age-Specific Body Weights (BW_i)

BW_1 = body weight representative of a young child (ages 2 - 6 years) = 17 kg
BW_2 = body weight representative of an older child (ages 7 - 16 years) = 40 kg
BW_3 = body weight representative of an adult (17 and older) = 70 kg

Representative Total Body Surface Areas ($TBSA_i$)*

$TBSA_1$ = 7,310 cm^2
$TBSA_2$ = 10,320 cm^2
$TBSA_3$ = 19,400 cm^2

* All values were derived using data presented in U.S. EPA's Exposure Factors Handbook, 1989 (4). Values for age groups i =1 or 2 were derived by computing the average of the various TBSA's reported for male children (in table 4B-3). For adults the TBSA was simply taken as the 50th percentile value for adult males from table 4B-1. Since males generally have larger TBSAs than females, these values were used to be more conservative.

Estimated Age-Specific Exposed Body Surface Areas (SA_i)

The age specific value for skin surface area exposed (SA_i) is calculated as follows.

SA_i = $TBSA_i$ x Percent of skin surface area exposed (specific to each exposure category, see below).

(a) S-1 Exposure Scenario

SA_1 = SA representative of a young child (ages 2 - 6 years) = 7,310 cm^2 x 36% = 2,632 cm^2
SA_2 = SA representative of an older child (ages 7 - 16 years) = 10,320 cm^2 x 26% = 3,432 cm^2
SA_3 = SA representative of an adult (17 and older) = 19,400 cm^2 x 26% = 5,044 cm^2

(b) S-2 and S-3 Exposure Scenarios

SA = TBSA for an adult worker (17 and older) = 19,400 cm^2x 16% = 3,104 cm^2

Age-specific Exposure Duration (EDi)

ED_1 = exposure duration for a young child = (6 yrs old - 2 yrs old + 1 yr) = 5 years
ED_2 = exposure duration for an older child = (16 yrs old - 7 yrs old + 1 yr) = 10 years
ED_3 = exposure duration for an adult = (31 yrs old - 17 yrs old + 1) = 15 years

Note that for purposes of these age notations the duration of one year for a 2 year old actually refers to time-span ranging from greater than one year of life up to two years (i.e., > 12 months up to 24 months).

A.2.2 Soil Category S-1

Soil Category S-1 standards are derived based on assuming a residential exposure scenario whereby potential receptors of all ages including children and adults may be exposed as the result of normal everyday activities such as playing in their yard. A high end estimate of 30 years was used to represent the duration for this residential exposure scenario.

For non-cancer effects, the most sensitive receptor of concern for which these DCRB concentrations were derived is a young child (age 2 to 6 years) who comes into contact with outdoor soils. Indoor dust was not included in this evaluation since this is estimated to be a fairly minor component relative to outdoor soil exposures.

For carcinogenic effects, the receptor of concern is the resident (age 2 to 31 years) who comes into contact with the soil as described above for the younger child and while working/gardening in the yard as an adult.

Frequency of Exposure

- The young child (2 to 6 years) is assumed to be in contact with the outdoor soil for a total of 160 days per year, based on NH-specific climatological data (5).

- The older child (7 to 16 years) and adult (17 to 31 years) is assumed to be in contact with the outdoor soil for a total of 160 days per year.

Intensity of Exposure

- Outdoors the young child (2 to 6 years) is assumed to ingest 200 mg of soil per day of exposure (3).

- Older children (7 to 16 years) and adults (17 to 31 years) are assumed to ingest 100 mg of soil per day of exposure (3).

- A soil adherence factor equal to 1 mg/cm^2 is assumed based on a high-end estimate reported in an appropriate EPA Guidance document (2).

Body Surface Areas and Body Weights

- It is assumed that the surface area of skin exposed includes the hands, arms, one third of the legs (due to shorts and socks), plus the face and neck. This represents approximately 36% of the TBSA for young children and 26% of the TBSA for older children and adults. The total body surface area representative of a male is used so as to provide a conservative estimate (4, 5).

- Typical body weights considered as representative of each age range were employed (4).

Appropriately derived S-1 DCRB concentrations for each of the various chemicals are listed in column 6 of the Appendix E summary table.

A.2.3 Soil Category S-2

Soil Category S-2 DCRB concentrations are derived assuming exposure may occur to a receptor who comes in contact with the contaminated soils in a work environment or in a passive recreational setting.

For both cancer and non-cancer effects, the receptor of concern is a maintenance worker (age 18 to 42 years of age) who comes into contact with the soil as part of their employment which is assumed to span a duration of 25 years. This evaluation considered passive recreational (i.e., low frequency/low intensity) exposures to children and found that, based on the exposure assumptions used, the adult maintenance worker scenario described here is protective of those exposures.

Frequency of Exposure

- The adult worker is assumed to be exposed to outdoor soils a total of 146 days per year. This figure was obtained assuming the maintenance worker is exposed to outdoor soils during the seven warmest months out of the year (April through October) and that a worker normally works 250 days over the course of the work year. The latter value is based on a five day work week and two weeks vacation per year (1).

  (7/12) * 250 days/year = 146 days per year.

Intensity of Exposure

- Adults are assumed to ingest 100 mg of soil per day exposure (3).

- A soil adherence factor equal to 1 mg/cm^2 is assumed based on a high-end estimate reported in an appropriate EPA Guidance document (2).

Body Surface Areas and Body Weights

- It is assumed that the surface area of skin exposed includes the hands, forearms, the face and neck. This scenario assumes a worker will wear pants (as opposed to shorts) and the legs will be covered. This equates to 16% of the total body surface area. The total body surface area representative of a male is used so as to provide a conservative estimate (4,5).

- Typical adult (average for adult males & females combined) body weights were used (4).

Appropriately derived S-2 DCRB concentrations for each of the various chemicals are listed in column 7 of the Appendix E summary table.

A.2.4 Soil Category S-3

Soil Category S-3 DCRB concentrations are derived assuming exposure may occur to an adult receptor who comes in contact with the contaminated soils during a short but intense exposure, such as during excavation work.

For both cancer and non-cancer effects, the receptor of concern is an adult excavation/construction worker (age 18 or older) who comes into contact with the soil during excavation work. This exposure scenario was modeled by assuming exposure spans a duration of four

months out of the year for one year. While it is acknowledged that it may not be entirely appropriate to estimate cancer risk-based concentrations for exposure durations less than chronic in duration, it was nevertheless decided not to change the high end exposure duration estimate to accommodate the evaluation of different toxic endpoints (i.e., either cancer or non-cancer effects).

Frequency of Exposure

- The adult worker is assumed to be exposed to outdoor soils a total of 83 days out of the four warmest months of the year. This figure was derived assuming the excavation worker is exposed to outdoor soils during the four warmest months (or 122 days) out of the year (May through August). Assuming a person takes two weeks vacation per year and works five days per week, the estimated exposure frequency is equal to 83 days out of the four months total duration.

  (4 months/12 months) * (5 days/7 days) * (350 days/year) = 83 days per year.

Intensity of Exposure

- Adult excavation workers are assumed to ingest 480 mg of soil per day of intense excavation work (3).

- A soil adherence factor equal to 1 mg/cm^2 is assumed based on a high-end estimate reported in an appropriate EPA Guidance document (2).

Body Surface Areas and Body Weights

- It is assumed that the surface area of skin exposed includes the hands, forearms, the face and neck. This scenario assumes a worker will wear pants (as opposed to shorts) and the legs will be covered. This equates to 16% of the total body surface area. The total body surface area representative of a male is used so as to provide a conservative estimate.

- Typical adult (average for adult males & females combined) body weights were used (4).

Appropriately derived S-3 DCRB concentrations for each of the various chemicals are listed in column 8 of the Appendix E summary table.

A.3 Relative Absorption Factors

The Relative Absorption Factor (RAF) is intended to correct for the absorption of any given chemical for actual exposure conditions relative to the absorption efficiency in the experimental study which provides the basis for the applicable dose-response value (i.e., RfD or CPF). Since each DCRB concentration is derived by taking into account combined exposure from incidental ingestion and dermal exposure, it is necessary to derive RAFs for each route of exposure under consideration. Greater RAF values will result in a lower estimated DCRB concentrations. Estimating the dermal RAF (RAF_d) is particularly important since most dose response values are derived based on laboratory studies whereby animals are exposed via the oral route. In other words, because the absorption of most chemicals via dermal route will often be substantially different (i.e., less) than absorption via the oral route, it is important to correct for this route-to-route discrepancy in absorption efficiency.

The RAF is calculated as follows:

$$RAF = \frac{\text{Absorption Efficiency}_{\textbf{site}\ \text{route/medium of exposure}}}{\text{Absorption Efficiency}_{\textbf{study}\ \text{route/medium of exposure}}}$$

A.3.1 Oral RAF

The process of evaluating individual RAFs for each specific chemical can be resource intensive. Regarding oral RAFs (RAF_o) other states (e.g., Massachusetts) have already devoted substantial resources to estimate values for a large number of chemicals (10, 11). Results of their research indicate that, except for a small number of chemicals, nearly all organic and inorganic chemicals evaluated (under the MCP) for similarly derived method 1 DCRBs have estimated RAF_o's either equal to or slightly less than one. For example, when an estimated RAF_o differed from one, rarely was the value *less* than 0.9. Therefore, when evaluating both organic and inorganic chemicals, for simplification, the DHHS recommends employing an RAF_o equal to one. However, when calculating DCRBs for new chemicals under Method 2, if upon researching the scientific literature appropriate studies are found that justify computing an RAF_o different than one this is acceptable so long as: 1) all studies used to derive the RAF_o be well referenced and, 2) findings of such studies are clearly and accurately summarized. Chemical specific RAF_o values used to calculate DCRB concentrations under this policy are listed in column AR of Table 3.

A.3.2 Dermal RAF

Dose-repsonse values (DRV's) for most of the chemicals evaluated in this policy are based on the dosing of laboratory animals via the oral route. Therefore, the equation used to estimate the RAF_D will most often be the ratio of a chemical's estimated human dermal absorption (ABS) efficiency from soils at a site to the estimated oral ABS efficiency in the animal test species.

$$RAF_D = \frac{\text{Absorption Efficiency}_{\text{site dermal route/soil medium}}}{\text{Absorption Efficiency}_{\text{study route/medium of exposure}}}$$

Unless if there is chemical-specific data to indicate otherwise, the oral ABS value for most organic contaminants (VOCs and SVOCs) is assumed to be equal to one. When there is sufficient information to indicate the Absorption Efficiency for the route (usually oral) and medium of exposure used to derive a DRV is different than one, and the DRV corresponds to an applied dose (typically the case), this value should be used in (the denominator of) the equation to estimate the dermal RAF. Since the oral ABS efficiency for many of the *inorganic* chemicals is often reported to be much less than one, the DHHS believes it is particularly critical to use chemical-specific oral ABS values in the denominator of the dermal RAF equation for this class of chemicals. All chemical-specific RAF_D values used to estimate DCRBs for this policy are provided in column AQ of Table 3.

A.3.3 Estimating Dermal Absorption

This section briefly describes the assumptions and methodologies that are used by NH DHHS to estimate dermal absorption efficiencies from exposure to chemicals in soils. It is not intended to provide a detailed review of the many complicated aspects involved with estimating dermal absorptions. The reader is referred to EPA's Dermal Exposure Assessment: Principles and Applications (herein referred to as EPA Dermal Guidance) for an in-depth review those concepts (2).

While this policy provides DCRBs for a large number of chemicals, only a very small subset of these have ever been studied in experimental animals *in vivo* to examine the amount that gets dermally absorbed from a soil vehicle. For most chemicals there is only a limited amount of information available to allow one to estimate the percent anticipated to be dermally absorbed by humans from a soil medium. In developing DCRB concentrations some agencies have left out evaluating the dermal absorption component of exposure altogether (25, 26). Others have estimated a chemical's dermal absorption (ABS) by employing a reference value that was assigned to represent the entire class of chemicals to which it belongs (i.e, VOCs, SVOCs, metals, etc.).

Because for certain chemicals the dermal ABS appears to contribute a significant component to overall exposure, it was decided to include this route of exposure into derivation of Method 1 DCRB concentrations. The EPA Dermal Guidance report provides a model which allows one to estimate an *organic* chemical's dermal ABS if one has all of the necessary chemical/physical parameters (2). A series of equations which may be used to estimate these dermal ABS values are provided in Chapters Four, Five and Six of EPA's Dermal Guidance (2). It is noted that because so few studies are available on the absorption of chemicals from soil, this model has not yet been validated. However, EPA reports that the model provides a promising approach to estimating compound-specific percutaneous absorption values for organic soil pollutants.

Researchers who have developed models to estimate dermal absorption report that certain chemical parameters are likely to influence this process. For example, research conducted by leaders in the field

indicate that dermal uptake is strongly influenced by certain factors such as a chemical's octanol/water partition coefficient ($K_{o/w}$), Henry's Law Constant, and molecular size (2).

A.3.3.a Estimating Dermal ABS for Inorganic Chemicals

The above-mentioned EPA model does not apply to estimating the dermal ABS for *inorganic* chemicals. Therefore, to estimate a dermal ABS for inorganic chemicals, it is recommended that in lieu of chemical-specific ABS data, the next preferred option is to use a reference ABS value that has already been derived from a well conducted study on an another inorganic chemical.

Wester et al. studied the absorption of cadmium chloride from soil using *in vitro* technique and human cadaver skin (14). After reviewing the results of this study, the EPA recommended that a range of 0.1 % to 1.0 % be used to evaluate dermal absorption of this inorganic chemical (2). Taking a midpoint absorption value from this study (0.55 %) and adjusting it to approximate an absorption for a 12 hour exposure period (as opposed to the 16 hour experimental exposure duration period), the DHHS derived a chemical-specific ABS for cadmium equal to 0.4%.

In the absence of ABS data for other inorganic chemicals, the DHHS recommends using results from this cadmium study as a reference dermal ABS value to represent other inorganic chemicals. However, a value at the high end of the recommended range by EPA (i.e., 1 %) is used as a reference so as to provide a conservative ABS estimate.

A.3.3.b Estimating Dermal ABS for Organic Chemicals

Chemicals with Empirically Derived Dermal Absorption Values

EPA's Dermal Guidance reports that dermal absorption from a soil matrix has been studied for only a limited number of organic chemicals. EPA has reviewed the experimental conditions and results from these various studies and has recommended a range of ABS values for those chemicals believed to have sufficient information available to make such an estimation (tetrachlorodibenzodioxin or TCDD, tetrachlorobiphenyl or TCB, and cadmium). The DHHS considers it first priority to adopt ABS values that are recommended by EPA. It is noted that additional dermal absorption information was reported in the scientific literature for the PCBs Aroclor 1242 and 1254 *after* the EPA Dermal Guidance was published (27). The DHHS used this more recent dermal absorption information reported for these Aroclors in place of the value reported by EPA for TCB since the former Aroclor mixtures will have a higher percentage of more chlorinated congeners and are anticipated to more closely represent the types of PCBs that would be encountered in soils at hazardous waste sites. When EPA recommends a range of ABS values for a given chemical the DHHS selected what it believes to be the appropriate ABS value within the specified range.

All ABS values are adjusted to approximate a 12 hour soil-to-skin contact period. Based on other studies conducted *in vivo*, DHHS has identified chemical-specific ABS values for six additional chemicals including benzene, chlordane, DDT, pentachlorophenol, 2,4-dichlorophenoxyacetic acid, and benzo(a)pyrene (12,13,15,17). ABS values selected for sufficiently studied organic chemicals are presented in table 1.

Table 1

Empirically Based 12-Hour Dermal ABS Estimates for N = 7 Organic Chemicals

Chemical	Class of Chemicals	Henry's Law Constant (atm*m³/mole)	Log K_{ow}	K_{oc}	Empiric-ally Based 12-hr ABS
Benzene	Volatile organic chemicals	5.5E-03	2.13	5.9E+01	4%
Benzo(a)pyrene	Semivolatile organic chemicals	1.1E-06	6.1	1.0E+06	7%
PCBs	Semivolatile organic chemicals	4.6E-03	6.8	5.3E+05	7%
Chlordane	Cyclodiene pesticides	4.9E-05	6.3	1.2E+05	2%
DDT	Other chlorinated pesticides	8.1E-06	6.5	2.6E+06	15%
Pentachlorophenol	Low volatility phenolic (& related) chemicals	2.4E-08	5.1	5.9E+02	12%
2,4-D	Low vol. / mod. water solubility chemical	1.0E-08	2.8	2.0E+01	3%

Estimating Dermal ABS Values for Chemicals Without Empirically Derived Values

As discussed previously, EPA has developed an equation to estimate dermal ABS values for organic chemicals. This equation is referred to as equation 6.11 presented on page 6-39 of EPA's Dermal Guidance report (2). Based on a personal communication with staff within EPA's Exposure Assessment Group, some minor corrections were recommended (and incorportated) for the equations used to calculate the term, Kvol (presented at the top of page 6-38 of EPA Dermal Guidance Report) and to equation 6.11. These equations, presented in their correct form, are provided in section A.2.7.a of this appendix. DHHS ran this equation to estimate ABS values for most of the organic chemicals evaluated in Method 1 of this policy, including those with empirically derived values. When the estimated ABS values were compared to empirically derived values (when available) it was observed that the calculated values tended to be consistently lower. Based on this finding the decision was made not to use the calculated ABS value, *as is*, to derive a chemical-specific ABS.

