January 24, 1994
(REVISED)

**New York State Department of Environmental Conservation**

**MEMORANDUM**

**TO:** Regional Haz. Waste Remediation Engineers, Bureau Dirs. & Section Chiefs
**FROM:** Michael J. O'Toole, Jr., Director, Div. of Hazardous Waste Remediation
**SUBJECT:** DIVISION TECHNICAL AND ADMINISTRATIVE GUIDANCE MEMORANDUM: DETERMINATION OF SOIL CLEANUP OBJECTIVES AND CLEANUP LEVELS
**DATE:**

JAN 24 1994 Michael J O'Toole Jr

The cleanup goal of the Department is to restore inactive hazardous waste sites to predisposal conditions, to the extent feasible and authorized by law. However, it is recognized that restoration to predisposal conditions will not always be feasible.

## 1. INTRODUCTION:

This TAGM provides a basis and procedure to determine soil cleanup levels at individual Federal Superfund, State Superfund, 1986 EQBA Title 3 and Responsible Party (RP) sites, when the Director of the DHWR determines that cleanup of a site to predisposal conditions is not possible or feasible.

The process starts with development of soil cleanup objectives by the Technology Section for the contaminants identified by the Project Managers. The Technology Section uses the procedure described in this TAGM to develop soil cleanup objectives. Attainment of these generic soil cleanup objectives will, at a minimum, eliminate all significant threats to human health and/or the environment posed by the inactive hazardous waste site. Project Managers should use these cleanup objectives in selecting alternatives in the Feasibility Study (FS). Based on the proposed selected remedial technology (outcome of FS), final site specific soil cleanup levels are established in the Record of Decision (ROD) for these sites.

It should be noted that even after soil cleanup levels are established in the ROD, these levels may prove to be unattainable when remedial construction begins. In that event, alternative remedial actions or institutional controls may be necessary to protect the environment.

## 2. BASIS FOR SOIL CLEANUP OBJECTIVES:

The following alternative bases are used to determine soil cleanup objectives:

(a) Human health based levels that correspond to excess lifetime

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cancer risks of one in a million for Class A[1] and B[2] carcinogens, or one in 100,000 for Class C[3] carcinogens. These levels are contained in USEPA's Health Effects Assessment Summary Tables (HEASTs) which are compiled and updated quarterly by the NYSDEC's Division of Hazardous Substances Regulation;

(b) Human health based levels for systemic toxicants, calculated from Reference Doses (RfDs). RfDs are an estimate of the daily exposure an individual (including sensitive individuals) can experience without appreciable risk of health effects during a lifetime. An average scenario of exposure in which children ages one to six (who exhibit the greatest tendency to ingest soil) is assumed. An intake rate of 0.2 gram/day for a five-year exposure period for a 16-kg child is assumed. These levels are contained in USEPA's Health Effects Assessment Summary Tables (HEASTs) which are compiled and updated quarterly by the NYSDEC's Division of Hazardous Substances Regulation;

(c) Environmental concentrations which are protective of groundwater/drinking water quality; based on promulgated or proposed New York State Standards;

(d) Background values for contaminants; and

(e) Detection limits.

A recommendation on the appropriate cleanup objective is based on the criterion that produces the most stringent cleanup level using criteria a, b, and c for organic chemicals, and criteria a, b, and d for heavy metals. If criteria a and/or b are below criterion d for a contaminant, its background value should be used as the cleanup objective. However, cleanup objectives developed using this approach must be, at a minimum, above the method detection limit (MDL) and it is preferable to have the soil cleanup objectives above the Contract Required Quantitation Limit (CRQL) as defined by NYSDEC. If the cleanup objective of a compound is "non-detectable", it should mean that it is not detected at the MDL. Efforts should be made to obtain the best MDL detection possible when selecting a laboratory and analytical protocol.

The water/soil partitioning theory is used to determine soil cleanup objectives which would be protective of groundwater/drinking water quality for its best use. This theory is conservative in nature and assumes that contaminated soil and groundwater are in direct contact. This theory is based upon the ability of organic matter in soil to adsorb organic chemicals. The approach predicts the maximum amount of contamination that may remain in soil so that leachate from the contaminated soil will not violate groundwater and/or drinking water standards.

