PARSONS ENGINEERING SCIENCE, INC.

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October 31, 2001

Commander
U.S. Army Corps of Engineers
Engineering and Support Center, Huntsville
Attn: Major David Sheets/ CEHNC-PM-EO
4820 University Square
Huntsville, AL 35816-1822

02115

154

SUBJECT: **Seneca Army Depot Activity - Final Action Memorandum and Engineering Evaluation/Cost Analysis (EE/CA) for the Miscellaneous Components Burial Site (SEAD-63).**

Dear Major Sheets:

Parsons Engineering Science (Parsons) is pleased to submit responses to USEPA's comments on the Action Memorandum and Engineering Evaluation/Cost Analysis (EE/CA) for SEAD-63 at the Seneca Army Depot Activity located in Romulus, New York dated July, 2001. Replacement pages to the document have been provided.

This work was performed in accordance with the Scope of Work (SOW) for Delivery Order 11 to the Parsons Contract DACA87-95-0031.

Parsons appreciates the opportunity to provide you with this memorandum. Should you have any questions, please do not hesitate to call me at (781) 401-2535 to discuss them.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Jacqueline Travers

Jacqueline Travers, P.E.
Task Order Manager

cc:
Maj. D. Sheets, USACE – Huntsville
K. Hoddinott, USACHPPM
J. Mullikin, USACHPPM
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PARSONS ENGINEERING SCIENCE, INC.

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October 31, 2001

Mr. Julio Vazquez
USEPA Region II
Superfund Federal Facilities Section
290 Broadway, 18th Floor
New York, NY 10007-1866

Ms. Alicia Thorne
New York State Department of Environmental Conservation (NYSDEC)
Bureau of Eastern Remedial Action
Division of Hazardous Waste Remediation
625 Broadway 11th Floor
Albany, NY 12233-7015

SUBJECT: **Seneca Army Depot Activity – Final Action Memorandum and Engineering Evaluation/Cost Analysis (EE/CA) for the Miscellaneous Components Burial Site (SEAD-63).**

Dear Mr. Vazquez/Ms. Thorne:

Parsons Engineering Science (Parsons) is pleased to submit responses to USEPA's comments on the Action Memorandum and Engineering Evaluation/Cost Analysis (EE/CA) for SEAD-63 at the Seneca Army Depot Activity located in Romulus, New York dated July 2001. Please find enclosed replacement pages to update the Action Memorandum and Appendices. Instructions are provided.

Should you have any questions, please do not hesitate to call me at (781) 401-2535 to discuss them.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Jacqueline Travers

Jacqueline Travers, P.E.
Task Order Manager

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SENECA ARMY DEPOT ACTIVITY
FINAL ACTION MEMORANDUM – OCTOBER 2001
Instructions to Complete Edit/Update to revised final document

Please find enclosed the following items to update the July 2001 revised final document to the October 2001 final document.

A. Update cover and spine for the Final Action Memorandum.
B. Final Action Memorandum:
   Reissued pages 3-1 and 5-3. Replace previous pages.
C. Appendix A – Engineering Evaluation/Cost Analysis (EE/CA):
   Reissued Table 2-15 and pages 2-64 and 7-3. Replace previous table and pages.
D. Reissued Appendix F and Attachment A to Appendix F. Replace previous Appendix F and Attachment A. Attachment A should be separated from Appendix F with the green divider sheet enclosed. Please note that Attachment B to Appendix F has not been reissued and should remain in the document.
E. Appendix I – Please add the responses to comments to the end of Appendix I.

If you have any questions please contact Jacqueline Travers at (781) 401-2535.

3.0 THREATS TO PUBLIC HEALTH, WELFARE OR THE ENVIRONMENT; STATUTORY AND REGULATORY AUTHORITIES

The removal action program discussed in this action memorandum is proposed to address the potential threats discussed below.

3.1 THREATS TO PUBLIC HEALTH OR WELFARE

A streamlined risk assessment (or mini-risk assessment) was conducted to determine the extent of human risk posed by the contaminants present at SEAD-63 (see **Section 2** of **Appendix A**). Likely receptors included a park worker, construction worker, and recreational visitor (child). A residential receptor was also considered for comparative purposes only. Future residential use of the land is highly unlikely. Except for groundwater and surface water exposure under the residential scenario, risks for the recreational child, park worker, and construction worker are acceptable (HI less than 1 and carcinogenic risk less than $1x10^{-4}$). The recreational child resulted in a hazard index of 0.4 and the lifetime cancer risk for an adult is 8×10^{-5}. The park worker resulted in a hazard index of 0.2 and a cancer risk of 5×10^{-5}. The primary constituents driving the cancer risks for recreational child and parker worker are dibenz(a,h)anthracene and benzo(a)pyrene in surface water. These two constituents were only detected in one out of 22 samples. Therefore, risk driven by these two constituents is most likely significantly lower than indicated by the mini-risk assessment; the likelihood of a residential receptor spending all of his/her exposure time at the one location where the detection was made is highly unlikely. Under the construction worker scenario, the hazard index is 0.3 and the cancer risk is 9×10^{-8}. The primary driver for noncarcinogenic risk is exposure to cadmium in soils. Mercury, which was also detected above background levels, did not contribute significantly to risk.

The residential scenario, which was considered for comparative purposes only, exhibited the greatest noncarcinogenic risk for a residential child (HI=2). This was primarily due to the presence of manganese in groundwater. As there is no source of manganese at SEAD-63 (soil concentrations of manganese did not exceed background levels), its presence in the groundwater is suspect and may be due to turbidity in the three groundwater samples collected from the site. The collection of additional groundwater data is recommended for this site. Carcinogenic risk is 1×10^{-4}, which is mainly caused by exposure to dibenz(a,h)anthracene and benzo(a)pyrene in surface water.