After calculating ABS values for all of the chemicals it was evident the equation predicted substantially higher values for some chemicals when compared to others, even when they were within the same class (e.g., VOCs). This led us to conclude that if one selects an empirically derived ABS for a single chemical to represent the majority of chemicals within a given class, this would likely lead to underestimating other chemical's ABS values if their chemical/physical properties indicate they will be more completely absorbed. Therefore, estimated ABS values are believed to have predictive value when trying to estimate one chemical's ABS relative to another chemical with a known (empirically derived) value.

Starting with a chemical that already has a known *empirically* derived ABS, and then comparing the *estimated* ABS values between it and another chemical, one can estimate what the second chemical's empirical ABS would be by adjusting it to the known chemical's empirical value. Take the following example: A VOC chemical, "A", has an empirically derived ABS value equal to 5%. Chemical A is referred to here as the reference chemical. One wants to obtain the best ABS estimate for another VOC chemical, "B", which does not have an empirically derived value. Using the equation 6.11 presented on page 6-39 of EPA's Dermal Guidance, one calculates ABS values for each chemical. A value of 0.1% is computed for chemical "A" and 0.5% for chemical "B". Making the assumption that the true ABS is directly proportional to the estimated ABS for any two chemicals (within a given class), one can now estimate an empirical ABS for chemical B, by setting up a simple proportional equation as follows:

$$\underline{\text{Est.}}\ \underline{ABS_a} \quad = \quad \underline{\text{Empirical}}\ \underline{ABS_a}$$

Est. ABS_b Empirical ABS_b

Rearranging, one can solve for the empirical ABS_b, as follows.

Empirical ABS_b = (5%) x (0.5%/0.1%) = 25%

Using this method of adjustment, which takes into account each chemical's unique properties, the equation predicts that chemical "B" is absorbed five times more than chemical "A".

Summary of Recommended Approach to Estimate Dermal ABS for Organic Chemicals

Figure 1 contains a flow chart to illustrate the process used in this policy to select the appropriate method to derive chemical-specific dermal absorption efficiencies. Under Method 1, the DHHS used the above-mentioned method to estimate ABS values for chemicals in cases where this resulted in an *upward* adjustment. In some cases a chemical's estimated ABS is lower than that of the applicable reference chemical representing its class, suggesting it may be absorbed *less*. In these situations, to be conservative (i.e., to err on the side of protecting public health) the DHHS chose not to adjust a reference chemical's ABS downward. Rather, in these cases, DHHS simply recommends adopting the appropriate reference chemical's empirically derived ABS *as is*.

Therefore, when estimating an ABS for a chemical (that does not yet already have one derived) under Method 2 of this policy, the adjustment procedure described above is only recommended when the chemical-under-consideration's estimated ABS is *greater* than that of the reference chemical's. Also, it is only recommended to estimate a chemical's ABS by adjusting a reference chemical that belongs to the same (or at least similar) class. To assist in determining which reference (organic) chemical most closely approaches the one under evaluation, a list of chemicals with empirically based ABS values is provided in Table 1 along with some of their associated chemical constants (H, log K_{ow}, K_{oc}).

A.3.4 Equations to Estimate an Organic Chemical's Dermal Absorption Efficiency

The EPA model used is based on Fick's first law, and incorporates a number of assumptions. For example, it assumes that partitioning between soil and interstitial water is the dominant process by which a chemical is made available for absorption through the skin. It is intended to take into account estimated loss of chemical over time due to 1) evaporation, and 2) removal due to absorption into the skin.

As described previously, Equation 6.11 in EPA's Dermal Guidance Report is the main equation used to estimate dermal absorption for this policy. The equation was amended per conversation with EPA officials (italicized variable represents correction) and reads as follows:

$$ABS = \frac{[SD * K_{p,s}\ soil * \mathit{1000\ mg/kg}]}{AF * (K_{soil} + K_{vol})} * [1 - e^{-(k_{soil} + K_{vol}) * t_{event}}]$$

Where:	SD	=	density of soil (g soil / cm^3 soil)
	$K_{p,s}$ soil	=	skin permeability coefficient for chemical in soil (cm/hr)
	AF	=	adherence factor (mg/cm^2*event)
	K_{soil}	=	loss constant due to ABS into skin ($hour^{-1}$)
	K_{vol}	=	loss constant due to volatilization ($hour^{-1}$)
	t_{event}	=	12 hours (central estimate)

Each calculated ABS value is provided in column AJ of Table 3. Default values for entry into the Dermal ABS equation (i.e., equation 6.11) are presented on page 6-39 of EPA's Dermal Guidance Report, and are provided in Table 2. Generic default values are assumed for soil density (SD), contact time (t_{event}), and soil-to-skin adherence factor (AF). Remaining input variables are chemical-specific and must be calculated. Equations used to estimate the loss of chemical from the soil as a result of volatilization (K_{vol}) and from dermal absorption into the skin (K_{soil}) are provided at the top of page 6-38 of EPA's Dermal Guidance Report, and are presented below. A number of input variables that enter into computation of K_{soil} and K_{vol} must also be calculated. This appendix is only intended to list some of the key equations. Each of the calculated variables are provided in their respective designated columns of Table 3. For those equations not included herein, the reader is referred to the appropriate location of the EPA Dermal Guidance report for more details.

The equation used to calculate K_{vol} also required some minor corrections (per personal communication with EPA) to allow for appropriate units conversion, and is presented in its correct form as follows:

$$K_{vol} = \frac{K_h * D_{air} * 3600 \text{ sec/hr} * 10^{-3} \text{ L/cm}^3 * 10^6 \text{ mg/kg}}{AF * K_D * L}$$

Where:	K_h	=	Dimensionless Henry's law constant
	D_{air}	=	Molecular diffusivity in air (cm^2/sec)
	AF	=	Soil-to-skin adherence factor
	K_D	=	Soil/water partition coefficient (L/kg)
	L	=	Boundary layer thickness at air-soil interface (cm)

Calculated values for K_{vol} are provided in column AG of Table 3. Both D_{air} and K_h must be calculated using equations presented on pages 6-39 and 6-40, respectively, of EPA's Dermal Guidance report.

The equation used to calculate K_D is as follows:

$$K_D = Koc * OC$$

Where:	Koc	=	Organic carbon partition coefficient (L/kg)
	OC	=	Organic carbon content of soil (unitless)

All K_D values are listed in column Z of Table 3.

The equation used to calculate K_{soil} is as follows:

$$Ksoil = \frac{K_{p,s} \text{ soil} * SD * 1000}{AF}$$

K_{soil} values calculated for each chemical are listed in column AF of Table 3.

The equation used to calculate $K_{p,s}$soil, the skin permeability coefficient for chemicals in soil, is presented on page 6-36 of EPA's Dermal Guidance report, as follows:

$$K_{p,s}soil = \frac{K_{p,s}water}{Ks/w}$$

Where: $K_{p,s}$water = Skin permeability coefficient for chemicals in water (cm/hr)
Ks/w = Soil/water partition coefficient (unitless)

All calculated $K_{p,s}$soil values are provided in column AE of Table 3.

The equation (eq. 5.8) used to generate the estimated $K_{p,s}$water is presented on page 5-38 of EPA's Dermal Guidance report, as follows:

$$\text{Log } K_{p,s}\text{water} = -2.72 + 0.71 * \log Ko/w - 0.0061 * MW$$

Where: Log Ko/w = Log of octanol/water partition coefficient (unitless)
MW = Molecular weight of chemical (grams/mole)

All calculated $K_{p,s}$water values are presented in column AD of Table 3.

The reader is referred to pages 5-36 to 5-38 of the Dermal Guidance report for details regarding the derivation of equation 5.8. The equation used to estimate a value for the term, Ks/w, is listed on page 6-36 of the Dermal Guidance report.

A.3.5 Chemical/Physical Properties

The types of chemical/physical parameters that were required to run the EPA Dermal Model and their associated units are provided in Table 2. Actual chemical-specific values for these parameters (along with the reference source they were derived from) that were used to estimate dermal ABS values under this policy are provided in Table 3. These values were primarily obtained from the following sources: EPA's Soil Screening Guidance: Technical Background Document (26), chemical-specific ATSDR Toxicological Profiles, National Library of Medicine's Hazardous Substance Data Bank (1996 Version), the three volume set of Handbooks of Environmental Fate and Exposure Data for Organic Chemicals, and the 2nd edition of the Handbook of Environmental Data on Organic Chemicals (19, 20, 21, 22). Efforts were made to use measured Koc values when these were available in the published literature. However, many Koc values were derived using regression equations provided on pages 74-75 of EPA's Superfund Exposure Assessment Manual (7). All Koc values are provided in column X of Table 3. All other values for chemical/physical properties are provided in columns D through L of Table 3, along with the references from which they were cited.

Table 2

Description of Parameters Used to Run the EPA Dermal Absorption Model Along with Default Values and Units

Parameter	Description	Units	Default value
MW	Molecular weight	grams/mole	chemical-specific
H	Henry's Law Constant	atm*m^3/moles	chemical-specific
R	Ideal Gas Constant	m^3*atm/mol*BK	8.205E-05
K_h	Dimensionless Henry's law constant	-	chemical-specific
K_{ow}	Octanol-water partition coefficient	-	chemical-specific
K_{oc}	Organic carbon partition coefficient	L/kg	chemical-specific
OC	Organic carbon content of soil	fraction	0.02

ρ_{soil}	Density of soil	grams soil/cm^3 soil	1.35
$K_{s/w}$	Soil/water partition coefficient	-	calculated
$K_{p,s}$ water	Skin permeability coefficient for chem. in water	cm/hr	calculated or measured
$K_{p,s}$ soil	Skin permeability coefficient for chem. in soil	cm/hr	calculated
AF	Soil-to-skin adherence factor	mg/cm^2	1
Dair	Molecular diffusivity in air	cm^2/sec	chemical-specific
L	Thickness of boundry layer at air-soil interface	cm	0.5
T	Ambient Temperature	BK	303
Ksoil	Soil-to-skin loss constant	$hour^{-1}$	chemical-specific
Kvol	Soil-to-air loss constant	$hour^{-1}$	chemical-specific
t_{event}	Duration of exposure event	hours	12

Figure 1

Flow Chart to Select Appropriate Method to Derive a Chemical-Specific Dermal ABS Efficiency

Is the chemical
inorganic (IOC) or organic (OC)?

Does IOC have
an empirically
derived ABS?

Does OC have
an empirically
derived ABS?

After adjusting
to approximate
a 12-hour ABS,
use empirical value

Use high-end
12-hour empirical
ABS of 1% for
approp. surrogate IOC
(cadmium)

After adjusting to
approximate 12-hr. ABS,
use empirical value (listed
in Table 1)

Using Table 1 to assist in
determining most approp.
chemical class. Apply EPA
model to est. ABS value
based on chem./phys.
properties.

Using EPA model is est.
ABS greater than the est.
ABS for the approp. reference
chemical (in its class)?

Use Reference chemical's
empirically derived ABS
adjusted to approximate
a 12-HR ABS as is.

Adjust the reference chem.
empirical ABS value upward
using methodology described
in section A.2.6.b and use the
adjusted dermal ABS
efficiency value.

Is chemical a VOC or SVOC?

Does adjusted ABS value
exceed 50%?

Does adjusted ABS value
exceed 100%?

Use ABS value as is.

Use a max ABS
value of 50%

Use ABS value as is

Use a maximum value
of 100%

A.4 Dose-Response Information

Dose-response information provides a quantitative evaluation of the toxicity information and allows for characterizing the relationship between the dose of a chemical administered and the incidence of adverse health effects in the exposed population. The U.S. EPA has performed toxicity assessments for numerous chemicals and has derived dose-response values (DRV's), such as reference doses (RfD's) and cancer potency factors (CPF's), for a range of contaminants that are commonly detected at hazardous waste sites. Toxicity assessments may be conducted for noncarcinogenic effects and/or carcinogenic effects for any given chemical. All DRV's used to derive a DCRB concentrations under this policy are provided in Table 4.

A.4.1 Threshold Effects

For many noncarcinogenic effects, a range of exposures from zero to some finite value, are believed to exist that can be tolerated with essentially no chance of expression of adverse effects. The toxicity DRV derived by the U.S. EPA to protect against noncarcinogenic threshold effects is referred to as the reference dose or RfD, and represents the human exposure dose at or below which deleterious noncarcinogenic effects are not anticipated to occur. The reader is referred to Part A of EPA's Risk Assessment Guidance for Superfund (Vol.1) Human Health Evaluation Manual (1) and EPA's Integrated Risk Information System (IRIS) (6) for a more detailed description of the RfD. When an RfD is derived by exposing the animals via the oral route of exposure this is referred to as an oral RfD. EPA has derived oral RfD's intended to be protective of chronic exposure durations and subchronic exposure durations, referred to as chronic and subchronic RfD's, respectively. DCRB's derived under this policy to protect against threshold effects were based on the use of oral RfD's when these were available for the chemical of concern. Both the chronic and subchronic RfD's used for development of DCRB concentrations are presented in Table 4. Chronic RfD's were primarily cited from EPA's IRIS2 Data Base (6). Subchronic RfDs were mainly cited from EPA's Health Effects Assessment Summary Tables (HEAST) (8). Some chronic RfD's were cited from either EPA HEAST tables or from risk assessment issue papers supplied by the U.S. EPA Technical Support Center.

A.4.2 Carcinogenic Effects

As opposed to non-carcinogenic effects, it is generally assumed that there is no threshold dose for carcinogenicity, and that there is no dose of a carcinogenic substance (other than zero exposure) that is zero risk. For a number of chemicals that are classified as either known or probable carcinogens, the EPA has calculated toxicity values, referred to as cancer potency factors or CPF's, that define quantitatively the relationship between the dose and response. Chemicals that are classified as possible human carcinogens may have EPA-generated CPF values. CPF values are typically derived from animal studies, however, for certain chemicals these were derived from human epidemiology studies. Using data derived from animal studies, the CPF is an estimate of the upper 95% Confidence Limit of the slope of the dose-response curve extrapolated to low doses. The CPF is expressed in units of $(mg/kg/day)^{-1}$.

Table 4

Human Health Dose Response Values used to
Develop Direct Contact Risk Based Concentrations

Chemical	CAS No.	EPA Cancer Classifica-tion (oral route)	Cancer Slope Factor $(mg/kg\text{-}d)^{-1}$	Ref.	Reference Dose (Chronic) mg/kg-d	Ref.	Reference Dose (Sub-chronic) mg/kg-d
Acetone	67-64-1				1.00E-01	6	1.00E+00
Acrylonitrile	107-13-1	B1	5.40E-01	6			
Alachlor	15972-60-8	B2					
Aldicarb	116-06-3				1.00E-03	6	1.00E-03
Aldicarb sulfoxide	1646-87-3						
Aldicarb sulfone	1646-88-4						
Aldrin	309-00-2	B2	1.70E+01	6	3.00E-05	6	3.00E-05
Allyl Chloride	107-05-1	C			2.90E-04	E	2.90E-03
Antimony	7440-36-0				4.00E-04	6	4.00E-04
Arsenic	7440-38-2	A	1.50E+00	6	3.00E-04	6	3.00E-04
Atrazine	1912-24-9	C			3.50E-02	6	3.50E-02
Barium	7440-39-3				7.00E-02	6	7.00E-02
Benzene	71-43-2	A	2.90E-02	6			
Benzidine	92-87-5	A	2.30E+02	6			
Benzoic acid	65-85-0				4.00E+00	6	4.00E+00
Beryllium	7440-41-7	B2	4.30E+00	6	5.00E-03	6	5.00E-03
Biphenyl, 1,1-	92-52-4				5.00E-02	6	5.00E-02
Bis(2-choroethyl)ether	111-44-4	B2	1.10E+00	6			
Bis (2-chloroisopropyl)ether	39638-32-9		7.00E-02	8	4.00E-02	6	4.00E-02
Bis (2-ethylhexyl)phthalate	117-81-7	B2	1.40E-02	6	2.00E-02	6	
Boron	7440-42-8				9.00E-02	6	9.00E-02
Bromodichloromethane	75-27-4	B2	6.20E-02	6	2.00E-02	6	2.00E-02
Bromoform	75-25-2	B2	7.90E-03	6	2.00E-02	6	2.00E-01
Bromomethane	74-83-9				1.40E-03	6	5.00E-03
Cadmium	7440-43-9	D*			1.00E-03	6	
Camphor	76-22-2				2.90E-02	N	2.90E-02
Carbofuran	1563-66-2	E			5.00E-03	6	5.00E-03
Carbon disulfide	75-15-0				1.00E-01	6	1.00E-01
Carbon Tetrachloride	56-23-5	B2	1.30E-01	6	7.00E-04	6	
Chlordane	57-74-9	B2	1.30E+00	6	6.00E-05	6	6.00E-05
Choroaniline, p-	106-47-8				4.00E-03	6	4.00E-03
Chorobenzene	108-90-7				2.00E-02	6	2.00E-02