(1) Class A are proved human carcinogens
(2) Class B are probable human carcinogens
(3) Class C are possible human carcinogens

This approach is not used for heavy metals, which do not partition appreciably into soil organic matter. For heavy metals, eastern USA or New York State soil background values may be used as soil cleanup objectives. A list of values that have been tabulated is attached. Soil background data near the site, if available, is preferable and should be used as the cleanup objective for such metals. Background samples should be free from the influences of this site and any other source of contaminants. Ideal background samples may be obtained from uncontaminated upgradient and upwind locations.

## 3. DETERMINATION OF SOIL CLEANUP GOALS FOR ORGANICS IN SOIL FOR PROTECTION OF WATER QUALITY

Protection of water quality from contaminated soil is a two-part problem. The first is predicting the amount of contamination that will leave the contaminated media as leachate. The second part of the problem is to determine how much of that contamination will actually contribute to a violation of groundwater standards upon reaching and dispersing into groundwater. Some of the contamination which initially leaches out of soil will be absorbed by other soil before it reaches groundwater. Some portion will be reduced through natural attenuation or other mechanism.

### PART A: PARTITION THEORY MODEL

There are many test and theoretical models which are used to predict leachate quality given a known value of soil contamination. The Water-Soil Equilibrium Partition Theory is used as a basis to determine soil standard or contamination limit for protection of water quality by most of the models currently in use. It is based on the ability of organic carbon in soil to adsorb contamination. Using a water quality value which may not be exceeded in leachate and the partition coefficient method, the equilibrium concentration (Cs) will be expressed in the same units as the water standards. The following expression is used:

Allowable Soil Concentration $Cs = f \times Koc \times Cw \ldots . (1)$

Where: f = fraction of organic carbon of the natural soil medium.

Koc = partition coefficient between water and soil media. Koc can be estimated by the following equation:

$$\log Koc = 3.64 - 0.55 \log S$$

S = water solubility in ppm
Cw = appropriate water quality value from TOGS 1.1.1

Most Koc and S values are listed in the Exhibit A-1 of the USEPA Superfund Public Health Evaluation Manual (EPA/540/1-86/060). The Koc values listed in this manual should be used for the purpose. If the Koc value for a contaminant is not listed, it should be estimated using the above mentioned equation.

## PART B: PROCEDURE FOR DETERMINATION OF SOIL CLEANUP OBJECTIVES

When the contaminated soil is in the unsaturated zone above the water table, many mechanisms are at work that prevent all of the contamination that would leave the contaminated soil from impacting groundwater. These mechanisms occur during transport and may work simultaneously. They include the following: (1) volatility, (2) sorption and desorption, (3) leaching and diffusion, (4) transformation and degradation, and (5) change in concentration of contaminants after reaching and/or mixing with the groundwater surface. To account for these mechanisms, a correction factor of 100 is used to establish soil cleanup objectives. This value of 100 for the correction is consistent with the logic used by EPA in its Dilution Attenuation Factor (DAF) approach for EP Toxicity and TCLP. (Federal Register/Vol. 55, No. 61, March 29, 1990/Pages 11826-27). Soil cleanup objectives are calculated by multiplying the allowable soil concentration by the correction factor. If the contaminated soil is very close (<3' - 5') to the groundwater table or in the groundwater, extreme caution should be exercised when using the correction factor of 100 (one hundred) as this may not give conservative cleanup objectives. For such situations the Technology Section should be consulted for site-specific cleanup objectives.

Soil cleanup objectives are limited to the following maximum values. These values are consistent with the approach promulgated by the States of Washington and Michigan.

1) Total VOCs $\leq$ 10 ppm.
2) Total Semi VOCs $\leq$ 500 ppm.
3) Individual Semi VOCs $\leq$ 50 ppm.
4) Total Pesticides $\leq$ 10 ppm.

One concern regarding the semi-volatile compounds is that some of these compounds are so insoluble that their Cs values are fairly large. Experience (Draft TOGS on Petroleum

Contaminated Soil Guidance) has shown that soil containing some of these insoluble substances at high concentrations can exhibit a distinct odor even though the substance will not leach from the soil. Hence any time a soil exhibits a discernible odor nuisance, it shall not be considered clean even if it has met the numerical criteria.