5.1.4 Engineering Evaluation/Cost Analysis

In order to determine the appropriate remedial technology for the SEAD-63, an EE/CA was conducted. The EE/CA is included as **Appendix A** of this report. The EE/CA contains a brief summary of the site history and the results of previous investigations.

5.1.5 Description of Alternative Technologies

The main focus of the EE/CA is an evaluation of the different remedial technologies. Because the impetus for the removal action at this site is the presence of debris, and due to the uncertain nature of these buried drums and military components, only one alternative, excavation and disposal, rather than any sort of in situ treatment of these items is logical. For this reason, no alternative technologies were evaluated as part of this evaluation.

5.1.6 Institutional Controls

There are no institutional controls required for this action. The requirement for institutional controls will be addressed as part of the overall remedial action.

5.1.7 Off-Site Disposal Policy

It is anticipated that no materials classified as hazardous waste will be generated during this removal action. All non-hazardous, non-radiological waste (construction debris, etc.) will be disposed in an approved non-hazardous waste landfill (if necessary). Envirocare in Clive, UT is proposed as the destination for any radiological containing debris or soils exhibiting radionuclides greater than clean up goals. Envirocare accepts low level radiological wastes and soils.

5.1.8 Post-Removal Site Control Activities

The depot is fenced and patrolled by armed guards to limit access.

5.1.9 QA/QC Plan

The removal contractor will be required to develop a QA/QC plan which will be submitted to the appropriate agencies for approval. This plan will address both detailed and broad QA/QC issues.

TABLE 2-15
CALCULATION OF TOTAL NONCARCINOGENIC AND CARCINOGENIC RISKS
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	EXPOSURE/RISK CALCULATIONS Table Number	HAZARD INDEX	CANCER RISK
PARK WORKER	Inhalation of Dust in Ambient Air	Table A-1	7E-07	1E-09
	Ingestion of Soil	Table A-4	1E-03	5E-08
	Dermal Contact to Soil	Table A-6	4E-04	8E-08
	Ingestion of Groundwater	Table A-9	1E-01	NQ
	Dermal Contact to Surface Water	Table A-13	4E-03	5E-05
	Dermal Contact to Sediment	Table A-14	1E-03	1E-06
	TOTAL RECEPTOR RISK (Nc & Car)		**2E-01**	**5E-05**
RECREATIONAL VISITOR (CHILD)	Inhalation of Dust Ambient Air	Table A-1	1E-06	5E-10
	Ingestion of Soil	Table A-4	4E-03	4E-08
	Dermal Contact to Soil	Table A-6	4E-04	2E-08
	Ingestion of Groundwater	Table A-8	3E-01	NQ
	Dermal Contact to Groundwater	Table A-11	5E-02	NQ
	Dermal Contact to Surface Water	Table A-13	4E-02	8E-05
	Dermal Contact to Sediment	Table A-15	1E-02	3E-06
	TOTAL RECEPTOR RISK (Nc & Car)		**4E-01**	**8E-05**
CONSTRUCTION WORKER	Inhalation of Dust in Ambient Air	Table A-1	9E-05	3E-08
	Ingestion of Soil	Table A-4	2E-01	4E-08
	Dermal Contact to Soil	Table A-6	2E-02	1E-08
	TOTAL RECEPTOR RISK (Nc & Car)		**3E-01**	**9E-08**
ADULT RESIDENT (Hazard Index)	Inhalation of Dust Ambient Air	Table A-2	3E-06	See risk below
	Ingestion of Soil	Table A-5	2E-03	
	Dermal Contact to Soil	Table A-7	3E-04	
	Ingestion of Groundwater	Table A-9	6E-01	
	Dermal Contact to Groundwater	Table A-12	1E-01	
	Dermal Contact to Surface Water	Table A-14	5E-03	
	Dermal Contact to Sediment	Table A-16	1E-03	
	TOTAL RECEPTOR RISK (Nc & Car)		**7E-01**	
CHILD RESIDENT (Hazard Index)	Inhalation of Dust Ambient Air	Table A-2	7E-06	See risk below
	Ingestion of Soil	Table A-5	2E-02	
	Dermal Contact to Soil	Table A-7	2E-03	
	Ingestion of Groundwater	Table A-9	1E+00	
	Dermal Contact to Groundwater	Table A-12	2E-01	
	Dermal Contact to Surface Water	Table A-14	4E-02	
	Dermal Contact to Sediment	Table A-16	1E-02	
	TOTAL RECEPTOR RISK (Nc & Car)		**2E+00**	
RESIDENT (Total Lifetime Cancer Risk)	Inhalation of Dust Ambient Air	Table A-2	See risk above	8E-09
	Ingestion of Soil	Table A-5		3E-07
	Dermal Contact to Soil	Table A-7		1E-08
	Ingestion of Groundwater	Table A-9		NQ
	Dermal Contact to Groundwater	Table A-12		NQ
	Dermal Contact to Surface Water	Table A-14		1E-04
	Dermal Contact to Sediment	Table A-16		4E-06
	TOTAL RECEPTOR RISK (Nc & Car)			**1E-04**

NQ = Not Quantified due to lack of toxicity data
Non-cancer risk is reported for adults and child residents separately. Cancer risk is considered over a lifetime, therefore the adult and child values are summed

p:\pit\projects\seneca\s63eeca\eeca\tables\fintbl2\TOTRISK_mem.XLS uses of the SEDA facility. The LRA has established that the Q Area, which includes SEAD-63, will be used as a Wildlife Conservation Area. At the time when the SEDA facility is relinquished by the Army, the Army will ensure that SEAD-63 can be used for the intended purpose.