Chloromethane	74-87-3	C	1.30E-02	8			
Chlorophenol, 2-	95-57-8				5.00E-03	6	5.00E-02
Chlorotoluene, 2-	95-49-8				2.00E-02	6	2.00E-01
Chlorotoluene, 4-	106-43-4				2.00E-02	6	2.00E-01
Chromium (III) (e.g., Cr2O3)	1308-38-9				1.00E+00	6	1.00E+00
Chromium (VI) (e.g., CrO3)	1333-82-0	D**			5.00E-03	6	2.00E-02
Copper	7440-50-8						
Cyanide	57-12-5				2.00E-02	6	2.00E-02
Dalapon	75-99-0				3.00E-02	6	3.00E-02
Dibromochloromethane	124-48-1	C	8.40E-02	6	2.00E-02	6	2.00E-01
Dibromo-3-chloropropane, 1,2-	96-12-8	B2	1.40E+00	8			

Table 4 *(Continued)*

Chemical	CAS No.	EPA Cancer Classifica-tion (oral route)	Cancer Slope Factor $(mg/kg\text{-}d)^{-1}$	Ref.	Reference Dose (Chronic) mg/kg-d	Ref.	Reference Dose (Sub-chronic) mg/kg-d
Dichlorobenzene, 1,2-	95-50-1				9.00E-02	6	9.00E-01
Dichlorobenzene, 1,3-	541-73-1				9.00E-02	I	9.00E-01
Dichlorobenzene, 1,4-	106-46-7	B2	2.40E-02	8			
Dichlorobenzidine, 3,3'	91-94-1	B2	4.50E-01	6			
Dichlorodifluoromethane	75-71-8				2.00E-01	6	9.00E-01
Dichorodiphenyl Dichloroethane, p,p' (DDD)	72-54-8	B2	2.40E-01	6			
Dichlorodiphenyldichloroethylene, p,p' (DDE)	72-55-9	B2	3.40E-01	6			
Dichlorodiphenyltrichloroethane, p,p' (DDT)	50-29-3	B2	3.40E-01	6	5.00E-04	6	5.00E-04
Dichloroethane, 1,1-	75-34-3	C			1.00E-01	Q	1.00E+00
Dichloroethane, 1,2-	107-06-2	B2	9.10E-02	6			
Dichloroethylene, 1,1-	75-35-4	C	6.00E-01	6	9.00E-03	6	9.00E-03
Dichloroethylene, Cis-1,2-	156-59-2				1.00E-02	8	1.00E-01
Dichloroethylene, Trans-1,2-	156-60-5				2.00E-02	6	2.00E-01
Dichlorophenol, 2,4-	120-83-2				3.00E-03	6	3.00E-03
Dichlorophenoxyacetic acid, 2,4-	94-75-7				1.00E-02	6	1.00E-02
Dichloropropane, 1,2-	78-87-5	B2	6.80E-02	8			
Dichloropropene, 1,3-	542-75-6	B2	1.80E-01	8	3.00E-04	6	
Dieldrin	60-57-1	B2	1.60E+01	6	5.00E-05	6	5.00E-05
Di(ethylhexyl)adipate	103-23-1	C					
Diethyl phthalate	84-66-2				8.00E-01	6	8.00E+00
Dimethyl phthalate	131-11-3				1.00E+01	8	1.00E+01
Dimethylphenol, 2,4-	105-67-9				2.00E-02	6	2.00E-01
Dinitrophenol, 2,4-	51-28-5				2.00E-03	6	2.00E-03
Dinitrotoluene, 2,4-	121-14-2	B2	6.80E-01	6	2.00E-03	6	2.00E-03
Dinoseb	88-85-7				1.00E-03	6	1.00E-03
Dioxin	1746-01-6	B2	1.50E+05	8			
Diphenylhydrazine, 1,2-	122-66-7	B2	8.00E-01	6			
Diquat dibromide	85-00-7				2.20E-03	6	2.20E-03
Endosulfan	115-29-7				6.00E-03	6	6.00E-03
Endothall	145-73-3				2.00E-02	6	2.00E-02
Endrin	72-20-8				3.00E-04	6	3.00E-04

Ethylene Dibromide	106-93-4	B2	8.50E+01	6				
Ethylene glycol	107-21-1				2.00E+00	6	2.00E+00	8
Fluoride	7782-41-4				6.00E-02	6	6.00E-02	8
Glyphosate	1071-83-6	E						
Heptachlor	76-44-8	B2	4.50E+00	6	5.00E-04	6	5.00E-04	8
Heptachlor epoxide	1024-57-3	B2	9.10E+00	6	1.30E-05	6	1.30E-05	8
Hexachlorobenzene	118-74-1	B2	1.60E+00	6	8.00E-04	6		
Hexachlorobutadiene	87-68-3	C	7.80E-02	6	2.00E-04	8	2.00E-03	J
Hexachlorocyclohexane, alpha	319-84-6	B2	6.30E+00	6				
Hexachlorocyclohexane, beta	319-85-7	C	1.80E+00	6				
Hexachlorocyclohexane, gamma	58-89-9	B2	1.30E+00	8	3.00E-04	6	3.00E-03	8

Table 4 *(Continued)*

Chemical	CAS No.	EPA Cancer Classifica-tion (oral route)	Cancer Slope Factor $(mg/kg\text{-}d)^{-1}$	Ref.	Reference Dose (Chronic) mg/kg-d	Ref.	Reference Dose (Sub-chronic) mg/kg-d	Ref.
Hexachlorodibenzodioxin	19408-74-3	B2	6.20E+03	6				
Hexachloroethane	67-72-1	C	1.40E-02	6	1.00E-03	6	1.00E-02	8
Isophorone	78-59-1	C	9.50E-04	6	2.00E-01	6	2.00E+00	8
Isopropyl benzene	98-82-8				4.00E-02	6	4.00E-01	8
Lead	7439-92-1	B2						
Mercury (inorganic)	7439-97-6				3.00E-04	8	3.00E-04	8
Methoxychlor	72-43-5				5.00E-03	6	5.00E-03	8
Methyl ethyl ketone	78-93-3				6.00E-01	6	2.00E+00	8
Methyl isobutyl ketone	108-10-1				5.00E-02	6	8.00E-01	8
Methyl mercury	22967-92-6	C			1.00E-04	6	1.00E-04	8
Methyl Phenol, 2-	95-48-7	C			5.00E-02	6	5.00E-03	K
Methyl Phenol, 4-	106-44-5	C			5.00E-03	K	5.00E-03	K
Methyl tert butyl ether	1634-04-4	C			1.00E-01	O	1.00E-01	P
Methylene Chloride	75-09-2	B2	7.50E-03	6	6.00E-02	6	6.00E-02	8
Nickel	7440-02-0	D**			2.00E-02	6	2.00E-02	8
Oxamyl	23135-22-0	E			2.50E-02	6	2.50E-02	G
Picloram	1918-02-1				7.00E-02	6	7.00E-02	G
Pentachlorophenol	87-86-5	B2	1.20E-01	6	3.00E-02	6	3.00E-02	8
Phenol	108-95-2				6.00E-01	6	6.00E-01	8
Polychorinated Biphenyls (PCBs)	1336-36-3	B2	2.00E+00	6	2.00E-5	6	5.00E-05	L
Selenium	7782-49-2				5.00E-03	6	5.00E-03	8
Silver	7440-22-4				5.00E-03	6	5.00E-03	8
Simazine	122-34-9	C			5.00E-03	6	5.00E-03	8
Styrene	100-42-5	C			2.00E-01	6	2.00E-01	8
Tetrachloroethane, 1,1,1,2-	630-20-6	C	2.60E-02	6	3.00E-02	6	3.00E-02	8
Tetrachloroethane, 1,1,2,2-	79-34-5	C	2.00E-01	6				
Tetrachloroethylene	127-18-4		5.20E-02	F	1.00E-02	6	1.00E-01	8
Tetrahydrofuran	109-99-9				2.20E-02	ADI	2.20E-02	ADI
Thallium (thallium chloride)	7440-28-0				8.00E-05	6	8.00E-04	8
Toluene	108-88-3				2.00E-01	6	2.00E+00	8
Total Petroleum Hydrocarbons	NA							
Toxaphene	8001-35-2	B2	1.10E+00	6				
Trichorobenzene, 1,2,4-	120-82-1				1.00E-02	6	1.00E-02	8
Trichlorobenzene, 1,3,5-	108-70-3				6.00E-03	M	6.00E-03	ADI/M

Trichloroethane, 1,1,1-	71-55-6				9.00E-2	8	9.00E-02
Trichloroethane, 1,1,2-	79-00-5	C	5.70E-02	6	4.00E-03	6	4.00E-02
Trichloroethylene	79-01-6		1.10E-02	F			
Trichlorofluoromethane	75-69-4				3.00E-01	6	7.00E-01
Trichlorophenol, 2,4,5-	95-95-4				1.00E-01	6	1.00E+00
Trichlorophenol, 2,4,6-	88-06-2	B2	1.10E-02	6			
2,4,5-Trichlorophenoxyacetic acid	93-76-5				1.00E-02	6	1.00E-01
Trichloropropane, 1,2,3-	96-18-4	B2			6.00E-03	6	6.00E-02
Vinyl chloride	75-01-4	A	1.90E+00	8			
Xylenes (mixed isomers)	1330-20-7				2.00E+00	6	4.00E-01

Table 4 *(Continued)*

Chemical	CAS No.	EPA Cancer Classifica-tion (oral route)	Cancer Slope Factor $(mg/kg\text{-}d)^{-1}$	Ref	Reference Dose (Chronic) mg/kg-d	Ref.	Reference Dose (Sub-chronic) mg/kg-d	Ref.
Polynuclear Aromatic Hydrocarbons - Carcinogenic								
Benzo(a)pyrene	50-32-8	B2	7.30E+00	6				
Benzo(a)anthracene	56-55-3	B2						
Benzo(b)fluoranthene	205-99-2	B2						
Benzo(k)fluoranthene	207-08-9	B2						
Chrysene	218-01-9	B2						
Dibenz(a,h)anthracene	53-70-3	B2						
Indeno(1,2,3-cd)pyrene	193-39-5	B2						
Polynuclear Aromatic Hydrocarbons - Noncarcinogenic								
*Acenaphthene	83-32-9				6.00E-02	6	6.00E-01	8
-Acenaphthylene	208-96-8							
*Anthracene	120-12-7				3.00E-01	6	3.00E+00	8
*Fluoranthene	206-44-0				4.00E-02	6	4.00E-01	8
*Fluorene	86-73-7				4.00E-02	6	4.00E-01	8
*Naphthalene	91-20-3				4.00E-02	Q	4.00E-02	8
-Methylnaphthalene, 2-	91-57-6							
*Pyrene	129-00-0				3.00E-02	6	3.00E-01	8
-Benzo(g,h,i)perylene	191-24-2							
-Phenanthrene	85-01-8							
Alkylbenzenes (class of chemicals)					1.00E-02	6	1.00E-02	C
-1,2,4-Trimethylbenzene	95-63-6							
-1,3,5-Trimethylbenzene	108-67-8							
-n-Propylbenzene	103-65-1							
-n-Butylbenzene	104-51-8							

-4-Isopropyl toluene	99-87-6							
-tert-Butylbenzene	98-06-6							
-sec-Butylbenzene	135-98-8							

6 = U.S. EPA, Integrated Risk Information System (IRIS).

8 = U.S. EPA. 1991-95. Health Effects Assessment Summary Tables (HEAST). Office of Research and Development. Published annually and updated periodically.

C = NH DPHS Derived Guideline, Chronic guideline as surrogate for subchronic.

D = Based on subchronic RfC reported on U.S. EPA HEAST.

E = Converted from RfC reported on U.S .EPA IRIS.

F = U.S. EPA Technical Support Ctr Risk Assessment Issue Paper 1996.

G = Subchronic RfD based on chronic RfD reported on IRIS.

H = o-chlorotoluene used as surrogate, from U.S. EPA HEAST 1995.

I = RfD for 12 DCB used as surrogate.

J = Subchronic RfD based on chronic RfD from HEAST.

K = U.S. EPA HEAST 1995, see cresol, p.

L = Subchronic RfD applies to Aroclor 1254.

ADI = Based on 1990 U.S. EPA provisional RfD.

M = U.S. EPA Table of Drinking Water Standards 1994.

N = U.S. EPA correspondence dated July 1987.

O = EPA draft LTHA RfD 1997.

P = Chronic LTHA RfD used to approximate subchronic RfD.

Q = ECAO, U.S. EPA (1994).

* = Cancer classification applies to oral route of exposure. By inhalation this chemical is classified by EPA as "B1" (probable human carcinogen).

** = Cancer classification applies to oral route of exposure. By inhalation this chemical is classified by EPA as "A" (known human carcinogen).

The U.S. EPA-derived oral CPF's were used to evaluate both oral and dermal exposures to carcinogens. The primary source for CPF's was U.S. EPA's IRIS2 database (6). Other CPF's were cited from U.S. EPA HEAST tables (8). All CPF's used under this policy to calculate DCRB concentrations are provided in Table 4.

As mentioned previously, for chemicals that have both a reported CPF value and a chronic RfD, separate DCRB concentrations were calculated based on protection against threshold non-cancer effects and carcinogenic effects. The lower (more protective) of these two values was then submitted as the DCRB concentration applicable to the specific soil use category.

A.5 Relative Source Contribution Factors

To determine the DCRB for non-carcinogens, the contribution from other potential sources of exposure, including drinking water, food and air must also be taken into account. When sufficient information was available to allow one to estimate the typical relative contribution from each source to total exposure, the DHHS used this information to calculate the DCRB. In the absence of data that allows one to estimate chemical-specific exposure intakes from these various media, the DPHS simply

uses a relative source contribution (RSC) factor of 20%, which is similar to the default RSC factor used by EPA to establish drinking water guidelines for non-carcinogenic contaminants.

In the process of deriving allowable limits for metals in sludge the U.S. EPA researched the total background intake for several different metals in both toddlers and adults (24). These representative total background intake values, expressed in units of mg/day, are central estimates and are presented on pages 5-29 (for adults) and 5-110 (for toddlers) of EPA's Technical Support Document for Land Application of Sewage Sludge (24). Using representative age range-specific body weights presented on page 3 of this policy, these background intakes were converted into background doses (expressed in units mg/kg/day). Once the typical background dose is estimated, a RSC factor can be derived by dividing the representative background dose by the oral reference dose and then subtracting this from one, as follows:

Estimated RSC Factor = 1 - (Representative Background Dose/Oral Reference Dose)

Using this approach, age range-specific RSC factors were calculated for five different inorganic chemicals, including cadmium, chromium, mercury, nickel, and selenium. When using this method to derive an RSC, if the estimated RSC exceeded 80%, the latter value was used as a maximum estimate. Background intake values were reported for zinc. However, since only the adult intake dose was less than the oral reference dose for zinc, an RSC factor was only derived for adults (with default RSC of 20% assumed for children). These age- and chemical-specific reported background intake values are presented in Tables 5 through 7, along with each chemical's oral reference dose and estimated RSC factor used in this policy. DCRBs were derived for all other chemicals under this policy assuming a RSC factor of 20%.

Table 5

Estimated Relative Source Contribution Factors
for a Young Child for Five Inorganic Chemicals

Chemical	Background Intake (mg/day)	Converted Background Dose[a] (mg/kg/day)	Reference Dose (mg/kg/day)	Estimated Relative Source Contribution Factor (unitless)
Cadmium	0.0082	4.8E-04	1E-03	0.52
Chromium	0.049	2.9E-03	1E+00	0.99 (0.8)
Mercury	0.0013	7.6E-05	3E-04	0.75
Nickel	0.155	9.1E-03	2E-02	0.54
Selenium	0.059	3.5E-03	5E-03	0.31

a. Background dose calculated by dividing background intake by 17 kg, body weight representative of young child.

Table 6

Estimated Relative Source Contribution Factors

for an Older Child for Five Inorganic Chemicals

Chemical	Background Intake[a] (mg/day)	Converted Background Dose[b] (mg/kg/day)	Reference Dose (mg/kg/day)	Estimated Relative Source Contribution Factor (unitless)
Cadmium	0.0161	4.03E-04	1E-03	0.60
Chromium	no value reported	NA	1E+00	NA
Mercury	0.0032	8.00E-05	3E-04	0.73
Nickel	0.173	4.33E-03	2E-02	0.78
Selenium	0.115	2.88E-03	5E-03	0.43

a. Since no background intake rate was reported for an older child, an intake rate corresponding to adults was used.

b. Background dose calculated by dividing background intake by 40 kg, body weight representative of older child.

Table 7

Estimated Relative Source Contribution Factors
for an Adult for Six Inorganic Chemicals

Chemical	Background Intake (mg/day)	Converted Background Dose[a] (mg/kg/day)	Reference Dose (mg/kg/day)	Estimated Relative Source Contribution Factor (unitless)
Cadmium	0.0161	2.3E-04	1E-03	0.77
Chromium	no value reported	NA	1E+00	NA
Mercury	0.0032	4.57E-05	3E-04	0.85 (0.8)
Nickel	0.173	2.47E-03	2E-02	0.88 (0.8)
Selenium	0.115	1.64E-03	5E-03	0.67
Zinc	13.42	1.92E-01	3E-01	0.36

a. Background dose calculated by dividing background intake by 70 kg, body weight representative of an adult.