4. DETERMINATION OF FINAL CLEANUP LEVELS:

Recommended soil cleanup objectives should be utilized in the development of final cleanup levels through the Feasibility Study (FS) process. During the FS, various alternative remedial actions developed during the Remedial Investigation (RI) are initially screened and narrowed down to the list of potential alternative remedial actions that will be evaluated in detail. These alternative remedial actions are evaluated using the criteria discussed in TAGM 4030, Selection of Remedial Actions at Inactive Hazardous Waste Sites, revised May 15, 1990, and the preferred remedial action will be selected. After the detailed evaluation of the preferred remedial action, the final cleanup levels which can be actually achieved using the preferred remedial action must be established. Remedy selection, which will include final cleanup levels, is the subject of TAGM 4030.

Recommended soil cleanup objectives that have been calculated by the Technology Section are presented in Appendix A. These objectives are based on a soil organic carbon content of 1% (0.01) and should be adjusted for the actual organic carbon content if it is known. For determining soil organic carbon content, use attached USEPA method (Appendix B). Please contact the Technology Section, Bureau of Program Management for soil cleanup objectives not included in Appendix A.

Attachments

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Regional Citizen Participation Spec.

**APPENDIX A**

**TABLE 1**

**Recommended soil cleanup objectives (mg/kg or ppm)**

**Volatile Organic Contaminants**

| Contaminant | Partition coefficient Koc | Groundwater Standards/ Criteria Cw ug/l or ppb. | a Allowable Soil conc. ppm. Cs | b Soil Cleanup objectives to Protect GW Quality (ppm) ** | USEPA Health Based (ppm) Carcinogens | USEPA Health Based (ppm) Systemic Toxicants | CRQL (ppb) | *** Rec.soil Clnup Objc (ppm) |
|---|---|---|---|---|---|---|---|---|
| Acetone | 2.2 | 50 | 0.0011 | 0.11 | N/A | 8,000 | 10 | 0.2 |
| Benzene | 83 | 0.7 | 0.0006 | 0.06 | 24 | N/A | 5 | 0.06 |
| Benzoic Acid | 54* | 50 | 0.027 | 2.7 | N/A | 300,000 | 5 | 2.7 |
| 2-Butanone | 4.5* | 50 | 0.003 | 0.3 | N/A | 4,000 | 10 | 0.3 |
| Carbon Disulfide | 54* | 50 | 0.027 | 2.7 | N/A | 8,000 | 5 | 2.7 |
| Carbon Tetrachloride | 110* | 5 | 0.006 | 0.6 | 5.4 | 60 | 5 | 0.6 |
| Chlorobenzene | 330 | 5 | 0.017 | 1.7 | N/A | 2,000 | 5 | 1.7 |
| Chloroethane | 37* | 50 | 0.019 | 1.9 | N/A | N/A | 10 | 1.9 |
| Chloroform | 31 | 7 | 0.003 | 0.30 | 114 | 800 | 5 | 0.3 |
| Dibromochloromethane | N/A | 50 | N/A | N/A | N/A | N/A | 5 | N/A |
| 1,2-Dichlorobenzene | 1,700 | 4.7 | 0.079 | 7.9 | N/A | N/A | 330 | 7.9 |
| 1,3-Dichlorobenzene | 310 * | 5 | 0.0155 | 1.55 | N/A | N/A | 330 | 1.6 |
| 1,4-Dichlorobenzene | 1,700 | 5 | 0.085 | 8.5 | N/A | N/A | 330 | 8.5 |
| 1,1-Dichloroethane | 30 | 5 | 0.002 | 0.2 | N/A | N/A | 5 | 0.2 |
| 1,2-Dichloroethane | 14 | 5 | 0.001 | 0.1 | 7.7 | N/A | 5 | 0.1 |
| 1,1-Dichloroethene | 65 | 5 | 0.004 | 0.4 | 12 | 700 | 5 | 0.4 |
| 1,2-Dichloroethene(trans) | 59 | 5 | 0.003 | 0.3 | N/A | 2,000 | 5 | 0.3 |
| 1,3-dichloropropane | 51 | 5 | 0.003 | 0.3 | N/A | N/A | 5 | 0.3 |
| Ethylbenzene | 1,100 | 5 | 0.055 | 5.5 | N/A | 8,000 | 5 | 5.5 |
| 113 Freon(1,1,2 Trichloro-1,2,2 Trifluoroethane) | 1,230* | 5 | 0.060 | 6.0 | N/A | 200,000 | 5 | 6.0 |
| Methylene chloride | 21 | 5 | 0.001 | 0.1 | 93 | 5,000 | 5 | 0.1 |
| 4-Methyl-2-Pentanone | 19* | 50 | 0.01 | 1.0 | N/A | N/A | 10 | 1.0 |
| Tetrachloroethene | 277 | 5 | 0.014 | 1.4 | 14 | 800 | 5 | 1.4 |
| 1,1,1-Trichloroethane | 152 | 5 | 0.0076 | 0.76 | N/A | 7,000 | 5 | 0.8 |
| 1,1,2,2-Tetrachloroethane | 118 | 5 | 0.006 | 0.6 | 35 | N/A | 5 | 0.6 |
| 1,2,3-trichloropropane | 68 | 5 | 0.0034 | 0.34 | N/A | 80 | 5 | 0.4 |
| 1,2,4-Trichlorobenzene | 670 * | 5 | 0.034 | 3.4 | N/A | N/A | 330 | 3.4 |
| Toluene | 300 | 5 | 0.015 | 1.5 | N/A | 20,000 | 5 | 1.5 |
| Trichloroethene | 126 | 5 | 0.007 | 0.70 | 64 | N/A | 5 | 0.7 |
| Vinyl chloride | 57 | 2 | 0.0012 | 0.12 | N/A | N/A | 10 | 0.2 |
| Xylenes | 240 | 5 | 0.012 | 1.2 | N/A | 200,000 | — | 1.2 |