The complete potential exposure pathways from sources to receptors, based upon current and future use scenarios, are shown in **Figure 2-12**. The potential for human exposures, with the exception of fugitive dust and radon gas, is directly affected by the accessibility to the site. Human and vehicular access to the site is restricted by a chain-link fence with a locking gate, which is part of SEDA's general security provisions.

Three scenarios shown in **Figure 2-12** were considered in conducting the mini-risk assessment for SEAD-63, the recreational child, park worker, and the construction worker. Only chemical constituents of concern were considered in the mini-risk assessment, since radionuclides were not present in soils above background levels and those present above background levels in sediments did not exhibit a dose equivalent of 10 mrem/yr above background. Risk assessment was conducted for residential receptors for comparative purposes only. Future residential use of the site is highly unlikely. In addition to the human health risk assessment, a mini-risk assessment was conducted for ecological risk. Four receptors were considered: the deer mouse, American robin, mourning dove, and short-tailed shrew. **Appendix F** provides the detailed assumptions and methodology used in conducting the mini-risk assessment.

Table 2-15 shows the human health risk associated with the exposure to soil, sediment, surface water (where applicable), and groundwater (where applicable). Risk calculated for the recreational child, park worker, and construction worker is acceptable (HI less than 1 and carcinogenic risk less than $1x10^{-4}$). The recreational child resulted in a hazard index of 0.4 and a cancer risk of 8×10^{-5}. The park worker resulted in a hazard index of 0.2 and a cancer risk of 5×10^{-5}. The primary constituents driving the cancer risk are dibenz(a,h)anthracene and benzo(a)pyrene in surface water. These two constituents were only detected in one out of 22 samples. In addition, the ditch is usually dry except during storm period. The vegetation observed in the ditches, i.e., cattail, verifies this conclusion since cattails prefer saturated soil conditions to flooded conditions. Therefore, the risks driven by these two constituents are most likely lower than indicated by the mini-risk assessment. Under the construction worker scenario, the hazard index is 0.3 and the cancer risk is 9×10^{-8}. The primary driver for non-carcinogenic risk is exposure to cadmium in soils. Mercury, which was also detected above background levels, did not contribute to risk.

EPA, 1989b. Bioremediation of Contaminated Surface Soils. EPA/600/9-89/073. Washington, D.C.: U.S. Environmental Protection Agency.

EPA, 1989c. Terra Vac In Situ Vacuum Extraction System, Applications Analysis Report. EPA/540/A5-89/003. Washington, D.C.: U.S. Environmental Protection Agency.

EPA, 1990. Handbook on In Situ Treatment of Hazardous Waste-Contaminated Soils. EPA/540/2-90/002. Washington, D.C.: U.S. Environmental Protection Agency.

EPA, 1999. Risk Assessment Guidance For Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Dermal Risk Assessment, Interim Guidance. Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C. 20460.

United States Army Toxic and Hazardous Materials Agency (USATHAMA), 1989. Seneca Army Depot Landfill/Burning Pit Site Investigation.

APPENDIX F
STREAMLINED RISK EVALUATION

The threat from a site can be quantified through the use of risk assessment techniques. Risk assessments have been performed at several of the higher priority sites and have been a useful tool in evaluating site conditions. Since future land use scenarios have been described as part of the Base Realignment Plan these scenarios have been incorporated into the risk assessment. Risk assessments are appropriate for developing and supporting planning decisions regarding the disposition of the remaining sites that exist at the Seneca Army Depot Activity.

This section of the EE/CA presents the streamlined risk evaluation, or mini-risk assessment, that has been performed for SEAD-63. The risk assessment provides an understanding of the potential threats that this site may pose. The outcome of this evaluation is used to support decisions regarding site disposition. If the site is above the EPA target risk level, it will be considered further. If the site is below these criteria, it may be eliminated from further consideration. Procedures for conducting a mini-risk assessment were presented to EPA and NYSDEC in the Decision Criteria Document dated March 1998.

The methods used to conduct mini-risk assessments for sites at SEDA are the same as those used in prior baseline risk assessments at several of the other sites with the exception that the maximum concentration of a component will be used instead of the Upper 95th Confidence Limit (UCL) of the mean. The reason for using the maximum concentration is that at many of the sites, the existing database is small. Using the maximum detected value will provide an added degree of conservatism. Biased sampling has been performed, and the data represent "worst case" conditions.

The objectives of the mini-risk assessment are:

- to quantify the threat that a site may pose;
- to help determine whether a remedial investigation is necessary;
- to provide a basis for determining if a removal action will eliminate the threat; and
- to help support selection of the "No Action" remedial alternative, where appropriate.

To meet these objectives, the *Risk Assessment Guidance for Superfund* (RAGS) (USEPA, 1989a) was followed when possible and applicable. Technical judgment, consultation with USEPA staff, and recent publications were used in the development of the baseline risk assessment.

SEAD-63, the Miscellaneous Components Burial Site, is shown in **Figure 2-2** of **Section 2** of the EE/CA. The future land use for this site is to be part of a conservation and recreation area.

F.1 Methodology and Organization

The methodology employed for this risk assessment follows USEPA guidance. This section contains seven major subsections, as follows:

1. Identification of Chemicals of Concern (**Section F.2**)

This section provides site-related data along with background chemical data. Detailed summaries and statistical analyses of these data are provided in this section. All chemicals with validated detections in the applicable environmental media were evaluated in the risk assessment. The relevant exposure pathway risks were calculated for each detected chemical. Also included in the Data Evaluation section is an evaluation of site background data. Relevant background data are presented and, where appropriate, statistical analyses were performed to allow for comparing on-site chemical concentrations with background concentrations. Based on these analyses, chemicals whose presence at the site is attributable to background were not further evaluated in the mini-risk assessment.