References Cited for Appendix A

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APPENDIX B

METHODOLOGY USED TO DEVELOP SOIL STANDARDS BASED ON CONTAMINANTS LEACHING FROM SOIL TO GROUNDWATER

Purpose: This appendix describes the manner in which New Hampshire established leachability-based soil standards for contaminated soil that will be protective of groundwater quality. The goal is to determine the allowable concentration of contaminants in soil such that soil contaminated at, or remediated to, these concentrations could not leach a sufficient mass of contaminant to adversely affect groundwater quality.

General Approach: New Hampshire's soil standards for the Risk Characterization and Management Policy contaminated soil were developed, in part, by using a combination of two contaminant transport models. The Seasonal SOIL Compartment Model (SESOIL) was used to model contaminant transport in the vadose zone and the Analytical Model of Transient 1, 2, and 3-Dimensional Waste Transport in Aquifers (AT123D) was used to model fate and transport in the saturated zone. Arthur D. Little, Inc. of Cambridge, MA developed SESOIL for the USEPA Office of Toxic Substances in 1984. AT123D was developed by Oak Ridge National Laboratory in 1981.

Generic Site Conditions: The standard contaminated site used to develop leachability based standards is depicted in Figure B-1. (Note: This same standard site was used by New Hampshire to develop soil standards for the "Interim Policy for the Management of Soils Contaminated from Spills/Releases of Virgin Petroleum Products"). As shown, the water table is assumed to be static at 3 meters (approx. 10 ft.) below the ground surface. The soil study area is 10 meters square. The first meter below the ground surface is uncontaminated. The very top of second meter is contaminated at a concentration of 10 ppm. The remainder of the second layer and all of the third layer is uncontaminated. A drinking water well is located 10 meters from the downgradient edge of the contaminated area. SESOIL is used to determine the maximum concentration of contaminant at the water table interface and AT123D is used to determine the concentration of contaminant in the down gradient well.

The physical constants used for the development of the Method 1 tables are contained in Table B-1. Example SESOIL computer model input screens are also attached at the end of Appendix B to facilitate Method 2 site specific modeling efforts. Organic contaminants that have a published Henry's constant and an organic carbon partition coefficient, Koc, were individually modeled in the SESOIL and the AT123D models for the standard site described above using the following site characteristics as input parameters:

SESOIL MODEL

SESOIL Soil Parameters:

C	Intrinsic permeability	$1x10^{-8}$ cm^2
C	Source area	1,000,000 cm^2 (10m x 10m)
C	Porosity	0.3
C	Disconnectness index	3.7
C	Soil Bulk Density	1.3 gm/cm^3
C	Soil Organic Carbon	0.1%
C	Volatile Fraction	0.2
C	Clay Content	0%
C	Layer 1 Thickness	100 cm
C	Layer 2 Thickness	100 cm
C	Layer 3 Thickness (5 sub-layers)	100 cm

All Other Values Set to Zero.

SESOIL Climate Parameters:

The SESOIL model is preloaded with climate data from 23 weather stations in New Hampshire. Climate data used in this model include monthly air temperature, cloud cover fraction, relative humidity, short wave albedo, rainfall depth, mean storm duration, number of storms per month, and length of rainy season within month. To determine the "representative" climate in New Hampshire, an average total precipitation was calculated. Data from New Hampshire's high and low precipitation stations was not used. From this calculation, the state average yearly precipitation is 101.6 cm/yr (40.0 in/yr). The station which came the closest to this value was Winchester, NH at 102.35 cm/yr. Climate data from Winchester will therefore be used in the model.

SESOIL Chemical Data:

- C Molecular Weight - (g/mol)
- C Organic Carbon partition coefficient (K_{oc}) - (ml/g)
- C Solubility - (mg/L)
- C Henry's Law constant (H) - (atm-m^3/mol)
- C Diffusion coefficient in air - (cm^2/sec)

SESOIL Application Data:

C	Application Month	October only
C	Application Layer	Full depth of second layer is at 10 ppm
C	Application rate	1500 microgram/cm^2
C	Application year	1 (or time to reach max. concentration)

Based on area, thickness, and bulk density, this produces an initial concentration of 10 ppm.

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AT123D MODEL:

AT123D Soil Parameters:

C	Soil Bulk Density	1.3 gm/cc
C	Porosity (n)	0.3
C	Hydraulic Conductivity (K)	0.36 m/hr
C	Hydraulic Gradient (I)	0.005
C	Longitudinal Dispersivity	20.0 m
C	Transverse Dispersivity	2.0 m
C	Vertical Dispersivity	2.0 m
C	Degradation Rates	0.0

LEACHING-BASED SOIL STANDARD

Using the concentration of contaminant in groundwater predicted by the models to exist at the well, and the known concentration of contaminant in soil at the source area, a Dilution Attenuation Factor (DAF) can be determined. A DAF is simply the ratio of initial soil concentration to the groundwater concentration predicted to exist at the well.

DAF = Input Soil Concentration/Modeled Groundwater Concentration
DAF = 10 ppm/Concentration Modeled at Well (ppm)

A soil standard can then be determined by multiplying the DAF by a chemical's Ambient Groundwater Quality Standard (AGQS).

$$\text{Soil Standard}_{(\text{leachability})} = \text{DAF X AGQS}_{(\text{ppm})}$$

B-3

APPENDIX C

Selection of Estimated Quantitation Limits For Method 1 Chemicals

The majority of the Estimated Quantitation Limits (EQL) for the MCP Method 1 chemicals are taken from one of two references on USEPA-approved laboratory methods. The references are:

- USEPA Test Methods for Evaluating Solid Waste, SW-846, Third Edition Final Update III, December 1996 (Reference 1)

- USEPA Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88/039, December, 1988 (Revised July 1991) (Reference 2)

The references provide a method number. Below is a description of the various methods that appear in the references. From USEPA Test Methods for Evaluating Solid Waste (often referred to as SW-846), EQLs were excerpted from the following methods:

a) USEPA Method 8260B: Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS)

b) USEPA Method 8270C: Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

c) USEPA Method 8081A: Organochlorine Pesticides by Gas Chromatography

d) USEPA Method 8290: Polychlorinated Dibenzo-p-Dioxin (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)

e) USEPA Method 6010B: Inductively Coupled Plasma-Atomic Emission Spectroscopy

f) USEPA Method 9012A: Total and Amenable Cyanide (Automated Colorimetric with off-line distillation)

g) USEPA Method 7196A: Chromium, Hexavalent (Colorimetric)

h) USEPA Method 7060A: Arsenic (AA, Furnace Technique)

i) USEPA Method 7471A: Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique)

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j) USEPA Method 8141A: Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique

k) USEPA Method 8151A: Chlorinated Herbicides by GC Using Methylation or Pentafluorobenzylation Derivitization

l) USEPA Method 8321A: Solvent Extractable Non-Volatile Compounds by High Performance Liquid Chromatography/Thermospray/Mass Spectrometry (HPLC/TS/MS) or Ultraviolet (UV) Detection

m) USEPA Method 8082: Polychlorinated Biphenyls (PCBs) by Gas Chromatography

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Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Acetone	67-64-1	0.010	8260B
Acrylonitrile	107-13-1	0.005	8260B
Aldicarb	116-06-3	0.017	8321A
Aldicarb sulfone	1646-87-3	0.023	8321A
Aldicarb sulfoxide	1646-88-4	0.15	8321A
Aldrin	309-00-2	0.09	8081A
Alkylbenzenes		NA*	-
Allyl Chloride	107-05-1	0.005	8260A
Antimony	7440-36-0	8	6010B
Arsenic	7440-38-2	1.0	7060A
Atrazine	1912-24-9	NA*	8141A
Barium	7440-39-3	0.5	6010B
Benzene	71-43-2	0.005	8260B
Benzidine	92-87-5	NA*	8270C
Benzoic Acid	65-85-0	3.30	8270C
Beryllium	7440-41-7	0.08	6010B
Biphenyl, 1,1-	92-52-4	NA*	-
Boron	7440-42-8	1.5	6010B
Bromodichloromethane	75-27-4	0.005	8260B
Bromoform	75-25-2	0.005	8260B
Bromomethane	74-83-9	0.005	8260B
Cadmium	7440-43-9	1.0	6010B
Camphor	76-22-2	NA*	-
Carbofuran	1563-66-2	NA*	8270C
Carbon disulfide	75-15-0	0.005	8260B
Carbon tetrachloride	56-23-5	0.005	8260B
Chlordane	57-74-9	0.1	8081A
Chloroaniline, p-	106-47-8	1.3	8270C
bis-(2-chloroethyl)ether	111-44-4	0.66	8270C
bis-(2-chloroisopropyl)ether	39638-32-9	0.66	8270C
Chloromethane	74-87-3	0.005	8260B

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Chlorophenol, 2-	95-57-8	1.3	8270C
Chlorotoluene, 2 (o)	95-49-8	0.005	8260B
Chlorotoluene, 4 (p)	106-43-4	0.005	8260B
Chromium (III)	16065-83-1	2	6010B
Chromium (VI)	18540-29-9	130	7196A
Copper	7440-50-8	1.5	6010B
Cyanide	57-12-5	50	9012A
2,4-D (Dichlorophenooxyacetic acid, 2,4-)	94-75-7	0.13	8151B
Dalapon	75-99-0	0.87	8151B
DDD (Dichlorodiphenyl dichloroethane, p,p')	72-54-8	0.09	8081A
DDE (Dichlorodiphenyl dichloroethylene, p,p')	72-55-9	0.07	8081A
DDT (Dichlorodiphenyl trichloroethane, p,p')	50-29-3	0.04	8081A
Dibromochloromethane	124-48-1	0.005	8260B
Dibromochloropropane		0.005	8260A
Dibutylphthalate	84-74-2	0.66	8270C
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	0.005	8260B
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	0.005	8260B
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	0.005	8260B
Dichlorobenzidine, 3,3'-	91-94-1	1.3	8270C
Dichlorodifluoromethane	75-71-8	0.005	8260B
Dichloroethane, 1,1-	75-34-3	0.005	8260B
Dichloroethane, 1,2-	107-06-2	0.005	8260B
Dichloroethylene, 1,1-	75-35-4	0.005	8260B
Dichloroethylene, cis-1,2-	156-59-2	0.005	8260B
Dichloroethylene, trans-1,2-	156-60-5	0.005	8260B
Dichloromethane (Methylene chloride)	75-09-2	0.050	8260B
Dichlorophenol, 2,4-	120-83-2	0.66	8270C
Dichloropropane, 1,2-	78-87-5	0.005	8260B
Dichloropropene, 1,3-	542-75-6	0.005	8260B
Dieldrin	60-57-1	0.06	8081A
Diethyl phthalate	84-66-2	0.66	8270C

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Di(ethylhexyl)phthalate (bis-(2-ethylhexyl)phthalate)	117-81-7	0.66	8270C
Dimethyl phthalate	131-11-3	0.66	8270C
Dimethylphenol, 2,4-	105-67-9	0.66	8270C
Dinitrophenol, 2,4-	51-28-5	3.30	8270C
Dinitrotoluene, 2,4-	121-14-2	0.66	8270C
Dinoseb	88-85-7	0.13	8151B
1,2-Diphenylhydrazine	122-66-7	NA*	8270C
Diquat (dibromide)	85-00-7	NA	(H_2O only)
Endosulfan	115-29-7	0.09	8081A
Endothall	145-73-3	NA	-
Endrin	72-20-8	0.1	8081A
Ethylbenzene	100-41-4	0.005	8260B
Ethylene dibromide	106-93-4	0.005	8260B
Ethylene glycol	107-21-1	50	8260B
Fluoride	16984-48-8	NA*	-
Heptachlor	76-44-8	0.09	8081A
Heptachlor epoxide	1024-57-3	0.10	8081A
Hexachlorobenzene	118-74-1	0.66	8270C
Hexachlorobutadiene	87-68-3	0.005	8270C
Hexachlorocyclohexane, alpha	319-84-6	0.06	8081A
Hexachlorocyclohexane, beta	319-85-7	0.06	8081A
Hexachlorocyclohexane, gamma (Lindane)	58-89-9	0.09	8081A
Hexachlorocyclopentadiene	77-47-4	0.66	8270C
Hexachlorodibenzodioxin	34465-46-8	1.25×10^{-5}	8290
Hexachloroethane	67-72-1	0.66	8270C
Isophorone	78-59-1	0.66	8270C
Isopropyl benzene	98-82-8	0.005	8260A
Lead	7439-92-1	11	6010B
Mercury	7439-97-6	0.05	7471A
Methoxychlor	72-43-5	NA	8081A
Methyl ethyl ketone	78-93-3	0.005	8260A

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Methyl isobutyl ketone	108-10-1	0.005	8260A
Methyl mercury	22967-92-6	0.001	
Methyl phenol, 2-	95-48-7	0.66	8270C
Methyl phenol,4	106-44-5	0.66	8270C
Methyl tert butyl ether	1634-04-4	0.005	8260B
Monochlorobenzene (Chlorobenzene)	108-90-7	0.005	8260B
Nickel	7440-02-0	4	6010B
Oxamyl	23135-22-0	0.015	8321A
Pentachlorophenol	87-86-5	3.30	8270C
Phenol	108-95-2	0.66	8270C
Picloram	1918-02-1	0.09	8151A
Polychlorinated biphenyls (PCBs)	1336-36-3	0.30	8082
Selenium	7782-49-2	20	6010B
Silver	7440-22-4	2	6010B
Simazine	122-34-9	NA*	8141A
Styrene	100-42-5	0.005	8260B
Sulfate	14808-79-8	-	-
TCDD, 2,3,7,8- (Dioxin)	1746-01-6	5×10^{-6}	8290
Tetrachloroethane, 1,1,1,2-	630-20-6	0.005	8260B
Tetrachloroethane, 1,1,2,2,-	79-34-5	0.005	8260B
Tetrachloroethylene	127-18-4	0.005	8260B
Tetrahydrofuran	109-99-9	0.01	8260B
Thallium (thallium chloride)	7440-28-0	10	6010B
Toluene	108-88-3	0.005	8260B
Total Petroleum Hydrocarbons †		†	†
Toxaphene	8001-35-2	0.8	8080A
TP, 2,4,5- (Trichlorophenoxyacetic acid, 2,4,5-; or Silvex)	93-76-5	0.05	8151A
Trichlorobenzene, 1,3,5-	108-70-3	0.005	8260A
Trichlorobenzene, 1,2,4-	120-82-1	0.66	8270C
Trichloroethane, 1,1,1-	71-55-6	0.005	8260B
Trichloroethane, 1,1,2-	79-00-5	0.005	8260B

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Trichloroethylene	79-01-6	0.005	8260B
Trichlorofluoromethane	75-69-4	0.005	8260B
Trichloromethane (Chloroform)	67-66-3	0.005	8260B
Trichlorophenol, 2,4,5-	95-95-4	0.66	8270C
Trichlorophenol, 2,4,6-	88-06-2	0.66	8270C
Trichloropropane, 1,2,3-	96-18-4	0.005	8260B
Vinyl chloride	75-01-4	0.005	8260B
Xylenes (mixed isomers)	1330-20-7	0.005	8260B
Zinc	7440-66-6	0.50	6010A
Polynuclear Aromatic Hydrocarbons - Carcinogenic			
Benzo(a)anthracene	56-55-3	0.66	8270C
Benzo(a)pyrene	50-32-8	0.66	8270C
Benzo(b)fluoranthene	205-99-2	0.66	8270C
Benzo(k)fluoranthene	207-08-9	0.66	8270C
Chrysene	218-01-9	0.66	8270C
Dibenzo(a,h)anthracene	53-70-3	0.66	8270C
Indeno(1,2,3-cd)pyrene	193-39-5	0.66	8270C
Polynuclear Aromatic Hydrocarbons - Noncarcinogenic			
Acenaphthene	83-32-9	0.66	8270C
Acenaphthylene	208-96-8	0.66	8270C
Anthracene	120-12-7	0.66	8270C
Benzo(g,h,i)perylene	191-24-2	0.66	8270C
Fluoranthene	206-44-0	0.66	8270C
Fluorene	86-73-7	0.66	8270C
Methylnaphthalene, 2-	91-57-6	0.66	8270C
Naphthalene	91-20-3	0.66	8270C
Phenanthrene	85-01-8	0.66	8270C
Pyrene	129-00-0	0.66	8270C

NA* = Not Determined

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.

† = The "Interim Policy for the Management of Soils Contaminated from Spills/Releases of Virgin Petroleum Products" establishes the policy recommending GCFID analyses for Total Petroleum Hydrocarbons.

APPENDIX D

Methodology for the Determination of Ceiling Concentrations

Ceiling Concentrations in Groundwater:

Except when a MCL, SMCL or AGQS exists that is higher, the ceiling concentrations in groundwater noted in the general methodologies described in Section 4.0 are set at a concentration of 50,000 Fg/liter, or 0.005%. The ceiling concentration serves two main purposes. First, in areas of current or future drinking water sources, it serves to minimize potential organoleptic (taste, odor) effects. Second, the ceiling concentration provides an upper limit on allowable groundwater contamination which may pose a risk to public welfare and the environment. Such a ceiling will act to minimize continued degradation of the groundwater as a general resource and to minimize the incremental increases to anthropogenic background.