a. Allowable Soil Concentration Cs = f x Cw x Koc

b. Soil cleanup objective = Cs x Correction Factor (CF)

N/A is not available

* Partition coefficient is calculated by using the following equation:
$\log Koc = -0.55 \log S + 3.64$, where S is solubility in water in ppm.
All other Koc values are experimental values.

** Correction Factor (CF) of 100 is used as per TAGM #4046

*** As per TAGM #4046, Total VOCs < 10 ppm.

Note: Soil cleanup objectives are developed for soil organic carbon content (f) of 1% , and should be adjusted for the actual soil organic carbon content if it is known.

**APPENDIX A (cont.)**
**TABLE 2**
**Recommended Soil Cleanup Objectives (mg/kg or ppm)**
**Semi-Volatile Organic Contaminants**

| Contaminant | Partition coefficient Koc | Groundwater Standards/ Criteria Cw ug/l or ppb. | a Allowable Soil conc. ppm. Cs | b ** Soil Cleanup objectives to Protect GW Quality (ppm) | USEPA Health Based (ppm) Carcinogens | USEPA Health Based (ppm) Systemic Toxicants | CRQL (ppb) | Rec.soil Clnup Objct. (ppm) |
|---|---|---|---|---|---|---|---|---|
| Acenaphthene | 4,600 | 20 | 0.9 | 90.0 | N/A | 5,000 | 330 | 50.0*** |
| Acenaphthylene | 2,056* | 20 | 0.41 | 41.0 | N/A | N/A | 330 | 41.0 |
| Aniline | 13.8 | 5 | 0.001 | 0.1 | 123 | N/A | 330 | 0.1 |
| Anthracene | 14,000 | 50 | 7.00 | 700.0 | N/A | 20,000 | 330 | 50.0*** |
| Benzo(a)anthracene | 1,380,000 | 0.002 | 0.03 | 3.0 | 0.224 | N/A | 330 | 0.224 or MDL |
| Benzo(a)pyrene | 5,500,000 | 0.002(ND) | 0.110 | 11.0 | 0.0609 | N/A | 330 | 0.061 or MDL |
| Benzo(b)fluoranthene | 550,000 | 0.002 | 0.011 | 1.1 | N/A | N/A | 330 | 1.1 |
| Benzo(g,h,i)perylene | 1,600,000 | 5 | 8.0 | 800 | N/A | N/A | 330 | 50.0*** |
| Benzo(k)fluoranthene | 550,000 | 0.002 | 0.011 | 1.1 | N/A | N/A | 330 | 1.1 |
| bis(2-ethylhexyl)phthalate | 8,706* | 50 | 4.35 | 435.0 | 50 | 2,000 | 330 | 50.0*** |
| Butylbenzylphthlate | 2,430 | 50 | 1.215 | 122.0 | N/A | 20,000 | 330 | 50.0*** |
| Chrysene | 200,000 | 0.002 | 0.004 | 0.4 | N/A | N/A | 330 | 0.4 |
| 4-Chloroaniline | 43 **** | 5 | 0.0022 | 0.22 | 200 | 300 | 330 | 0.220 or MD |
| 4-Chloro-3-methylphenol | 47 | 5 | 0.0024 | 0.24 | N/A | N/A | 330 | 0.240 or MC |
| 2-Chlorophenol | 15* | 50 | 0.008 | 0.8 | N/A | 400 | 330 | 0.8 |
| Dibenzofuran | 1,230* | 5 | 0.062 | 6.2 | N/A | N/A | 330 | 6.2 |
| Dibenzo(a,h)anthracene | 33,000,000 | 50 | 1,650 | 165,000 | 0.0143 | N/A | 330 | 0.014 or MD |
| 3,3'-Dichlorobenzidine | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| 2,4-Dichlorophenol | 380 | 1 | 0.004 | 0.4 | N/A | 200 | 330 | 0.4 |