2. Exposure Assessment (**Section F.3**)

This section includes derivation and presentation of the applicable exposure point concentrations (EPCs) used in the human health risk assessment. Exposure point concentrations for the baseline risk assessment are based on analytical data and modeling results. The EPCs provided are used for future onsite land-use scenarios, and correspond to the applicable exposure pathways for the baseline risk assessment.

For the future on-site land-use scenario, construction workers, park workers, and recreational visitors (child) are the most conservative and relevant exposed populations. In all scenarios, the calculated risk values apply to a hypothetical reasonable maximum exposure (RME) individual working on or visiting the site, and the risk values are dictated by the collected environmental sampling data used in the risk assessment as exposure point concentrations for the applicable media. A residential receptor was also considered for comparative purposes only. Future residential use of the land is highly unlikely.

The three primary exposure routes considered in the baseline risk assessment are ingestion, inhalation, and dermal contact. Chemical intake values for future land use are calculated based on exposure pathways, specific exposure values, and assumptions. Equations used to calculate intakes for all applicable exposure pathways are presented in this section.

3. Toxicity Assessment (**Section F.4**)

This section presents oral, inhalation, and dermal toxicity values used in the human health risk calculations. Appropriate data sources (i.e., IRIS, HEAST and EPA Risk Assessment Issue papers) are provided to support the toxicity values.

4. Risk Characterization (**Section F.5**)

This section presents the risk calculations for all human health exposure pathways for the expected future land use. Non-carcinogenic and carcinogenic risk estimates are summarized for each receptor and exposure pathway.

F.2 Identification of Chemicals of Concern

Data collected were evaluated for suitability of use in the risk assessment as discussed in RAGS (EPA, 1989a). These decisions were based on analytical methods, quantitation limits, qualifiers, and blank contamination.

The data usability criteria for documentation, analytical methods, data validation, precision, accuracy, representativeness, comparability, and completeness are discussed below in Section F.2.1.

A portion of the data used in the mini-risk assessment were collected during ESI field investigation conducted in June through July 1994 and documented in the report cited in the last paragraph. Additional data for surface water and sediment were collected in the fall, 1997 and are presented in **Section 2** of this report.

Twelve subsurface soil, 22 sediment and 22 surface water samples were collected at SEAD-63. Groundwater samples were collected from the three monitoring wells, which were installed at SEAD-63 during the RI.

The following sections describe the processes by which the data were analyzed, examined, and reduced to arrive at a list of analytes, for each exposure pathway, that were quantified for use in the human health mini-risk assessment.

F2.1 Data Usability

The data usability criteria for documentation, analytical methods, data validation, precision, accuracy, representativeness, comparability, and completeness are discussed in this section.

The RI data were collected during two investigations, the SEAD-63 ESI and the SEAD-63 RI. The ESI began in the late spring/early summer (i.e., June/July) of 1994 and the RI was conducted in December of 1997.

The data used for the risk assessment were grouped into six databases, one for each of the exposure route/exposure scenarios that were developed from the exposure point pathway models. Individual databases contained data specific to one of the following sample combinations: surface soils (defined as soil samples collected from 0 to 2 inches below grade) only, surface and subsurface soils (i.e. all soils data), groundwater, surface water, and sediments for the human health risk assessment and a combined surface soils/sediment sample to a depth of two feet for the ecological risk assessment

The following sections describe the processes by which the data were analyzed, examined, and reduced to arrive at a list of analytes and their representative concentrations, for each exposure pathway addressed in the baseline human health and ecological risk assessments.

F2.1.1 Documentation

Documentation of sample collection and laboratory analysis is essential in order to authenticate conclusions derived from data. Standard operating procedures (SOPs) for field collection of samples are provided in the generic workplan, and were followed during sample collection. Formal chain-of-custody records that included sample identifications (IDs), date sampled, sample collector, analyses and methods required, matrix, preservation per analysis, and comments were maintained.

Laboratory SOPs were used for all analyses required. Deviations from these SOPs were documented in case narratives that were part of each sample delivery group (SDG). Deviations from these SOPs were minor and did not adversely affect data quality.

F2.1.2 Evaluation of Analytical Methods

All data used in the risk assessment were generated using level IV CLP protocols. The CLP was developed to ensure that consistent QA/QC methods are used when evaluating samples from

Superfund site. However, this does not mean that all CLP data are automatically of sufficient quality and reliability for use in the quantitative risk assessment.

The data used in this baseline risk assessment were validated in compliance with EPA Region II validation guidelines. The following criteria were considered and used to validate the data: spike/matrix spike duplicates, field duplicates, internal standard performance, compound identification, compound quantitation, spike sample recovery for metals, laboratory duplicates for metals, interference for metals, and qualifiers. Several steps were taken to ensure that the data were appropriate and reliable for use in the risk assessment. These steps, such as evaluation of quantitation limits, are discussed in the following sections.

F.2.1.3 Evaluation of Qualified and Coded Data

Qualifiers are attached to analytical data by personnel of the laboratory performing the analysis or by data validation personnel. These qualifiers often pertain to QA/QC problems and may indicate questions concerning chemical identity, chemical concentration, or both. The qualifiers used are as follows:

U	The analyte was not detected.
UJ	The analyte was not detected; however, the associated reporting limit is approximate.
J	The analyte was positively identified; however, QC results indicate that the reported concentration may not be accurate and is therefore an estimate.
R, JR, UR	The analyte was rejected due to laboratory QC deficiencies, sample preservation problems, or holding time exceedance. The presence or absence of the analyte cannot be determined.