Ceiling Concentrations in Soil:

The ceiling concentrations in soil noted in the general methodology presented in Section 5.0 are set considering the odor index of the chemical, the volatility of the chemical and the soil category. The odor index developed for a chemical is the ratio of the vapor pressure (VP) for the chemical, measured at approximately 20° to 30° Celsius, and the 50th percentile odor recognition threshold ($ORT_{50\%}$). Chemicals with a relatively high odor index have correspondingly lower ceiling concentrations.

$$\textbf{Odor Index} = \frac{VP_{20^o - 30^o}}{ORT_{50\%}}$$

Volatile chemicals (i.e., those with vapor pressure greater than 1 Torr at approximately 20° to 30° Celsius) are also assigned relatively low ceiling concentrations.

The ceiling concentrations serve two main purposes. First, in high exposure potential areas (category S-1), the ceiling concentrations provide an upper limit for chemicals which may pose a risk to public health through an inhalation pathway. Second, the ceiling concentrations provide an upper limit on allowable soil contamination which may pose a risk to public welfare and the environment.

The following ceiling concentrations have been applied in the development of the Method 1 and Method 2 Soil Standards:

CEILING CONCENTRATIONS		
Soil Category	**Criteria**	**Ceiling Value Adopted**
Category S-1	Odor Index > 100, or Vapor Pressure > 1 Torr	100 ug/g
	1.0 < Odor Index < 100	500 ug/g
	Odor Index < 1	1,000 ug/g
Category S-2	Odor Index > 100, or Vapor Pressure > 1 Torr	500 ug/g
	1.0 < Odor Index < 100	1,000 ug/g
	Odor Index < 1	2,500 ug/g
Category S-3	Odor Index > 100, or	500 ug/g
	Vapor Pressure > 1 Torr	1,000 ug/g
	1.0 < Odor Index < 100	2,500 ug/g
	Odor Index < 1	5,000 ug/g

APPENDIX E

Soil Standard Selection Methodology Summary Table

Appendix E

METHOD 1 SOIL STANDARDS SELECTION

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Acetone	67-64-1	**9**	**9**	**9**	1,600	7,900	25,100	9		0.010	
Acrylonitrile	107-13-1	**0.06**	**0.06**	**0.06**	1	4	66	0.06		0.005	
Aldicarb	116-06-3	**0.04**	**0.04**	**0.04**	28	180	180	0.04		0.017	
Aldicarb sulfone	1646-87-3	**Î**	**Î**	**Î**	28	180	180	NM		0.023	
Aldicarb sulfoxide	1646-88-4	**Î**	**Î**	**Î**	28	180	180	NM		0.15	
Aldrin	309-00-2	**0.09**	**0.2**	**1**	0.06	0.2	1	NCM		0.09	
Alkylbenzenes Ï		**59**	**59**	**59**	59	250	250	Ï		NA	
Allyl chloride	107-05-1	**0.6**	**0.6**	**0.6**	0.7	5	10	0.6		0.005	
Antimony	7440-36-0	**8**	**26**	**26**	5	26	26	NM		8	
Arsenic	7440-38-2	**12**	**12**	**12**	0.8	3	12	NM	12	1	
Atrazine	1912-24-9	**0.08**	**0.08**	**0.08**	97	630	630	0.08		NA	
Barium	7440-39-3	**750**	**2,500**	**3,400**	750	3,400	3,400	NM		0.5	(3)
Benzene	71-43-2	**0.3**	**0.3**	**0.3**	26	75	1,200	0.3		0.005	
Benzidine	92-87-5	**0.002**	**0.007**	**0.01**	0.002	0.007	0.1	0.01		NA	
Benzoic acid	65-85-0	**350**	**350**	**350**	110,000	720,000	720,000	350		3.3	
Beryllium	7440-41-7	**0.1**	**0.1**	**1**	0.01	0.03	1	NM		0.08	
Biphenyl, 1,1-	92-52-4	**200**	**200**	**200**	1,000	5,500	5,500	200		NA	
Boron	7440-42-8	**1,000**	**2,500**	**5,000**	3,100	24,000	24,000	NM		1.5	(3)
Bromodichloromethane	75-27-4	**0.01**	**0.01**	**0.01**	6	17	410	0.01		0.005	
Bromoform	75-25-2	**0.1**	**0.1**	**0.1**	22	60	1,900	0.1		0.005	
Bromomethane	74-83-9	**0.3**	**0.3**	**0.3**	36	220	220	0.3		0.005	
Cadmium	7440-43-9	**32**	**230**	**230**	32	230	230	NM	1.9	1.0	
Camphor	76-22-2	**11**	**11**	**11**	890	6,300	6,300	11		NA	
Carbofuran	1563-66-2	**0.6**	**0.6**	**0.6**	140	910	910	0.6		NA	
Carbon disulfide	75-15-0	**0.4**	**0.4**	**0.4**	2,500	16,000	16,000	0.4		0.005	
Carbon tetrachloride	56-23-5	**6**	**12**	**12**	6	17	24	12		0.005	
Chlordane	57-74-9	**0.8**	**2**	**2**	0.8	2	2	NCM		0.1	
Chloroaniline, p-	106-47-8	**1.3**	**1.3**	**1.3**	76	400	400	0.5		1.3	
bis-(Chloroethyl)ether	111-44-4	**0.7**	**0.7**	**0.7**	0.1	0.3	10	0.1		0.66	
bis-(Chloroisopropyl)ether	39638-32-9	**2**	**4**	**9**	2	4	150	9		0.66	
Chloromethane	74-87-3	**0.2**	**0.2**	**0.2**	58	170	2,700	0.2		0.005	
Chlorophenol, 2-	95-57-8	**2**	**2**	**2**	75	370	1,200	2		1.3	
Chlorotoluene, 2 (o)	95-49-8	**30**	**30**	**30**	230	1,100	4,000	30		0.005	(2)

Appendix E

METHOD 1 SOIL STANDARDS SELECTION

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Chlorotoluene, 4 (p)	106-43-4	**21**	**21**	**21**	180	800	3,300	21		0.005	(2)
Chromium (III)	16065-83-1	**1,000**	**2,500**	**5,000**	44,300	91,600	91,600	NM	33*	2	(3)
Chromium (VI)	18540-29-9	**130**	**460**	**540**	88	458	540	NM	33*	130	
Cyanide	57-12-5	**100Ð**	**500Ð**	**500Ð**	510	3,100	3,100	NM		50	(1) &(2)
2,4-D (Dichlorophenooxyacetic acid, 2,4-)	94-75-7	**1**	**1**	**1**	280	1,800	1,800	1		0.13	
Dalapon	75-99-0	**3**	**3**	**3**	830	5,400	5,400	3		0.87	
DDD (Dichlorodiphenyl dichloroethane, p,p')	72-54-8	**0.7**	**2**	**64**	0.7	2	64	NCM		0.09	
DDE (Dichlorodiphenyl dichloroethylene, p,p')	72-55-9	**0.7**	**2**	**56**	0.7	2	56	NCM		0.07	
DDT (Dichlorodiphenyl trichloroethane, p,p')	50-29-3	**0.9**	**3**	**11**	0.9	3	11	NCM		0.04	
Dibromochloromethane	124-48-1	**0.01**	**0.01**	**0.01**	3	8	220	0.01		0.005	
Dibromochloropropane	96-12-8	**0.01**	**0.01**	**0.01**	0.4	1	22	0.01		0.005	
Dibutylphthalate	84-74-2	**1,000**	**2,500**	**5,000**	1,700	8,500	26,000	NCM		0.66	
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	**66**	**66**	**66**	490	2,000	9,600	66		0.005	
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	**45**	**45**	**45**	460	1,900	9,100	45		0.005	
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	**6**	**9**	**9**	6	17	560	9		0.005	
Dichlorobenzidine, 3,3'-	91-94-1	**1.3**	**1.3**	**1.3**	0.7	2	52	0.2		1.3	
Dichlorodifluoromethane	75-71-8	**1,000**	**2,500**	**5,000**	5,100	31,000	31,000	NCM		0.005	(3)
Dichloroethane, 1,1-	75-34-3	**3**	**3**	**3**	250	1,600	3,400	3		0.005	
Dichloroethane, 1,2-	107-06-2	**0.08**	**0.08**	**0.08**	7	21	370	0.08		0.005	
Dichloroethylene, 1,1-	75-35-4	**1**	**4**	**14**	1	4	59	14		0.005	
Dichloroethylene, cis-1,2-	156-59-2	**2**	**2**	**2**	250	1,600	3,400	2		0.005	
Dichloroethylene, trans-1,2-	156-60-5	**9**	**9**	**9**	510	3,100	6,800	9		0.005	
Dichloromethane (Methylene chloride)	75-09-2	**0.1**	**0.1**	**0.1**	100	290	2,000	0.1		0.050	
Dichlorophenol, 2,4-	120-83-2	**0.7**	**0.7**	**0.7**	45	220	220	0.7		0.66	
Dichloropropane, 1,2-	78-87-5	**0.1**	**0.1**	**0.1**	11	32	530	0.1		0.005	
Dichloropropene, 1,3-	542-75-6	**1**	**1**	**1**	4	12	12	1		0.005	
Dieldrin	60-57-1	**0.06**	**0.2**	**3**	0.06	0.2	3	NCM		0.06	
Diethyl phthalate	84-66-2	**1,000**	**2,500**	**5,000**	15,000	80,000	230,000	NM		0.66	(3)
Di(ethylhexyl)phthalate (bis(2-ethyl phthalate)	117-81-7	**39**	**110**	**2,200**	39	110	2,200	NCM		0.66	

Appendix E

METHOD 1 SOIL STANDARDS SELECTION

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Dimethyl phthalate	131-11-3	**1,000**	**1,500**	**1,500**	200,000	1E+06	1E+06	1,500		0.66	(3)
Dimethylphenol, 2,4-	105-67-9	**4**	**4**	**4**	300	1,500	4,800	4		0.66	
Dinitrophenol, 2,4-	51-28-5	**3.3**	**3.3**	**3.3**	30	150	150	1.5		3.30	
Dinitrotoluene, 2,4-	121-14-2	**0.7**	**0.7**	**0.7**	0.8	2	45	0.2		0.66	
Dinoseb	88-85-7	**0.3**	**0.3**	**0.3**	13	62	62	0.3		0.13	
Diphenylhydrazine, 1,2-	122-66-7	**0.8**	**0.8**	**0.8**	1	3	47	0.8		NA	
Diquat (dibromide)	85-00-7	**0.3**	**0.3**	**0.3**	61	400	400	0.3		NA	
Endosulfan	115-29-7	**45**	**45**	**45**	180	1,300	1,300	45		0.09	
Endothall	145-73-3	**2**	**2**	**2**	560	3,600	3,600	2		NA	
Endrin	72-20-8	**8**	**54**	**54**	8	54	54	NCM		0.1	
Ethylbenzene	100-41-4	**140**	**140**	**140**	1,500	7,400	24,000	140		0.005	
Ethylene dibromide	106-93-4	**0.005**	**0.005**	**0.005**	0.007	0.02	0.4	0.0009		0.005	
Ethylene glycol	107-21-1	**90**	**90**	**90**	56,000	360,000	360,000	90		50	
Fluoride	7782-41-4	**Î**	**Î**	**Î**	2,100	16,000	16,000	NM		NA	
Heptachlor	76-44-8	**0.2**	**0.7**	**9**	0.2	0.7	9	NCM		0.09	
Heptachlor epoxide	1024-57-3	**0.1**	**0.3**	**0.5**	0.1	0.3	0.5	NCM		0.1	
Hexachlorobenzene	118-74-1	**0.7**	**0.7**	**7**	0.07	0.2	7	NCM		0.66	
Hexachlorobutadiene	87-68-3	**0.2**	**0.8**	**3**	0.2	0.8	3	NCM		0.005	
Hexachlorocyclohexane, alpha	319-84-6	**0.06**	**0.06**	**0.06**	0.06	0.2	4	0.002		0.06	
Hexachlorocyclohexane, beta	319-85-7	**0.06**	**0.06**	**0.06**	0.2	0.6	14	0.04		0.06	
Hexachlorocyclohexane, gamma	58-89-9	**0.09**	**0.09**	**0.09**	0.3	0.8	7	0.002		0.09	
Hexachlorocyclopentadiene	77-47-4	**36**	**150**	**710**	36	150	710	NCM		0.66	
Hexachlorodibenzodioxin	19408-74-3	**Î**	**Î**	**Î**	6E-05	2E-04	4E-03	NM		1.2E-05	
Hexachloroethane	67-72-1	**0.7**	**0.7**	**0.7**	0.5	2	10	0.4		0.66	
Isophorone	78-59-1	**2**	**2**	**2**	300	1,100	4,800	2		0.66	
Isopropyl benzene	98-82-8	**123**	**123**	**123**	1,100	5,100	7,700	123		0.005	
Lead	7439-92-1	**400Ñ**	**400Ñ**	**400Ñ**	400Ñ	400Ñ	400Ñ	NM	54	11	
Mercury (inorganic)	7439-97-6	**1**	**7**	**7**	1	7	7	NM	0.33	0.05	
Methoxychlor	72-43-5	**38**	**170**	**170**	38	170	170	NCM		NA	
Methyl ethyl ketone	78-93-3	**2**	**2**	**2**	6,700	30,000	38,000	2		0.01	
Methyl isobutyl ketone	108-10-1	**10**	**10**	**10**	300	1,300	9,200	10		0.01	
Methyl mercury	22967-92-6	**0.3**	**3**	**3**	0.3	3	3	NM		0.001	
Methyl phenol, 2-	95-48-7	**18**	**18**	**18**	75	370	370	18		0.66	

Appendix E

METHOD 1 SOIL STANDARDS SELECTION

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Methyl phenol, 4-	106-44-5	**5**	**5**	**5**	8	37	37	5		0.66	
Methyl tert butyl ether	1634-04-4	**2**	**2**	**2**	220	1,200	1,200	2		0.005	
Monochlorobenzene (Chlorobenzene)	108-90-7	**6**	**6**	**6**	260	1,200	1,200	6		0.005	
Nickel	7440-02-0	**580**	**2,500**	**3,900**	580	3,900	3,900	NM	24	4	(3)
Oxamyl	23135-22-0	**0.4**	**0.4**	**0.4**	700	4,500	4,500	0.4		0.015	
Pentachlorophenol	87-86-5	**3.3**	**3.3**	**3.3**	3	9	210	0.1		3.30	
Phenol	108-95-2	**56**	**56**	**56**	9,000	44,000	44,000	56		0.66	
Picloram	1918-02-1	**11**	**11**	**11**	2,000	13,000	13,000	11		0.09	
Polychlorinated Biphenyls (PCBs)	1336-36-3	**1Ò**	**1Ò**	**2**	0.2	0.7	2	NM		0.3	
Selenium	7782-49-2	**260**	**2,500**	**4,200**	260	4,200	4,200	NM	2.2	20	(3)
Silver	7440-22-4	**45**	**200**	**200**	45	200	200	NM		2	
Simazine	122-34-9	**0.4**	**0.4**	**0.4**	14	91	91	0.4		NA	
Styrene	100-42-5	**14**	**14**	**14**	180	770	3200	14		0.005	
TCDD, 2,3,7,8- (Dioxin)	1746-01-6	**Î**	**Î**	**Î**	7E-06	2E-05	3E-04	NM		5 E-06	
Tetrachloroethane, 1,1,1,2-	630-20-6	**2**	**2**	**2**	11	30	61	2		0.005	
Tetrachloroethane, 1,1,2,2,-	79-34-5	**0.005**	**0.005**	**0.005**	0.8	2	69	0.004		0.005	
Tetrachloroethylene	127-18-4	**2**	**2**	**2**	14	42	690	2		0.005	
Tetrahydrofuran	109-99-9	**7**	**7**	**7**	560	3,400	3,400	7		0.010	
Thallium (thallium chloride)	7440-28-0	**10**	**21**	**32**	3	21	32	NM		10	
Toluene	108-88-3	**100**	**100**	**100**	3,800	20,000	57,000	100		0.005	
Total Petroleum Hydrocarbons		**10,000**	**10,000**	**10,000**	NA	NA	NA			NA	
Toxaphene	8001-35-2	**0.8**	**0.8**	**15**	0.2	0.5	15	NCM		0.8	
TP, 2,4,5- (Trichlorophenoxyacetic acid, 2,4,5-)	93-76-5	**6**	**6**	**6**	280	1,800	3,600	6		0.05	
Trichlorobenzene, 1,3,5-	108-70-3	**27**	**27**	**27**	31	130	130	27		0.005	
Trichlorobenzene, 1,2,4-	120-82-1	**15**	**15**	**15**	51	210	210	15		0.66	
Trichloroethane, 1,1,1-	71-55-6	**42**	**42**	**42**	2,300	14,000	14,000	42		0.005	
Trichloroethane, 1,1,2-	79-00-5	**0.1**	**0.1**	**0.1**	7	20	100	0.1		0.005	