| 2,4-Dinitrophenol | 38 | 5 | 0.002 | 0.2 | N/A | 200 | 1,600 | 0.200 or MD |
| 2,6 Dinitrotoluene | 198* | 5 | 0.01 | 1.0 | 1.03 | N/A | 330 | 1.0 |
| Diethylphthlate | 142 | 50 | 0.071 | 7.1 | N/A | 60,000 | 330 | 7.1 |
| Dimethylphthlate | 40 | 50 | 0.020 | 2.0 | N/A | 80,000 | 330 | 2.0 |
| Di-n-butyl phthalate | 162* | 50 | 0.081 | 8.1 | N/A | 8,000 | 330 | 8.1 |
| Di-n-octyl phthlate | 2,346* | 50 | 1.2 | 120.0 | N/A | 2,000 | 330 | 50.0*** |
| Fluoranthene | 38,000 | 50 | 19 | 1900.0 | N/A | 3,000 | 330 | 50.0*** |
| Fluorene | 7,300 | 50 | 3.5 | 350.0 | N/A | 3,000 | 330 | 50.0*** |
| Hexachlorobenzene | 3,900 | 0.35 | 0.014 | 1.4 | 0.41 | 60 | 330 | 0.41 |
| Indeno(1,2,3-cd)pyrene | 1,600,000 | 0.002 | 0.032 | 3.2 | N/A | N/A | 330 | 3.2 |
| Isophorone | 88.31* | 50 | 0.044 | 4.40 | 1,707 | 20,000 | 330 | 4.40 |
| 2-methylnaphthalene | 727* | 50 | 0.364 | 36.4 | N/A | N/A | 330 | 36.4 |
| 2-Methylphenol | 15 | 5 | 0.001 | 0.1 | N/A | N/A | 330 | 0.100 or MC |
| 4-Methylphenol | 17 | 50 | 0.009 | 0.9 | N/A | 4,000 | 330 | 0.9 |
| Naphthalene | 1,300 | 10 | 0.130 | 13.0 | N/A | 300 | 330 | 13.0 |
| Nitrobenzene | 36 | 5 | 0.002 | 0.2 | N/A | 40 | 330 | 0.200 or MC |
| 2-Nitroaniline | 86 | 5 | 0.0043 | 0.43 | N/A | N/A | 1,600 | 0.430 or MK |
| 2-Nitrophenol | 65 | 5 | 0.0033 | 0.33 | N/A | N/A | 330 | 0.330 or MK |
| 4-Nitrophenol | 21 | 5 | 0.001 | 0.1 | N/A | N/A | 1,600 | 0.100 or MK |
| 3-Nitroaniline | 93 | 5 | 0.005 | 0.5 | N/A | N/A | 1,600 | 0.500 or M |
| Pentachlorophenol | 1,022 | 1 | 0.01 | 1.0 | N/A | 2,000 | 1,600 | 1.0 or MDL |
| Phenanthrene | 4,365* | 50 | 2.20 | 220.0 | N/A | N/A | 330 | 50.0*** |
| Phenol | 27 | 1 | 0.0003 | 0.03 | N/A | 50,000 | 330 | 0.03 or MD |
| Pyrene | 13,295* | 50 | 6.65 | 665.0 | N/A | 2,000 | 330 | 50.0*** |
| 2,4,5-Trichlorophenol | 89* | 1 | 0.001 | 0.1 | N/A | 8,000 | 330 | 0.1 |

a. Allowable Soil Concentration Cs = f x Cw x Koc
b. Soil cleanup objective = Cs x Correction Factor (CF)

N/A is not available
MDL is Method Detection Limit

* Partition coefficient is calculated by using the following equation:
log Koc = -0.55 log S + 3.64, where S is solubility in water in ppm. Other Koc values are experimental values.
** Correction Factor (CF) of 100 is used as per TAGM #4046
*** As per TAGM #4046, Total VOCs < 10 ppm., Total Semi-VOCs < 500 ppm. and Individual Semi-VOCs < 50 ppm.
**** Koc is derived from the correlation Koc = 0.63 Kow ( Determining Soil Response Action Levels.....
EPA/540/2-89/057 ). Kow is obtained from the USEPA computer database 'MAIN'.