Before data were used in the quantitative risk assessment all qualifiers were addressed. This was done according to the prescribed data validation procedures. The end result of the data validation was four possible situations:

1) the result was rejected by either laboratory or data validation personnel and considered unusable (R, JR, UR),
2) the compound was analyzed for but was not detected (U),
3) the result was an estimated value (J), or

4) the result was unqualified.

Data that was not detected by the laboratory (U) and was assigned a J by the data validation personnel is considered a non-detect for the risk assessment (UJ).

F2.1.4 Chemicals in Blanks

Blanks are QC samples analyzed in the same manner as environmental samples, and provide a means of identifying possible contamination of environmental samples. Sources of contamination include the laboratory, the sampling environment, and the sampling equipment. To address contamination, three types of blanks were analyzed: method blanks, trip blanks, and equipment rinsates. Method blanks consisted of laboratory reagent water or pre-purified and extracted sand taken through the same analytical process as environmental samples. Trip blanks consisted of distilled water poured into a 40-milliliter glass vial and sealed with a Teflon septum for soil and water samples. The trip blanks accompanied sample bottles to the field during sample collection. Trip blanks were not opened during sample collection. Equipment rinsates consisted of deionized water poured into or pumped through sampling devices and then transferred to sample bottles.

According to the data validation guidelines, if the blank contained detectable levels of a common laboratory contaminant, then the sample results were considered positive (unqualified hit) only if the concentration in the sample exceeded ten times the maximum amount detected in any blank. If the concentration in the sample was less than ten times the maximum amount detected in the blank, it was concluded that the chemical was not detected. Common laboratory contaminants are acetone, 2-butanone, methylene chloride, toluene, and phthalate esters. If the blank contained detectable levels of a chemical that is not a common laboratory contaminant, then the sample results were considered positive (unqualified hit) only if the concentration in the sample exceeded five times the maximum amount detected in any blank. If the concentration in the sample was less than five times the maximum amount detected in the blank, it was concluded that the chemical was not detected. This procedure was performed as part of the data validation.

F2.1.5 Precision

The term precision is used to describe the reproducibility of results. It can be defined as the agreement between the numerical values of two or more measurements resulting from the same process. In the case of chemical analyses, precision is determined through the analyses of duplicate environmental samples. Duplicate sample analyses include matrix spikes, blank spikes, blind field duplicates, and replicate instrumental analyses of individual environmental samples.

Matrix spikes involve the introduction of compounds or elements to samples of known concentrations. The assumption is that these introduced compounds will be recovered from environmental samples to the same degree as in matrix spikes. Blank spikes involve the introduction of compounds or elements to laboratory reagent water or pre-purified and extracted sand. Blank spikes eliminate the possibility of matrix interference's or contributions, thereby monitoring analytical performance from sample preparation to analysis. Blind field duplicates are samples labeled with a fictitious sample ID taken from an existing sampling location. They are collected simultaneously with a properly labeled sample and provide the most legitimate means of assessing precision.

Precision estimates were obtained using the relative percent difference (RPD) between duplicate analyses. Overall precision, as well as precision control limits, was estimated using a weighted combination of RPDs from spikes and duplicate analyses. Precision and RPD were acceptable.

F2.1.6 Accuracy

Accuracy is the degree to which a measurement represents the true value of that parameter. Estimates of accuracy are more difficult to obtain than precision since accuracy requires knowledge of the true quantity being measured. In the case of chemical analyses, accuracy is determined through the introduction of compounds or elements to samples of known concentrations, or analytical spikes. The assumption is that compounds will be recovered from environmental samples to the same degree as in analytical spikes.

Two types of compounds were added to environmental samples to assess accuracy: surrogate compounds and matrix spike compounds. Surrogates are compounds that closely approximate target analytes in structure, but are not target analytes. Surrogate compounds generally are added to samples in the preparation stages and monitor the effectiveness of the preparation process. Matrix spike compounds are target analytes that are added based upon expectations of matrix interference's, that impede analyte detection. Laboratory method blank samples were spiked with surrogate compounds, per analysis day, as an additional means of estimating accuracy. The accuracy of chemical analyses was estimated using the percent recovery (PR) of compounds or elements that were added to analytical spikes. Accuracy and PR were acceptable.

F2.1.7 Representativeness

Representativeness expresses the extent to which sample data characterize the population or environmental media. Factors influencing representativeness include sample collection, selection of sampling locations representative of site conditions, and use of appropriate chemical methods for sample analyses. Appropriate chemical analysis methods were followed as described in **Section F2.1.2**. Sampling from locations representative of site conditions was achieved through implementation of the approved field sampling plan. Blind field duplicates were collected and analyzed in order to assess the influence of sample collection on representativeness. Approximately 5 percent of field samples were collected in duplicate. Representativeness was estimated using the RPD between blind field duplicates and was acceptable.

F2.1.8 Comparability

Comparability refers to the consistency of one laboratory's results with others. Comparability factors include the use of standard analytical methodologies, data reported in standard or consistent units, appropriate frequency of applicable QC analyses, and laboratory participation in appropriate performance evaluation studies. All data were reported in appropriate and acceptable units. The laboratory performing the CLP inorganic and organic analyses participated in the quarterly USEPA blind performance evaluation program and the MRD performance evaluation program. Their performance in this program was acceptable.

F2.1.9 Completeness

Completeness measures the amount of usable data relative to the amount of samples collected and analyzed. The completeness goal in the project workplan was 90 percent. Completeness was acceptable.