Appendix E

METHOD 1 SOIL STANDARDS SELECTION

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Trichloroethylene	79-01-6	**0.8**	**0.8**	**0.8**	68	200	3,200	0.8		0.005	
Trichlorofluoromethane	75-69-4	**1,000**	**2,500**	**5,000**	7,600	47,000	47,000	NCM		0.005	(3)
Trichloromethane (Chloroform)	67-66-3	**0.1**	**0.1**	**0.1**	120	360	360	0.1		0.005	
Trichlorophenol, 2,4,5-	95-95-4	**120**	**120**	**120**	1,500	7,400	24,000	120		0.66	
Trichlorophenol, 2,4,6-	88-06-2	**0.7**	**0.7**	**0.7**	34	94	2,300	0.6		0.66	
Trichloropropane, 1,2,3-	96-18-4	**1.4**	**1.4**	**1.4**	50	220	920	1.4		0.005	
Vinyl chloride	75-01-4	**0.4**	**1**	**9**	0.4	1	19	9		0.005	
Xylenes (mixed isomers)Ó	1330-20-7	**500**	**1,000**	**1,100**	29,000	140,000	140,000	1100		0.005	(1)
Zinc	7440-66-6	**1,000**	**2,500**	**5,000**	9,200	65,000	65,000	NM	98	0.5	(3)
Polynuclear Aromatic Hydrocarbons - Carcinogenic Ô											
Benzo(a)anthracene	56-55-3	**0.7**	**2**	**40**	0.7	2	40	NCM		0.66	
Benzo(a)pyrene	50-32-8	**0.7**	**0.7**	**4**	0.07	0.2	4	NCM		0.66	
Benzo(b)fluoranthene	205-99-2	**7**	**20**	**400**	7	20	400	NCM		0.66	
Benzo(k)fluoranthene	207-08-9	**7**	**20**	**400**	7	20	400	NCM		0.66	
Chrysene	218-01-9	**70**	**200**	**4,000**	70	200	4,000	NCM		0.66	
Dibenzo(a,h)anthracene	53-70-3	**0.7**	**0.7**	**4**	0.07	0.2	4	NCM		0.66	
Indeno(1,2,3-cd)pyrene	193-39-5	**0.7**	**2**	**40**	0.7	2	40	NCM		0.66	
Polynuclear Aromatic Hydrocarbons - Noncarcinogenic Õ											
Acenaphthene	83-32-9	**270**	**270**	**270**	1,200	6,600	18,000	270		0.66	(3)
Acenaphthylene	208-96-8	**300**	**300**	**300**				300		0.66	(3)
Anthracene	120-12-7	**1,000**	**1,700**	**1,700**	6,100	33,000	89,000	1,700		0.66	(3)
Fluoranthene	206-44-0	**810**	**2,500**	**5,000**	Total less than 810	Total less than 4,410	Total less than 11,800	NCM		0.66	(3)
Fluorene	86-73-7	**510**	**510**	**510**				510		0.66	
Methylnaphthalene, 2-	91-57-6	**150**	**150**	**150**				150		0.66	
Naphthalene	91-20-3	**5**	**5**	**5**				5		0.66	
Benzo(g,h,i)perylene	191-24-2	**Total < 480**	**Total < 2,400**	**Total < 5,000**	Total < 480	Total < 2,400	Total < 7,500	NCM		0.66	(3)
Phenanthrene	85-01-8							NCM		0.66	(1)
Pyrene	129-00-0							NCM		0.66	(3)

*Endnotes:	
Column (1):	Chemical Name.
Column (2):	Chemical Abstract Service (CAS) Number.
Column (3):	Method 1 Category S-1 Soil Standard.
Column (4):	Method 1 Category S-2 Soil Standard.
Column (5):	Method 1 Category S-3 Soil Standard.
Column (6):	Soil Category S-1 Direct Contact Risk-based Standards are based upon sensitive uses of property and accessible soil, either currently or in the reasonably foreseeable future
Column (7):	Soil Category S-2 Direct Contact Risk-based Standards are based upon moderate exposure and accessible soil, either currently or in the reasonably foreseeable future.
Column (8):	Soil Category S-3 Direct Contact Risk-based Standards are based upon restricted access property with limited potential for exposure, either currently or in the reasonably foreseeable future. **ID**=Insufficient Data currently available. (NHDHHS Risk Assessment Protocols in Appendix A.)
Column (9):	Leaching-based Standards consider the potential of chemicals to leach from soil and contaminate the underlying groundwater. The SESOIL and AT123D models were combined to calculate the concentration of a chemical in soil that would not cause a violation of GW-1 Groundwater Standards in groundwater. **NCM**=Negligible Contaminant Migration; i.e., Leaching models indicate negligible contaminant migration over thirty years **NM**=Not Modeled. (1) Metals: Due to the difference in the chemical-specific properties of the various forms of naturally occurring metals in the environment, and site-specific conditions, predicting the leaching characteristics of metals is impractical. Whereas the Standards are based on other considerations, if metals exceed groundwater standards at a site, site-specific investigations may be required to evaluate the leaching potential of site metals. (2) Non-metals: The data necessary to run the models for non-metal chemicals was not readily available. Modeling input parameters are described in Appendix B.
Column (10):	Background concentrations of metals in soil are described in Section 1.6(4). (***** Total Chromium.)
Column (11):	Practical Quantitation Limits (PQLs) were provided by the NHDES Laboratory Services Unit. The associated analytical methods are provided in Appendix C. **NA**=Not Applicable or Not Available.
Column (12):	(1) - the soil standard ceiling concentration was identified due to the contaminant's Odor Index value. (2) - the soil standard ceiling concentration was identified due to the contaminant's Vapor Pressure value. (3) - the soil standard ceiling concentration was identified due to insufficient information to calculate an Odor Index.

NOTES:	Î	Standards were not developed for this contaminant because the necessary physical property information was not available to run the leaching model or because of questions related to PQLs.
	Ï	For the purposes of this policy, alkylbenzenes include 1,2,4 trimethyl benzene, 1,3,5 trimethyl benzene, n-propyl benzene, n-butyl benzene, 4-isopropyl toluene, tert-butyl benzene and sec-butyl benzene. NH DES evaluates the risk posed by alkylbenzenes as a group because of the similar structures of these compounds and the lack of toxicological data for all compounds in this class of chemicals. The sum of the total of these compounds is compared to the NH S-1, NH S-2 and NH S-3 standards. The leaching numbers for these compounds are as follows: 1,2,4 trimethy benzene = 69 ppm, 1,3,5 trimethyl benzene = 27 ppm, n-propyl benzene = 10 ppm, n-butyl benzene = 18 ppm, 4-isopropyl toluene (not available), tert-butyl benzene = 6 ppm and sec-butyl benzene = 7 ppm. DES decided to use the S-1 health standard as the leaching standard for this class of compounds because of the similarity of the S-1 number to the modeled leaching numbers and the additional conservativism added by using a cumulative approach to this class of compounds.
	Ð	Cyanide standards were developed using free cyanide toxicity and physical characteristics. Complexed cyanide or other cyanide species can be addressed via Method 2 or 3 Risk Characterization methodologies.
	Ñ	A screening level of 400 mg/kg has been set for lead based on EPA's "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities" (U.S. EPA, 1984).
	Ò	The S-1 PCB number is based on EPA's August 1990 "Guidance on Remedial Actions for Superfund Sites with PCB Contamination" for residential areas.
	Ó	Xylene standard based on modeling of leaching of xylene from soil to groundwater and the GW-2 standard.
	Ô	Standards for carcinogenic PAHs were calculated using the potency factors developed by EPA, based on equivalency to Benzo(a)pyrene.
	Õ	Method 1 soil standards for Benzo(g,h,i) perylene, Phenanthrene and Pyrene are derived by adding the concentrations of each of these three compounds and comparing the total value to the appropriate value in column 3, 4 or 5.

APPENDICES

APPENDIX A: Methodologies for Calculating Direct Contact Risk-based Soil Standards

APPENDIX B: Methodologies for Calculating Leaching-based Soil Standards

APPENDIX C: Selection of Practical Quantitation Limits For Method 1 Chemicals

APPENDIX D: Methodology for the Determination of Ceiling Concentrations

APPENDIX E: Soil Standard Selection Methodology Summary Table

APPENDIX A

METHODOLOGY USED TO DEVELOP SOIL STANDARDS BASED ON DIRECT CONTACT RISK TO HUMAN HEALTH

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APPENDIX B

METHODOLOGY USED TO DEVELOP SOIL STANDARDS BASED ON CONTAMINANTS LEACHING FROM SOIL TO GROUNDWATER

Purpose: This appendix describes the manner in which New Hampshire established leachability-based soil standards for contaminated soil that will be protective of groundwater quality. The goal is to determine the allowable concentration of contaminants in soil such that soil contaminated at, or remediated to, these concentrations could not leach a sufficient mass of contaminant to adversely affect groundwater quality.

General Approach: New Hampshire's soil standards for the Risk Characterization and Management Policy contaminated soil were developed, in part, by using a combination of two contaminant transport models. The Seasonal SOIL Compartment Model (SESOIL) was used to model contaminant transport in the vadose zone and the Analytical Model of Transient 1, 2, and 3-Dimensional Waste Transport in Aquifers (AT123D) was used to model fate and transport in the saturated zone. Arthur D. Little, Inc. of Cambridge, MA developed SESOIL for the USEPA Office of Toxic Substances in 1984. AT123D was developed by Oak Ridge National Laboratory in 1981.

Generic Site Conditions: The standard contaminated site used to develop leachability based standards is depicted in Figure B-1. (Note: This same standard site was used by New Hampshire to develop soil standards for the "Interim Policy for the Management of Soils Contaminated from Spills/Releases of Virgin Petroleum Products"). As shown, the water table is assumed to be static at 3 meters (approx. 10 ft.) below the ground surface. The soil study area is 10 meters square. The first meter below the ground surface is uncontaminated. The very top of second meter is contaminated at a concentration of 10 ppm. The remainder of the second layer and all of the third layer is uncontaminated. A drinking water well is located 10 meters from the downgradient edge of the contaminated area. SESOIL is used to determine the maximum concentration of contaminant at the water table interface and AT123D is used to determine the concentration of contaminant in the down gradient well.

The physical constants used for the development of the Method 1 tables are contained in Table B-1. Example SESOIL computer model input screens are also attached at the end of Appendix B to facilitate Method 2 site specific modeling efforts. Organic contaminants that have a published Henry's constant and an organic carbon partition coefficient, Koc, were individually modeled in the SESOIL and the AT123D models for the standard site described above using the following site characteristics as input parameters:

SESOIL MODEL

SESOIL Soil Parameters:

C	Intrinsic permeability	$1x10^{-8}$ cm^2
C	Source area	1,000,000 cm^2 (10m x 10m)
C	Porosity	0.3
C	Disconnectness index	3.7
C	Soil Bulk Density	1.3 gm/cm^3
C	Soil Organic Carbon	0.1%
C	Volatile Fraction	0.2
C	Clay Content	0%
C	Layer 1 Thickness	100 cm
C	Layer 2 Thickness	100 cm
C	Layer 3 Thickness (5 sub-layers)	100 cm

All Other Values Set to Zero.

SESOIL Climate Parameters:

The SESOIL model is preloaded with climate data from 23 weather stations in New Hampshire. Climate data used in this model include monthly air temperature, cloud cover fraction, relative humidity, short wave albedo, rainfall depth, mean storm duration, number of storms per month, and length of rainy season within month. To determine the "representative" climate in New Hampshire, an average total precipitation was calculated. Data from New Hampshire's high and low precipitation stations was not used. From this calculation, the state average yearly precipitation is 101.6 cm/yr (40.0 in/yr). The station which came the closest to this value was Winchester, NH at 102.35 cm/yr. Climate data from Winchester will therefore be used in the model.

SESOIL Chemical Data:

- C Molecular Weight - (g/mol)
- C Organic Carbon partition coefficient (K_{oc}) - (ml/g)
- C Solubility - (mg/L)
- C Henry's Law constant (H) - (atm-m^3/mol)
- C Diffusion coefficient in air - (cm^2/sec)

SESOIL Application Data:

C	Application Month	October only
C	Application Layer	Full depth of second layer is at 10 ppm
C	Application rate	1500 microgram/cm^2
C	Application year	1 (or time to reach max. concentration)

Based on area, thickness, and bulk density, this produces an initial concentration of 10 ppm.

AT123D MODEL:

AT123D Soil Parameters:

C	Soil Bulk Density	1.3 gm/cc
C	Porosity (n)	0.3
C	Hydraulic Conductivity (K)	0.36 m/hr
C	Hydraulic Gradient (I)	0.005
C	Longitudinal Dispersivity	20.0 m
C	Transverse Dispersivity	2.0 m
C	Vertical Dispersivity	2.0 m
C	Degradation Rates	0.0

LEACHING-BASED SOIL STANDARD

Using the concentration of contaminant in groundwater predicted by the models to exist at the well, and the known concentration of contaminant in soil at the source area, a Dilution Attenuation Factor (DAF) can be determined. A DAF is simply the ratio of initial soil concentration to the groundwater concentration predicted to exist at the well.

DAF = Input Soil Concentration/Modeled Groundwater Concentration
DAF = 10 ppm/Concentration Modeled at Well (ppm)

A soil standard can then be determined by multiplying the DAF by a chemical's Ambient Groundwater Quality Standard (AGQS).

$$\text{Soil Standard}_{(\text{leachability})} = \text{DAF X AGQS}_{(\text{ppm})}$$

APPENDIX C

Selection of Estimated Quantitation Limits For Method 1 Chemicals

The majority of the Estimated Quantitation Limits (EQL) for the MCP Method 1 chemicals are taken from one of two references on USEPA-approved laboratory methods. The references are:

- USEPA Test Methods for Evaluating Solid Waste, SW-846, Third Edition Final Update III, December 1996 (Reference 1)

- USEPA Methods for the Determination of Organic Compounds in Drinking Water, EPA-600/4-88/039, December, 1988 (Revised July 1991) (Reference 2)

The references provide a method number. Below is a description of the various methods that appear in the references. From USEPA Test Methods for Evaluating Solid Waste (often referred to as SW-846), EQLs were excerpted from the following methods:

a) USEPA Method 8260B: Volatile Organics by Gas Chromatography/Mass Spectrometry (GC/MS)

b) USEPA Method 8270C: Semivolatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)

c) USEPA Method 8081A: Organochlorine Pesticides by Gas Chromatography

d) USEPA Method 8290: Polychlorinated Dibenzo-p-Dioxin (PCDDs) and Polychlorinated Dibenzofurans (PCDFs) by High-Resolution Gas Chromatography/High-Resolution Mass Spectrometry (HRGC/HRMS)

e) USEPA Method 6010B: Inductively Coupled Plasma-Atomic Emission Spectroscopy

f) USEPA Method 9012A: Total and Amenable Cyanide (Automated Colorimetric with off-line distillation)

g) USEPA Method 7196A: Chromium, Hexavalent (Colorimetric)

h) USEPA Method 7060A: Arsenic (AA, Furnace Technique)

i) USEPA Method 7471A: Mercury in Solid or Semisolid Waste (Manual Cold-Vapor Technique)

C-1

j) USEPA Method 8141A: Organophosphorus Compounds by Gas Chromatography: Capillary Column Technique

k) USEPA Method 8151A: Chlorinated Herbicides by GC Using Methylation or Pentafluorobenzylation Derivitization

l) USEPA Method 8321A: Solvent Extractable Non-Volatile Compounds by High Performance Liquid Chromatography/Thermospray/Mass Spectrometry (HPLC/TS/MS) or Ultraviolet (UV) Detection

m) USEPA Method 8082: Polychlorinated Biphenyls (PCBs) by Gas Chromatography

C-2

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Acetone	67-64-1	0.010	8260B
Acrylonitrile	107-13-1	0.005	8260B
Aldicarb	116-06-3	0.017	8321A
Aldicarb sulfone	1646-87-3	0.023	8321A
Aldicarb sulfoxide	1646-88-4	0.15	8321A
Aldrin	309-00-2	0.09	8081A
Alkylbenzenes		NA*	-
Allyl Chloride	107-05-1	0.005	8260A
Antimony	7440-36-0	8	6010B
Arsenic	7440-38-2	1.0	7060A
Atrazine	1912-24-9	NA*	8141A
Barium	7440-39-3	0.5	6010B
Benzene	71-43-2	0.005	8260B
Benzidine	92-87-5	NA*	8270C
Benzoic Acid	65-85-0	3.30	8270C
Beryllium	7440-41-7	0.08	6010B
Biphenyl, 1,1-	92-52-4	NA*	-
Boron	7440-42-8	1.5	6010B
Bromodichloromethane	75-27-4	0.005	8260B
Bromoform	75-25-2	0.005	8260B
Bromomethane	74-83-9	0.005	8260B
Cadmium	7440-43-9	1.0	6010B
Camphor	76-22-2	NA*	-
Carbofuran	1563-66-2	NA*	8270C
Carbon disulfide	75-15-0	0.005	8260B
Carbon tetrachloride	56-23-5	0.005	8260B
Chlordane	57-74-9	0.1	8081A