Note: Soil cleanup objectives are developed for soil organic carbon content (f) of 1%,
and should be adjusted for the actual soil organic carbon content if it is known.

APPENDIX A (cont.)

TABLE 3

Recommended soil cleanup objectives (mg/kg or ppm)

Organic Pesticides / Herbicides and PCBs

| Contaminant | Partition coefficient Koc | Groundwater Standards/ Criteria Cw ug/l or ppb. | a Allowable Soil conc. ppm. Cs | b ** Soil Cleanup objectives to Protect GW Quality (ppm) | USEPA Health Based (ppm) Carcinogens | Systemic Toxicants | CRQL (ppb) | *** Rec.soil Clnup Objct (ppm) |
|---|---|---|---|---|---|---|---|---|
| Aldrin | 96,000 | ND(<0.01) | 0.005 | 0.5 | 0.041 | 2 | 8 | 0.041 |
| alpha - BHC | 3,800 | ND(<0.05) | 0.002 | 0.2 | 0.111 | N/A | 8 | 0.11 |
| beta - BHC | 3,800 | ND(<0.05) | 0.002 | 0.2 | 3.89 | N/A | 8 | 0.2 |
| delta - BHC | 6,600 | ND(<0.05) | 0.003 | 0.3 | N/A | N/A | 8 | 0.3 |
| Chlordane | 21,305* | 0.1 | 0.02 | 2.0 | 0.54 | 50 | 80 | 0.54 |
| 2,4-D | 104* | 4.4 | 0.005 | 0.5 | N/A | 800 | 800 | 0.5 |
| 4,4'-DDD | 770,000* | ND(<0.01) | 0.077 | 7.7 | 2.9 | N/A | 16 | 2.9 |
| 4,4'-DDE | 440,000* | ND(<0.01) | 0.0440 | 4.4 | 2.1 | N/A | 16 | 2.1 |
| 4,4'-DDT | 243,000* | ND(<0.01) | 0.025 | 2.5 | 2.1 | 40 | 16 | 2.1 |
| Dibenzo-P-dioxins(PCDD) 2,3,7,8 TCDD | 1709800 | 0.000035 | 0.0006 | 0.06 | N/A | N/A | N/A | N/A |
| Dieldrin | 10,700* | ND(<0.01) | 0.0010 | 0.1 | 0.044 | 4 | 16 | 0.044 |
| Endosulfan I | 8,168* | 0.1 | 0.009 | 0.9 | N/A | N/A | 16 | 0.9 |
| Endosulfan II | 8,031* | 0.1 | 0.009 | 0.9 | N/A | N/A | 16 | 0.9 |
| Endosulfan Sulfate | 10,038* | 0.1 | 0.01 | 1.0 | N/A | N/A | 16 | 1.0 |
| Endrin | 9,157* | ND(<0.01) | 0.001 | 0.1 | N/A | 20 | 8 | 0.10 |
| Endrin keytone | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| gamma - BHC (Lindane) | 1,080 | ND(<0.05) | 0.0006 | 0.06 | 5.4 | 20 | 8 | 0.06 |
| gamma - chlordane | 140,000 | 0.1 | 0.14 | 14.0 | 0.54 | 5 | 80 | 0.54 |
| Heptachlor | 12,000 | ND(<0.01) | 0.0010 | 0.1 | 0.16 | 40 | 8 | 0.10 |
| Heptachlor epoxide | 220 | ND(<0.01) | 0.0002 | 0.02 | 0.077 | 0.8 | 8 | 0.02 |
| Methoxychlor | 25,637 | 35.0 | 9.0 | 900 | N/A | 400 | 80 | *** |
| Mitotane | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Parathion | 760 | 1.5 | 0.012 | 1.2 | N/A | 500 | 8 | 1.2 |
| PCBs | 17,510* | 0.1 | 0.1 | 10.0 | 1.0 | N/A | 160 | 1.0(Surfac 10(sub-sur |
| Polychlorinated dibenzo-furans(PCDF) | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |
| Silvex | 2,600 | 0.26 | 0.007 | 0.7 | N/A | 600 | 330 | 0.7 |
| 2,4,5-T | 53 | 35 | 0.019 | 1.9 | N/A | 200 | 330 | 1.9 |

a. Allowable Soil Concentration Cs = f x Cw x Koc

b. Soil cleanup objective = Cs x Correction Factor (CF)