F.2.2 <u>Site-Specific Data Evaluation Considerations</u>

The maximum concentration of a component in the database was used as the exposure point concentration in the mini-risk assessment.

NYSDEC CLP Statement of Work methods were used for the analysis of organic and inorganic constituents in soil and groundwater. These methods provide data suitable for the mini-risk assessment.

For inorganics, the site data set was compared against the SEDA background dataset to determine if the site data set is statistically different from the background dataset. This background comparison was performed for two media: soil and groundwater.

For each inorganic constituent, the average concentration for the site was compared to 2 times the average background concentration. If the site average concentration for a constituent was less than 2 times the background average concentration, the constituent was considered to be present due to background conditions, and it was eliminated from further consideration in the risk assessment. USEPA Region 2 recommended this comparison method.

Removing analytes from further consideration is consistent with RAGS (EPA 1989a). Inorganic constituents that were not detected were not considered; these were eliminated from further consideration as is consistent with RAGS (EPA, 1989a).

Only inorganic constituents were compared to background. Anthropogenic organic constituents have not been considered. Organic compounds were eliminated from further consideration only if they were not detected at a particular site. This has produced a more conservative risk assessment since all organic constituents have been assumed to be present due to previous site activities. Background data sets are provided in **Appendix D**.

Two inorganic analytes were found to occur in the SEAD-63 soil dataset at average concentrations that were greater than twice the average for those observed in the background soil measurements. They are cadmium and mercury. These inorganic constituents in soil were retained for further analysis in the mini-risk assessment performed for SEAD-63.

For the groundwater samples, two inorganic analytes, sodium and manganese, were found to occur in the groundwater dataset at an average concentration that was twice the background average. These inorganic constituents in groundwater were retained for further analysis in the mini-risk assessment performed for SEAD-63.

Although samples of sediment have been collected from the drainage ditches that surround and transect portions of SEAD-63, these samples have been treated as shallow soil samples within the ecological mini risk assessments. Generally, the drainage ditches in the area of SEAD-63 are dry except when they carry storm-water runoff; thus, these areas are unlikely to support any form of aquatic or amphibian life. To assess the potential effect of chemicals identified in "sediment" at SEAD-63 therefore, this dataset has been used to augment the shallow soil dataset that is used for the evaluation of potential impacts on the mammalian and avian receptors. The combined shallow soil/sediment dataset is presented in **Table F-1**.

Tables F-2 and **F-3** summarize the results of average comparisons for the soil dataset and the groundwater dataset, respectively. **Table F-4** summarizes the result of the average comparison for the combined shallow soil/sediment data set that has been used for the ecological risk assessment only.

F.2.3 Data Quantification for Use in the Risk Assessment

After eliminating inorganic analytes present at background levels from the risk assessment, exposure point concentrations (EPCs) were selected as the maximum detected value for each constituent of concern. When the maximum value occurred in a sample that had a duplicate sample, the maximum value was used in the risk assessment, i.e., the samples were not averaged.

Table F-5 lists the chemicals of potential concern for the mini-risk assessment for SEAD-63 in all soils and groundwater, less the inorganic analytes found at background levels. The number of analyses performed, the number of times detected, the frequency of detection, and the maximum detected concentration for each chemical of potential concern are provided in the data tables presented in **Section 2** of **Appendix A** and in **Table F-1** for the combined shallow soil/sediment dataset used for the ecological risk assessment.

F.3 Exposure Assessment

F.3.1 Overview and Characterization of Exposure Setting

The objective of the exposure assessment was to estimate the type and magnitude of exposures to the Chemicals of Potential Concern (COPC) that are present at, or migrating from, the site. This component of the risk assessment can be performed either qualitatively or quantitatively. Quantitative assessment is preferred when toxicity factors necessary to characterize a compound of concern are available.

The exposure assessment consists of three steps (EPA, 1989a):

1) **Characterize Exposure Setting:** In this step, information on the physical characteristics of the site that may influence exposure is considered. The physical setting involves

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RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Matrix								SOIL		SOIL		SOIL		SOIL		SOIL		SEDIMENT	
Area								SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
Sample Depth (ft)								2		2		1.5		1.5		1.5		0.05	
Sample Date								06/26/94		06/26/94		06/27/94		06/27/94		06/28/94		13-Jun-94	
Location								TP63-2		TP63-5		TP63-7		TP63-8		TP63-10		SD63-1	
Sample Number								225561		225564		225566		225596		225803			
SDG								45062		45062		45062		45062		45062			
Volatile Organic Compounds																			
Acetone	ug/Kg	150	29.6%	200	0	8	27	12	U	12	U	12	U	12	U	12	U	15	U
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	12	U	12	U	12	U	12	U	12	U	15	U
Benzene	ug/Kg	2	20.0%	60	0	1	5	12	U	12	U	12	U	2	J	12	U		
Toluene	ug/Kg	14	7.4%	1500	0	2	27	12	U	12	U	12	U	6	J	12	U	15	U
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5	12	U	12	U	12	U	14		12	U		
SemiVolatile Organic Compounds																			
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22											480	U
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	390	U	410	U	380	U	390	U	410	U	69	J
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	390	U	410	U	380	U	24	J	410	U	73	J
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	390	U	410	U	380	U	21	J	410	U	130	J
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	390	U	410	U	380	U	21	J	410	U	89	J
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	290	J	1800	J	80	J	71	J	67	J	25	J
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22											480	U
Carbazole	ug/Kg	430	45.5%		0	10	22											480	U
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	390	U	410	U	380	U	23	J	410	U	110	J
Di-n-butylphthalate	ug/Kg	120	25.9%	8100	0	7	27	390	U	410	U	380	U	390	U	410	U	480	U
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22											480	U
Dibenz(a,h)anthracene	ug/Kg	1200	40.7%	14	9	11	27	390	U	410	U	380	U	390	U	410	U	480	U
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22											480	U
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22											480	U
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	390	U	410	U	380	U	38	J	410	U	110	J
Fluorene	ug/Kg	110	13.6%	50000	0	3	22											480	U
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	390	U	410	U	380	U	390	U	410	U	46	J
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22											480	U
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	390	U	410	U	380	U	390	U	410	U	49	J
Phenol	ug/Kg	93	4.5%	30	1	1	22											480	U
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22											100	J
Organochlorine Pesticides																			
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	3.9	UJ	4.1	UJ	3.8	UJ	3.9	UJ	4.1	U	4.9	UJ
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	3.9	UJ	4.1	UJ	3.8	UJ	3.9	UJ	4.1	U	4.9	UJ
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	3.9	UJ	4.1	UJ	3.8	UJ	3.9	UJ	4.1	U	4.9	UJ
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22											2.5	UJ
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22											4.9	UJ
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22											4.9	UJ