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Chloroaniline, p-	106-47-8	1.3	8270C
bis-(2-chloroethyl)ether	111-44-4	0.66	8270C
bis-(2-chloroisopropyl)ether	39638-32-9	0.66	8270C
Chloromethane	74-87-3	0.005	8260B
Chlorophenol, 2-	95-57-8	1.3	8270C
Chlorotoluene, 2 (o)	95-49-8	0.005	8260B
Chlorotoluene, 4 (p)	106-43-4	0.005	8260B
Chromium (III)	16065-83-1	2	6010B
Chromium (VI)	18540-29-9	130	7196A
Copper	7440-50-8	1.5	6010B
Cyanide	57-12-5	50	9012A
2,4-D (Dichlorophenooxyacetic acid, 2,4-)	94-75-7	0.13	8151B
Dalapon	75-99-0	0.87	8151B
DDD (Dichlorodiphenyl dichloroethane, p,p')	72-54-8	0.09	8081A
DDE (Dichlorodiphenyl dichloroethylene, p,p')	72-55-9	0.07	8081A
DDT (Dichlorodiphenyl trichloroethane, p,p')	50-29-3	0.04	8081A
Dibromochloromethane	124-48-1	0.005	8260B
Dibromochloropropane		0.005	8260A
Dibutylphthalate	84-74-2	0.66	8270C
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	0.005	8260B
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	0.005	8260B
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	0.005	8260B
Dichlorobenzidine, 3,3'-	91-94-1	1.3	8270C
Dichlorodifluoromethane	75-71-8	0.005	8260B
Dichloroethane, 1,1-	75-34-3	0.005	8260B
Dichloroethane, 1,2-	107-06-2	0.005	8260B
Dichloroethylene, 1,1-	75-35-4	0.005	8260B

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Dichloroethylene, cis-1,2-	156-59-2	0.005	8260B
Dichloroethylene, trans-1,2-	156-60-5	0.005	8260B
Dichloromethane (Methylene chloride)	75-09-2	0.050	8260B
Dichlorophenol, 2,4-	120-83-2	0.66	8270C
Dichloropropane, 1,2-	78-87-5	0.005	8260B
Dichloropropene, 1,3-	542-75-6	0.005	8260B
Dieldrin	60-57-1	0.06	8081A
Diethyl phthalate	84-66-2	0.66	8270C
Di(ethylhexyl)phthalate (bis-(2-ethylhexyl)phthalate)	117-81-7	0.66	8270C
Dimethyl phthalate	131-11-3	0.66	8270C
Dimethylphenol, 2,4-	105-67-9	0.66	8270C
Dinitrophenol, 2,4-	51-28-5	3.30	8270C
Dinitrotoluene, 2,4-	121-14-2	0.66	8270C
Dinoseb	88-85-7	0.13	8151B
1,2-Diphenylhydrazine	122-66-7	NA*	8270C
Diquat (dibromide)	85-00-7	NA	(H_2O only)
Endosulfan	115-29-7	0.09	8081A
Endothall	145-73-3	NA	-
Endrin	72-20-8	0.1	8081A
Ethylbenzene	100-41-4	0.005	8260B
Ethylene dibromide	106-93-4	0.005	8260B
Ethylene glycol	107-21-1	50	8260B
Fluoride	16984-48-8	NA*	-
Heptachlor	76-44-8	0.09	8081A
Heptachlor epoxide	1024-57-3	0.10	8081A
Hexachlorobenzene	118-74-1	0.66	8270C
Hexachlorobutadiene	87-68-3	0.005	8270C

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Hexachlorocyclohexane, alpha	319-84-6	0.06	8081A
Hexachlorocyclohexane, beta	319-85-7	0.06	8081A
Hexachlorocyclohexane, gamma (Lindane)	58-89-9	0.09	8081A
Hexachlorocyclopentadiene	77-47-4	0.66	8270C
Hexachlorodibenzodioxin	34465-46-8	1.25×10^{-5}	8290
Hexachloroethane	67-72-1	0.66	8270C
Isophorone	78-59-1	0.66	8270C
Isopropyl benzene	98-82-8	0.005	8260A
Lead	7439-92-1	11	6010B
Mercury	7439-97-6	0.05	7471A
Methoxychlor	72-43-5	NA	8081A
Methyl ethyl ketone	78-93-3	0.005	8260A
Methyl isobutyl ketone	108-10-1	0.005	8260A
Methyl mercury	22967-92-6	0.001	
Methyl phenol, 2-	95-48-7	0.66	8270C
Methyl phenol,4	106-44-5	0.66	8270C
Methyl tert butyl ether	1634-04-4	0.005	8260B
Monochlorobenzene (Chlorobenzene)	108-90-7	0.005	8260B
Nickel	7440-02-0	4	6010B
Oxamyl	23135-22-0	0.015	8321A
Pentachlorophenol	87-86-5	3.30	8270C
Phenol	108-95-2	0.66	8270C
Picloram	1918-02-1	0.09	8151A
Polychlorinated biphenyls (PCBs)	1336-36-3	0.30	8082
Selenium	7782-49-2	20	6010B
Silver	7440-22-4	2	6010B
Simazine	122-34-9	NA*	8141A

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Styrene	100-42-5	0.005	8260B
Sulfate	14808-79-8	-	-
TCDD, 2,3,7,8- (Dioxin)	1746-01-6	5×10^{-6}	8290
Tetrachloroethane, 1,1,1,2-	630-20-6	0.005	8260B
Tetrachloroethane, 1,1,2,2,-	79-34-5	0.005	8260B
Tetrachloroethylene	127-18-4	0.005	8260B
Tetrahydrofuran	109-99-9	0.01	8260B
Thallium (thallium chloride)	7440-28-0	10	6010B
Toluene	108-88-3	0.005	8260B
Total Petroleum Hydrocarbons †		†	†
Toxaphene	8001-35-2	0.8	8080A
TP, 2,4,5- (Trichlorophenoxyacetic acid, 2,4,5-; or Silvex)	93-76-5	0.05	8151A
Trichlorobenzene, 1,3,5-	108-70-3	0.005	8260A
Trichlorobenzene, 1,2,4-	120-82-1	0.66	8270C
Trichloroethane, 1,1,1-	71-55-6	0.005	8260B
Trichloroethane, 1,1,2-	79-00-5	0.005	8260B
Trichloroethylene	79-01-6	0.005	8260B
Trichlorofluoromethane	75-69-4	0.005	8260B
Trichloromethane (Chloroform)	67-66-3	0.005	8260B
Trichlorophenol, 2,4,5-	95-95-4	0.66	8270C
Trichlorophenol, 2,4,6-	88-06-2	0.66	8270C
Trichloropropane, 1,2,3-	96-18-4	0.005	8260B
Vinyl chloride	75-01-4	0.005	8260B
Xylenes (mixed isomers)	1330-20-7	0.005	8260B
Zinc	7440-66-6	0.50	6010A

Polynuclear Aromatic Hydrocarbons - Carcinogenic

Table C-1

ESTIMATED QUANTIFICATION LIMITS FOR SOILS

NHDES Risk Characterization and Management Policy - Appendix C

Chemical Name	CAS No.	EQL (mg/kg)	USEPA Method No.
Benzo(a)anthracene	56-55-3	0.66	8270C
Benzo(a)pyrene	50-32-8	0.66	8270C
Benzo(b)fluoranthene	205-99-2	0.66	8270C
Benzo(k)fluoranthene	207-08-9	0.66	8270C
Chrysene	218-01-9	0.66	8270C
Dibenzo(a,h)anthracene	53-70-3	0.66	8270C
Indeno(1,2,3-cd)pyrene	193-39-5	0.66	8270C
Polynuclear Aromatic Hydrocarbons - Noncarcinogenic			
Acenaphthene	83-32-9	0.66	8270C
Acenaphthylene	208-96-8	0.66	8270C
Anthracene	120-12-7	0.66	8270C
Benzo(g,h,i)perylene	191-24-2	0.66	8270C
Fluoranthene	206-44-0	0.66	8270C
Fluorene	86-73-7	0.66	8270C
Methylnaphthalene, 2-	91-57-6	0.66	8270C
Naphthalene	91-20-3	0.66	8270C
Phenanthrene	85-01-8	0.66	8270C
Pyrene	129-00-0	0.66	8270C

NA* = Not Determined

† = The "Interim Policy for the Management of Soils Contaminated from Spills/Releases of Virgin Petroleum Products" establishes the policy recommending GCFID analyses for Total Petroleum Hydrocarbons.

APPENDIX D

Methodology for the Determination of Ceiling Concentrations

Ceiling Concentrations in Groundwater:

Except when a MCL, SMCL or AGQS exists that is higher, the ceiling concentrations in groundwater noted in the general methodologies described in Section 4.0 are set at a concentration of 50,000 Fg/liter, or 0.005%. The ceiling concentration serves two main purposes. First, in areas of current or future drinking water sources, it serves to minimize potential organoleptic (taste, odor) effects. Second, the ceiling concentration provides an upper limit on allowable groundwater contamination which may pose a risk to public welfare and the environment. Such a ceiling will act to minimize continued degradation of the groundwater as a general resource and to minimize the incremental increases to anthropogenic background.

Ceiling Concentrations in Soil:

The ceiling concentrations in soil noted in the general methodology presented in Section 5.0 are set considering the odor index of the chemical, the volatility of the chemical and the soil category. The odor index developed for a chemical is the ratio of the vapor pressure (VP) for the chemical, measured at approximately 20° to 30° Celsius, and the 50th percentile odor recognition threshold ($ORT_{50\%}$). Chemicals with a relatively high odor index have correspondingly lower ceiling concentrations.

$$\textbf{Odor Index} = \frac{VP_{20^{o} - 30^{o}}}{ORT_{50\%}}$$

Volatile chemicals (i.e., those with vapor pressure greater than 1 Torr at approximately 20° to 30° Celsius) are also assigned relatively low ceiling concentrations.

The ceiling concentrations serve two main purposes. First, in high exposure potential areas (category S-1), the ceiling concentrations provide an upper limit for chemicals which may pose a risk to public health through an inhalation pathway. Second, the ceiling concentrations provide an upper limit on allowable soil contamination which may pose a risk to public welfare and the environment.

The following ceiling concentrations have been applied in the development of the Method 1 and Method 2 Soil Standards:

CEILING CONCENTRATIONS		
Soil Category	**Criteria**	**Ceiling Value Adopted**
Category S-1	Odor Index > 100, or Vapor Pressure > 1 Torr	100 ug/g
	1.0 < Odor Index < 100	500 ug/g
	Odor Index < 1	1,000 ug/g
Category S-2	Odor Index > 100, or Vapor Pressure > 1 Torr	500 ug/g
	1.0 < Odor Index < 100	1,000 ug/g
	Odor Index < 1	2,500 ug/g
Category S-3	Odor Index > 100, or	500 ug/g
	Vapor Pressure > 1 Torr	1,000 ug/g
	1.0 < Odor Index < 100	2,500 ug/g
	Odor Index < 1	5,000 ug/g

APPENDIX E

Soil Standard Selection Methodology Summary Table

Appendix E

METHOD 1 SOIL STANDARDS SELECTION

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Acetone	67-64-1	**9**	**9**	**9**	1,600	7,900	25,100	9		0.010	
Acrylonitrile	107-13-1	**0.06**	**0.06**	**0.06**	1	4	66	0.06		0.005	
Aldicarb	116-06-3	**0.04**	**0.04**	**0.04**	28	180	180	0.04		0.017	
Aldicarb sulfone	1646-87-3	**Î**	**Î**	**Î**	28	180	180	NM		0.023	
Aldicarb sulfoxide	1646-88-4	**Î**	**Î**	**Î**	28	180	180	NM		0.15	
Aldrin	309-00-2	**0.09**	**0.2**	**1**	0.06	0.2	1	NCM		0.09	
Alkylbenzenes Ï		**59**	**59**	**59**	59	250	250	Ï		NA	
Allyl chloride	107-05-1	**0.6**	**0.6**	**0.6**	0.7	5	10	0.6		0.005	
Antimony	7440-36-0	**8**	**26**	**26**	5	26	26	NM		8	
Arsenic	7440-38-2	**12**	**12**	**12**	0.8	3	12	NM	12	1	
Atrazine	1912-24-9	**0.08**	**0.08**	**0.08**	97	630	630	0.08		NA	
Barium	7440-39-3	**750**	**2,500**	**3,400**	750	3,400	3,400	NM		0.5	(3)
Benzene	71-43-2	**0.3**	**0.3**	**0.3**	26	75	1,200	0.3		0.005	
Benzidine	92-87-5	**0.002**	**0.007**	**0.01**	0.002	0.007	0.1	0.01		NA	
Benzoic acid	65-85-0	**350**	**350**	**350**	110,000	720,000	720,000	350		3.3	
Beryllium	7440-41-7	**0.1**	**0.1**	**1**	0.01	0.03	1	NM		0.08	
Biphenyl, 1,1-	92-52-4	**200**	**200**	**200**	1,000	5,500	5,500	200		NA	
Boron	7440-42-8	**1,000**	**2,500**	**5,000**	3,100	24,000	24,000	NM		1.5	(3)
Bromodichloromethane	75-27-4	**0.01**	**0.01**	**0.01**	6	17	410	0.01		0.005	
Bromoform	75-25-2	**0.1**	**0.1**	**0.1**	22	60	1,900	0.1		0.005	
Bromomethane	74-83-9	**0.3**	**0.3**	**0.3**	36	220	220	0.3		0.005	
Cadmium	7440-43-9	**32**	**230**	**230**	32	230	230	NM	1.9	1.0	
Camphor	76-22-2	**11**	**11**	**11**	890	6,300	6,300	11		NA	
Carbofuran	1563-66-2	**0.6**	**0.6**	**0.6**	140	910	910	0.6		NA	
Carbon disulfide	75-15-0	**0.4**	**0.4**	**0.4**	2,500	16,000	16,000	0.4		0.005	
Carbon tetrachloride	56-23-5	**6**	**12**	**12**	6	17	24	12		0.005	
Chlordane	57-74-9	**0.8**	**2**	**2**	0.8	2	2	NCM		0.1	
Chloroaniline, p-	106-47-8	**1.3**	**1.3**	**1.3**	76	400	400	0.5		1.3	
bis-(Chloroethyl)ether	111-44-4	**0.7**	**0.7**	**0.7**	0.1	0.3	10	0.1		0.66	
bis-(Chloroisopropyl)ether	39638-32-9	**2**	**4**	**9**	2	4	150	9		0.66	
Chloromethane	74-87-3	**0.2**	**0.2**	**0.2**	58	170	2,700	0.2		0.005	
Chlorophenol, 2-	95-57-8	**2**	**2**	**2**	75	370	1,200	2		1.3	
Chlorotoluene, 2 (o)	95-49-8	**30**	**30**	**30**	230	1,100	4,000	30		0.005	(2)

Appendix E

METHOD 1 SOIL STANDARDS SELECTION

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Chlorotoluene, 4 (p)	106-43-4	**21**	**21**	**21**	180	800	3,300	21		0.005	(2)
Chromium (III)	16065-83-1	**1,000**	**2,500**	**5,000**	44,300	91,600	91,600	NM	33*	2	(3)
Chromium (VI)	18540-29-9	**130**	**460**	**540**	88	458	540	NM	33*	130	
Cyanide	57-12-5	**100Ð**	**500Ð**	**500Ð**	510	3,100	3,100	NM		50	(1) &(2)
2,4-D (Dichlorophenooxyacetic acid, 2,4-)	94-75-7	**1**	**1**	**1**	280	1,800	1,800	1		0.13	
Dalapon	75-99-0	**3**	**3**	**3**	830	5,400	5,400	3		0.87	
DDD (Dichlorodiphenyl dichloroethane, p,p')	72-54-8	**0.7**	**2**	**64**	0.7	2	64	NCM		0.09	
DDE (Dichlorodiphenyl dichloroethylene, p,p')	72-55-9	**0.7**	**2**	**56**	0.7	2	56	NCM		0.07	
DDT (Dichlorodiphenyl trichloroethane, p,p')	50-29-3	**0.9**	**3**	**11**	0.9	3	11	NCM		0.04	
Dibromochloromethane	124-48-1	**0.01**	**0.01**	**0.01**	3	8	220	0.01		0.005	
Dibromochloropropane	96-12-8	**0.01**	**0.01**	**0.01**	0.4	1	22	0.01		0.005	
Dibutylphthalate	84-74-2	**1,000**	**2,500**	**5,000**	1,700	8,500	26,000	NCM		0.66	
Dichlorobenzene, 1,2- (o-DCB)	95-50-1	**66**	**66**	**66**	490	2,000	9,600	66		0.005	
Dichlorobenzene, 1,3- (m-DCB)	541-73-1	**45**	**45**	**45**	460	1,900	9,100	45		0.005	
Dichlorobenzene, 1,4- (p-DCB)	106-46-7	**6**	**9**	**9**	6	17	560	9		0.005	
Dichlorobenzidine, 3,3'-	91-94-1	**1.3**	**1.3**	**1.3**	0.7	2	52	0.2		1.3	
Dichlorodifluoromethane	75-71-8	**1,000**	**2,500**	**5,000**	5,100	31,000	31,000	NCM		0.005	(3)
Dichloroethane, 1,1-	75-34-3	**3**	**3**	**3**	250	1,600	3,400	3		0.005	
Dichloroethane, 1,2-	107-06-2	**0.08**	**0.08**	**0.08**	7	21	370	0.08		0.005	
Dichloroethylene, 1,1-	75-35-4	**1**	**4**	**14**	1	4	59	14		0.005	
Dichloroethylene, cis-1,2-	156-59-2	**2**	**2**	**2**	250	1,600	3,400	2		0.005	
Dichloroethylene, trans-1,2-	156-60-5	**9**	**9**	**9**	510	3,100	6,800	9		0.005	
Dichloromethane (Methylene chloride)	75-09-2	**0.1**	**0.1**	**0.1**	100	290	2,000	0.1		0.050	
Dichlorophenol, 2,4-	120-83-2	**0.7**	**0.7**	**0.7**	45	220	220	0.7		0.66	
Dichloropropane, 1,2-	78-87-5	**0.1**	**0.1**	**0.1**	11	32	530	0.1		0.005	
Dichloropropene, 1,3-	542-75-6	**1**	**1**	**1**	4	12	12	1		0.005	
Dieldrin	60-57-1	**0.06**	**0.2**	**3**	0.06	0.2	3	NCM		0.06	
Diethyl phthalate	84-66-2	**1,000**	**2,500**	**5,000**	15,000	80,000	230,000	NM		0.66	(3)
Di(ethylhexyl)phthalate (bis(2-ethyl phthalate)	117-81-7	**39**	**110**	**2,200**	39	110	2,200	NCM		0.66	