N/A is not available

* Partition coefficient is calculated by using the following equation:
log Koc = -0.55 log S + 3.64, where S is solubility in water in ppm.
All other Koc values are experimental values.

** Correction Factor (CF) of 100 is used as per TAGM #4046

*** As per TAGM #4046, Total Pesticides < 10 ppm.

Note: Soil cleanup objectives are developed for soil organic carbon content (f) of 1% (5% for PCBs as per PCB guidance document), and should be adjusted for the actual soil organic Carbon content if it is known.

APPENDIX A

Rev. 12/93

TABLE 4

Recommended Soil Cleanup Objectives (mg/kg or ppm) for Heavy Metals

| Contaminants | Protect Water Quality ppm | Eastern USA Background ppm | * CRDL mg/kg or ppm | ***** Rec.soil Clnup Objct. (ppm) |
|---|---|---|---|---|
| Aluminum | N/A | 33,000 | 2.0 | SB |
| Antimony | N/A | N/A | 0.6 | SB |
| Arsenic | N/A | 3-12 ** | 0.1 | 7.5 or SB |
| Barium | N/A | 15-600 | 2.0 | 300 or SB |
| Beryllium | N/A | 0-1.75 | 0.05 | 0.16(HEAST) or SB |
| Cadmium | N/A | 0.1-1 | 0.05 | 1 or SB |
| Calcium | N/A | 130 - 35,000 ** | 50.0 | SB |
| Chromium | N/A | 1.5-40 ** | 0.1 | 10 or SB |
| Cobalt | N/A | 2.5-60 ** | 0.5 | 30 or SB |
| Copper | N/A | 1-50 | 0.25 | 25 or SB |
| Cyanide | N/A | N/A | 0.1 | *** |
| Iron | N/A | 2,000 - 550,000 | 1.0 | 2,000 or SB |
| Lead | N/A | **** | 0.03 | SB**** |
| Magnesium | N/A | 100 - 5,000 | 50.0 | SB |
| Manganese | N/A | 50 - 5,000 | 0.15 | SB |
| Mercury | N/A | 0.001-0.2 | 0.002 | 0.1 |
| Nickel | N/A | 0.5-25 | 0.4 | 13 or SB |
| Potassium | N/A | 8,500 - 43,000 ** | 50.0 | SB |
| Selenium | N/A | 0.1-3.9 | 0.05 | 2 or SB |
| Silver | N/A | N/A | 0.1 | SB |
| Sodium | N/A | 6,000 - 8,000 | 50.0 | SB |
| Thallium | N/A | N/A | 0.1 | SB |
| Vanadium | N/A | 1-300 | 0.5 | 150 or SB |
| Zinc | N/A | 9-50 | 0.2 | 20 or SB |

Note: Some forms of metal salts such as Aluminum Phosphide, Calcium Cyanide, Potassium Cyanide, Copper cyanide, Silver cyanide, Sodium cyanide, Zinc phosphide, Thallium salts, Vanadium pentoxide, and Chromium (VI) compounds are more toxic in nature. Please refer to the USEPA HEASTs database to find cleanup objectives if such metal salts are present in soil.

SB is site background

N/A is not available

* CRDL is contract required detection limit which is approx. 10 times the CRDL for water.

** New York State backgrond

*** Some forms of Cyanide are complex and very stable while other forms are pH dependent and hence are very unstable. Site-specific form(s) of Cyanide should be taken into consideration when establishing soil cleanup objective.

**** Background levels for lead vary widely. Average levels in undeveloped, rural areas may range from 4-61 ppm. Average background levels in metropolitan or suburban areas or near highways are much higher and typically range from 200-500 ppm.

*****Recommended soil cleanup objectives are average background concentrations as reported in a 1984 survey of reference material by E. Carol McGovern, NYSDEC.