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Matrix								SOIL		SOIL		SOIL		SOIL		SOIL		SEDIMENT	
Area								SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
Sample Depth (ft)								2		2		1.5		1.5		1.5		0.05	
Sample Date								06/26/94		06/26/94		06/27/94		06/27/94		06/28/94		13-Jun-94	
Location								TP63-2		TP63-5		TP63-7		TP63-8		TP63-10		SD63-1	
Sample Number								225561		225564		225566		225596		225803			
SDG								45062		45062		45062		45062		45062			
Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Metals/Cyanide																			
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	14800	J	15300	J	11700	J	16500	J	18000	J	7590	
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5	0.26	UJ	0.27	UJ	0.23	J	0.3	UJ	0.31	UJ		
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	5.4		4.9		4.2		5.2		5.3		4.1	
Barium	mg/Kg	107	100.0%	300	0	27	27	65.3	J	75.4	J	45.8	J	59.5	J	72.4	J	36.3	J
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.74	J	0.69	J	0.54	J	0.64	J	0.71	J	0.44	J
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.26	J	0.52	J	0.56	J	0.24	J	0.39	J	0.6	J
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	3830	J	40500	J	39800	J	5440	J	14200	J	101000	
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	22.9	J	23.2	J	19.1	J	21.5	J	24.6	J	13.8	J
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	11.6		12.4		10.7		9.7	J	12.7		10.6	J
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	27.1	J	35.1	J	35.3	J	20.2	J	27.3	J	25.2	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22											0.6	U
Iron	mg/Kg	30100	100.0%	38110	0	27	27	30100	J	28100	J	25000	J	25000	J	28500	J	17100	
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	18.5		22.3		15.6		15.5		17.1		33.5	R
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	4530	J	8310	J	8160	J	4400	J	5520	J	15000	
Manganese	mg/Kg	995	100.0%	1095	0	27	27	278	J	403	J	359	J	350	J	452	J	449	
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.05	J	0.06	J	0.04	J	0.06	J	0.05	J	0.04	J
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	31.5	J	42	J	39.1	J	23.9	J	33.5	J	29.8	
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	1180	J	2150	J	1310	J	1530	J	2000	J	1370	J
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	1.5		1.5		0.74		1.3		1.1	J	0.62	U
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	50.6	J	138	J	124	J	50.6	J	46.7	U	121	J
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	0.38	U	0.3	J	0.29	J	0.44	U	0.45	U	0.44	U
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	25.2	J	22.4	J	16.8	J	27.6	J	28.4	J	19.9	
Zinc	mg/Kg	534	100.0%	115	7	27	27	74.8	J	88.9	J	95.7	J	68.6	J	63.4	J	105	
Others																			
Total Solids	%W/W	85.8	100.0%		0	5	5	83.7		81.2		85.8		85.2		79.6			

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Matrix								SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
Area								SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
Sample Depth (ft)								0.05		0.05		0.05		0.8		0.8		0.6	
Sample Date								12-Jun-94		13-Jun-94		13-Jun-94		4-Dec-97		4-Dec-97		5-Dec-97	
Location								SD63-2		SD63-3		SD63-4		63101		12215		63102	
Sample Number																			
SDG																			
Parameter	**Unit**	**Maximum Concentration Measured**	**Frequency of Detection**	**TAGM Level**	**Number of Samples above TAGM**	**Number of Samples where Detected**	**Number of Samples Collected**	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Acetone	ug/Kg	150	29.6%	200	0	8	27	23	UJ	12	UJ	150	J	16		18	U	14	U
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	8	J	12	UJ	35	J	16	U	18	U	14	U
Benzene	ug/Kg	2	20.0%	60	0	1	5												
Toluene	ug/Kg	14	7.4%	1500	0	2	27	18	UJ	12	UJ	14	J	16	U	18	U	14	U
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5												
SemiVolatile Organic Compounds																			
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	140	J	70	J	350	J	13	U	14	J	51	J
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	170	J	79	J	540	J	21	U	23	J	58	J
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	380	J	110	J	860	J	37	U	39	JY	120	Y
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	180	J	66	J	470	J	120	U	120	U	88	U
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	700	UJ	390	U	720	UJ	25	U	21	JB	110	B
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22	700	UJ	390	U	720	UJ	22	J	19	J	88	U
Carbazole	ug/Kg	430	45.5%		0	10	22	700	UJ	390	U	34	J	120	U	120	U	9.4	J
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	200	J	110	J	540	J	13	U	14	J	73	J
Di-n-butylphthalate	ug/Kg	120	25.9%	8100	0	7	27	700	UJ	390	U	720	UJ	14	J	19	JB	18	JB
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22	700	UJ	19	J	720	UJ	120	U	120	U	88	U
Dibenz(a,h)anthracene	ug/Kg	1200	40.7%	14	9	11	27	700	UJ	390	U	140	J	120	U	8.7	U	19	J
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22	700	UJ	390	U	720	UJ	120	U	7.4	JB	4.7	JB
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	240	J	100	J	720	J	32	U	32	J	100	
Fluorene	ug/Kg	110	13.6%	50000	0	3	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	83	J	42	J	320	J	12	U	14	J	37	J
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	120	J	50	J	270	J	14	J	16	J	51	J
Phenol	ug/Kg	93	4.5%	30	1	1	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22	220	J	110	J	600	J	23	U	23	J	80	J
Organochlorine Pesticides																			
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	7	UJ	3.9	UJ	3.9	J	6.2	U	6.1	U	4.4	U
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	6	J	3.9	UJ	9.2	J	6.2	U	6.1	U	4.4	U
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	7	UJ	3.9	UJ	4.3	J	6.2	U	6.1	U	4.4	U
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22	7.5	J	4.6	J	3.7	UJ	3.2	U	3.1	U	2.3	U
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22	7	UJ	3.9	UJ	5.2	J	6.2	U	6.1	U	4.4	U
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22	7	UJ	3.9	UJ	9.4	J	6.2	U	6.1	U	4.4	U