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METHOD 1 SOIL STANDARDS SELECTION

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Dimethyl phthalate	131-11-3	**1,000**	**1,500**	**1,500**	200,000	1E+06	1E+06	1,500		0.66	(3)
Dimethylphenol, 2,4-	105-67-9	**4**	**4**	**4**	300	1,500	4,800	4		0.66	
Dinitrophenol, 2,4-	51-28-5	**3.3**	**3.3**	**3.3**	30	150	150	1.5		3.30	
Dinitrotoluene, 2,4-	121-14-2	**0.7**	**0.7**	**0.7**	0.8	2	45	0.2		0.66	
Dinoseb	88-85-7	**0.3**	**0.3**	**0.3**	13	62	62	0.3		0.13	
Diphenylhydrazine, 1,2-	122-66-7	**0.8**	**0.8**	**0.8**	1	3	47	0.8		NA	
Diquat (dibromide)	85-00-7	**0.3**	**0.3**	**0.3**	61	400	400	0.3		NA	
Endosulfan	115-29-7	**45**	**45**	**45**	180	1,300	1,300	45		0.09	
Endothall	145-73-3	**2**	**2**	**2**	560	3,600	3,600	2		NA	
Endrin	72-20-8	**8**	**54**	**54**	8	54	54	NCM		0.1	
Ethylbenzene	100-41-4	**140**	**140**	**140**	1,500	7,400	24,000	140		0.005	
Ethylene dibromide	106-93-4	**0.005**	**0.005**	**0.005**	0.007	0.02	0.4	0.0009		0.005	
Ethylene glycol	107-21-1	**90**	**90**	**90**	56,000	360,000	360,000	90		50	
Fluoride	7782-41-4	**Î**	**Î**	**Î**	2,100	16,000	16,000	NM		NA	
Heptachlor	76-44-8	**0.2**	**0.7**	**9**	0.2	0.7	9	NCM		0.09	
Heptachlor epoxide	1024-57-3	**0.1**	**0.3**	**0.5**	0.1	0.3	0.5	NCM		0.1	
Hexachlorobenzene	118-74-1	**0.7**	**0.7**	**7**	0.07	0.2	7	NCM		0.66	
Hexachlorobutadiene	87-68-3	**0.2**	**0.8**	**3**	0.2	0.8	3	NCM		0.005	
Hexachlorocyclohexane, alpha	319-84-6	**0.06**	**0.06**	**0.06**	0.06	0.2	4	0.002		0.06	
Hexachlorocyclohexane, beta	319-85-7	**0.06**	**0.06**	**0.06**	0.2	0.6	14	0.04		0.06	
Hexachlorocyclohexane, gamma	58-89-9	**0.09**	**0.09**	**0.09**	0.3	0.8	7	0.002		0.09	
Hexachlorocyclopentadiene	77-47-4	**36**	**150**	**710**	36	150	710	NCM		0.66	
Hexachlorodibenzodioxin	19408-74-3	**Î**	**Î**	**Î**	6E-05	2E-04	4E-03	NM		1.2E-05	
Hexachloroethane	67-72-1	**0.7**	**0.7**	**0.7**	0.5	2	10	0.4		0.66	
Isophorone	78-59-1	**2**	**2**	**2**	300	1,100	4,800	2		0.66	
Isopropyl benzene	98-82-8	**123**	**123**	**123**	1,100	5,100	7,700	123		0.005	
Lead	7439-92-1	**400Ñ**	**400Ñ**	**400Ñ**	400Ñ	400Ñ	400Ñ	NM	54	11	
Mercury (inorganic)	7439-97-6	**1**	**7**	**7**	1	7	7	NM	0.33	0.05	
Methoxychlor	72-43-5	**38**	**170**	**170**	38	170	170	NCM		NA	
Methyl ethyl ketone	78-93-3	**2**	**2**	**2**	6,700	30,000	38,000	2		0.01	
Methyl isobutyl ketone	108-10-1	**10**	**10**	**10**	300	1,300	9,200	10		0.01	
Methyl mercury	22967-92-6	**0.3**	**3**	**3**	0.3	3	3	NM		0.001	
Methyl phenol, 2-	95-48-7	**18**	**18**	**18**	75	370	370	18		0.66	

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METHOD 1 SOIL STANDARDS SELECTION

NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Methyl phenol, 4-	106-44-5	**5**	**5**	**5**	8	37	37	5		0.66	
Methyl tert butyl ether	1634-04-4	**2**	**2**	**2**	220	1,200	1,200	2		0.005	
Monochlorobenzene (Chlorobenzene)	108-90-7	**6**	**6**	**6**	260	1,200	1,200	6		0.005	
Nickel	7440-02-0	**580**	**2,500**	**3,900**	580	3,900	3,900	NM	24	4	(3)
Oxamyl	23135-22-0	**0.4**	**0.4**	**0.4**	700	4,500	4,500	0.4		0.015	
Pentachlorophenol	87-86-5	**3.3**	**3.3**	**3.3**	3	9	210	0.1		3.30	
Phenol	108-95-2	**56**	**56**	**56**	9,000	44,000	44,000	56		0.66	
Picloram	1918-02-1	**11**	**11**	**11**	2,000	13,000	13,000	11		0.09	
Polychlorinated Biphenyls (PCBs)	1336-36-3	**1Ò**	**1Ò**	**2**	0.2	0.7	2	NM		0.3	
Selenium	7782-49-2	**260**	**2,500**	**4,200**	260	4,200	4,200	NM	2.2	20	(3)
Silver	7440-22-4	**45**	**200**	**200**	45	200	200	NM		2	
Simazine	122-34-9	**0.4**	**0.4**	**0.4**	14	91	91	0.4		NA	
Styrene	100-42-5	**14**	**14**	**14**	180	770	3200	14		0.005	
TCDD, 2,3,7,8- (Dioxin)	1746-01-6	**Î**	**Î**	**Î**	7E-06	2E-05	3E-04	NM		5 E-06	
Tetrachloroethane, 1,1,1,2-	630-20-6	**2**	**2**	**2**	11	30	61	2		0.005	
Tetrachloroethane, 1,1,2,2,-	79-34-5	**0.005**	**0.005**	**0.005**	0.8	2	69	0.004		0.005	
Tetrachloroethylene	127-18-4	**2**	**2**	**2**	14	42	690	2		0.005	
Tetrahydrofuran	109-99-9	**7**	**7**	**7**	560	3,400	3,400	7		0.010	
Thallium (thallium chloride)	7440-28-0	**10**	**21**	**32**	3	21	32	NM		10	
Toluene	108-88-3	**100**	**100**	**100**	3,800	20,000	57,000	100		0.005	
Total Petroleum Hydrocarbons		**10,000**	**10,000**	**10,000**	NA	NA	NA			NA	
Toxaphene	8001-35-2	**0.8**	**0.8**	**15**	0.2	0.5	15	NCM		0.8	
TP, 2,4,5- (Trichlorophenoxyacetic acid, 2,4,5-)	93-76-5	**6**	**6**	**6**	280	1,800	3,600	6		0.05	
Trichlorobenzene, 1,3,5-	108-70-3	**27**	**27**	**27**	31	130	130	27		0.005	
Trichlorobenzene, 1,2,4-	120-82-1	**15**	**15**	**15**	51	210	210	15		0.66	
Trichloroethane, 1,1,1-	71-55-6	**42**	**42**	**42**	2,300	14,000	14,000	42		0.005	
Trichloroethane, 1,1,2-	79-00-5	**0.1**	**0.1**	**0.1**	7	20	100	0.1		0.005	

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NHDES Risk Characterization and Management Policy (Section 7.5(2))

(1) CHEMICAL NAME	(2) CAS No.	(3) NH S-1 (mg/kg)	(4) NH S-2 (mg/kg)	(5) NH S-3 (mg/kg)	(6) Risk S-1 (mg/kg)	(7) Risk S-2 (mg/kg)	(8) Risk S-3 (mg/kg)	(9) Leaching (GW-1) (mg/kg)	(10) Back-ground (mg/kg)	(11) EQL (mg/kg)	(12) Ceiling Conc. (mg/kg)
Trichloroethylene	79-01-6	**0.8**	**0.8**	**0.8**	68	200	3,200	0.8		0.005	
Trichlorofluoromethane	75-69-4	**1,000**	**2,500**	**5,000**	7,600	47,000	47,000	NCM		0.005	(3)
Trichloromethane (Chloroform)	67-66-3	**0.1**	**0.1**	**0.1**	120	360	360	0.1		0.005	
Trichlorophenol, 2,4,5-	95-95-4	**120**	**120**	**120**	1,500	7,400	24,000	120		0.66	
Trichlorophenol, 2,4,6-	88-06-2	**0.7**	**0.7**	**0.7**	34	94	2,300	0.6		0.66	
Trichloropropane, 1,2,3-	96-18-4	**1.4**	**1.4**	**1.4**	50	220	920	1.4		0.005	
Vinyl chloride	75-01-4	**0.4**	**1**	**9**	0.4	1	19	9		0.005	
Xylenes (mixed isomers)Ó	1330-20-7	**500**	**1,000**	**1,100**	29,000	140,000	140,000	1100		0.005	(1)
Zinc	7440-66-6	**1,000**	**2,500**	**5,000**	9,200	65,000	65,000	NM	98	0.5	(3)
Polynuclear Aromatic Hydrocarbons - Carcinogenic Ô											
Benzo(a)anthracene	56-55-3	**0.7**	**2**	**40**	0.7	2	40	NCM		0.66	
Benzo(a)pyrene	50-32-8	**0.7**	**0.7**	**4**	0.07	0.2	4	NCM		0.66	
Benzo(b)fluoranthene	205-99-2	**7**	**20**	**400**	7	20	400	NCM		0.66	
Benzo(k)fluoranthene	207-08-9	**7**	**20**	**400**	7	20	400	NCM		0.66	
Chrysene	218-01-9	**70**	**200**	**4,000**	70	200	4,000	NCM		0.66	
Dibenzo(a,h)anthracene	53-70-3	**0.7**	**0.7**	**4**	0.07	0.2	4	NCM		0.66	
Indeno(1,2,3-cd)pyrene	193-39-5	**0.7**	**2**	**40**	0.7	2	40	NCM		0.66	
Polynuclear Aromatic Hydrocarbons - Noncarcinogenic Õ											
Acenaphthene	83-32-9	**270**	**270**	**270**	1,200	6,600	18,000	270		0.66	(3)
Acenaphthylene	208-96-8	**300**	**300**	**300**				300		0.66	(3)
Anthracene	120-12-7	**1,000**	**1,700**	**1,700**	6,100	33,000	89,000	1,700		0.66	(3)
Fluoranthene	206-44-0	**810**	**2,500**	**5,000**	Total less than 810	Total less than 4,410	Total less than 11,800	NCM		0.66	(3)
Fluorene	86-73-7	**510**	**510**	**510**				510		0.66	
Methylnaphthalene, 2-	91-57-6	**150**	**150**	**150**				150		0.66	
Naphthalene	91-20-3	**5**	**5**	**5**				5		0.66	
Benzo(g,h,i)perylene	191-24-2	**Total < 480**	**Total < 2,400**	**Total < 5,000**	Total < 480	Total < 2,400	Total < 7,500	NCM		0.66	(3)
Phenanthrene	85-01-8							NCM		0.66	(1)
Pyrene	129-00-0							NCM		0.66	(3)

*Endnotes:	
Column (1):	Chemical Name.
Column (2):	Chemical Abstract Service (CAS) Number.
Column (3):	Method 1 Category S-1 Soil Standard.
Column (4):	Method 1 Category S-2 Soil Standard.
Column (5):	Method 1 Category S-3 Soil Standard.
Column (6):	Soil Category S-1 Direct Contact Risk-based Standards are based upon sensitive uses of property and accessible soil, either currently or in the reasonably foreseeable future
Column (7):	Soil Category S-2 Direct Contact Risk-based Standards are based upon moderate exposure and accessible soil, either currently or in the reasonably foreseeable future.
Column (8):	Soil Category S-3 Direct Contact Risk-based Standards are based upon restricted access property with limited potential for exposure, either currently or in the reasonably foreseeable future. **ID**=Insufficient Data currently available. (NHDHHS Risk Assessment Protocols in Appendix A.)
Column (9):	Leaching-based Standards consider the potential of chemicals to leach from soil and contaminate the underlying groundwater. The SESOIL and AT123D models were combined to calculate the concentration of a chemical in soil that would not cause a violation of GW-1 Groundwater Standards in groundwater. **NCM**=Negligible Contaminant Migration; i.e., Leaching models indicate negligible contaminant migration over thirty years **NM**=Not Modeled. (1) Metals: Due to the difference in the chemical-specific properties of the various forms of naturally occurring metals in the environment, and site-specific conditions, predicting the leaching characteristics of metals is impractical. Whereas the Standards are based on other considerations, if metals exceed groundwater standards at a site, site-specific investigations may be required to evaluate the leaching potential of site metals. (2) Non-metals: The data necessary to run the models for non-metal chemicals was not readily available. Modeling input parameters are described in Appendix B.
Column (10):	Background concentrations of metals in soil are described in Section 1.6(4). (***** Total Chromium.)
Column (11):	Practical Quantitation Limits (PQLs) were provided by the NHDES Laboratory Services Unit. The associated analytical methods are provided in Appendix C. **NA**=Not Applicable or Not Available.
Column (12):	(1) - the soil standard ceiling concentration was identified due to the contaminant's Odor Index value. (2) - the soil standard ceiling concentration was identified due to the contaminant's Vapor Pressure value. (3) - the soil standard ceiling concentration was identified due to insufficient information to calculate an Odor Index.

NOTES:	Î	Standards were not developed for this contaminant because the necessary physical property information was not available to run the leaching model or because of questions related to PQLs.
	Ï	For the purposes of this policy, alkylbenzenes include 1,2,4 trimethyl benzene, 1,3,5 trimethyl benzene, n-propyl benzene, n-butyl benzene, 4-isopropyl toluene, tert-butyl benzene and sec-butyl benzene. NH DES evaluates the risk posed by alkylbenzenes as a group because of the similar structures of these compounds and the lack of toxicological data for all compounds in this class of chemicals. The sum of the total of these compounds is compared to the NH S-1, NH S-2 and NH S-3 standards. The leaching numbers for these compounds are as follows: 1,2,4 trimethy benzene = 69 ppm, 1,3,5 trimethyl benzene = 27 ppm, n-propyl benzene = 10 ppm, n-butyl benzene = 18 ppm, 4-isopropyl toluene (not available), tert-butyl benzene = 6 ppm and sec-butyl benzene = 7 ppm. DES decided to use the S-1 health standard as the leaching standard for this class of compounds because of the similarity of the S-1 number to the modeled leaching numbers and the additional conservativism added by using a cumulative approach to this class of compounds.
	Ð	Cyanide standards were developed using free cyanide toxicity and physical characteristics. Complexed cyanide or other cyanide species can be addressed via Method 2 or 3 Risk Characterization methodologies.
	Ñ	A screening level of 400 mg/kg has been set for lead based on EPA's "Revised Interim Soil Lead Guidance for CERCLA Sites and RCRA Corrective Action Facilities" (U.S. EPA, 1984).
	Ò	The S-1 PCB number is based on EPA's August 1990 "Guidance on Remedial Actions for Superfund Sites with PCB Contamination" for residential areas.
	Ó	Xylene standard based on modeling of leaching of xylene from soil to groundwater and the GW-2 standard.
	Ô	Standards for carcinogenic PAHs were calculated using the potency factors developed by EPA, based on equivalency to Benzo(a)pyrene.
	Õ	Method 1 soil standards for Benzo(g,h,i) perylene, Phenanthrene and Pyrene are derived by adding the concentrations of each of these three compounds and comparing the total value to the appropriate value in column 3, 4 or 5.