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
							Matrix	SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.05		0.05		0.05		0.8		0.8		0.6	
							Sample Date	12-Jun-94		13-Jun-94		13-Jun-94		4-Dec-97		4-Dec-97		5-Dec-97	
							Location	SD63-2		SD63-3		SD63-4		63101		12215		63102	
							Sample Number												
							SDG												
Volatile Organic Compounds																			
Metals/Cyanide																			
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	11700	J	11100		11000	J	9770	*	16700	*	2030	*
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5												
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	3.7	J	4.3		2.4	J	2.9		5.2		2.3	B
Barium	mg/Kg	107	100.0%	300	0	27	27	63.5	J	37.2		90.6	J	68.1		107		19.9	B
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.59	J	0.52	J	0.54	J	0.51	B	0.8	B	0.11	B
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.83	J	0.38	J	0.68	J	0.08	U	0.08	U	0.08	U
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	89800	J	31500		34100	J	2090		3080	*	139000	*
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	19.1	J	20.3	J	18.2	J	15	*	23.4	*	4.1	*
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	11.9	J	11.2		10.5	J	7.9		10.7	B	3.2	B
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	35.6	J	32.7		30.7	J	15.9		24		8.7	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22	0.97	UJ	0.53	U	0.99	UJ	1.1	UJ	1.1	UN	2.1	N
Iron	mg/Kg	30100	100.0%	38110	0	27	27	19200	J	26500		18700	J	16300		24400	*	4790	*
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	37.4	R	27.5	R	37.2	R	17.6	*	[redacted]	N*	8.6	N*
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	13900	J	6210		8590	J	2610	*	4090	*	9380	*
Manganese	mg/Kg	995	100.0%	1095	0	27	27	653	J	260		801	J	431	J	536	*	225	*
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.06	J	0.03	J	0.12	J	0.08	U	0.07	BN	0.05	UN
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	35	J	44.2		32.8	J	18.4		29.5	*	8.8	B*
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	2570	J	1340	J	1670	J	1120		1830	B	597	B
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	0.68	UJ	1.1		0.97	J	1.2	U	1.3	U	1.2	U
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	194	J	197	J	119	J	234	U	302	B	323	B
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	0.48	UJ	0.34	U	0.62	UJ	[redacted]	B	1.8	UN	1.6	UN
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	27.5	J	19.1		21.2	J	17.1		27.7		10.9	B
Zinc	mg/Kg	534	100.0%	115	7	27	27	133	J	68		325	J	52.3	*	81	E	37.2	E
Others																			
Total Solids	%W/W	85.8	100.0%		0	5	5												

T[illegible]E F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

							Matrix	SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.3		0.6		0.7		0.5		0.45		0.3	
							Sample Date	11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97	
							Location	63103		63104		63105		63106		63107		63108	
							Sample Number												
							SDG												
Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Acetone	ug/Kg	150	29.6%	200	0	8	27	10	J	20	U	7	U	8	U	27	U	35	
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	18	U	20	U	18	U	21	U	27	U	17	U
Benzene	ug/Kg	2	20.0%	60	0	1	5												
Toluene	ug/Kg	14	7.4%	1500	0	2	27	18	U	20	U	18	U	21	U	27	U	17	U
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5												
SemiVolatile Organic Compounds																			
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22	150	U	150	U	130	U	100	U	220	U	12	J
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	15	J	12	J	9.5	J	8.1	J	130	J	660	
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	22	J	15	J	12	J	10	J	[redacted]	J	790	
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	23	J	33	JY	14	J	15	J	240		1400	E
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	17	J	150	U	14	J	9.9	J	150	J	570	
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	13	J	9.6	J	19	J	8.3	J	22	J	16	J
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22	150	U	150	U	130	U	100	U	16	J	120	U
Carbazole	ug/Kg	430	45.5%		0	10	22	150	U	150	U	130	U	100	U	32	J	260	
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	22	J	15	J	14	J	12	J	180	J	840	
Di-n-butylphthalate	ug/Kg.	120	25.9%	8100	0	7	27	9.5	J	150	U	130	U	6.5	J	11	J	120	U
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22	150	U	150	U	130	U	100	U	220	U	120	U
Dibenz(a,h)anthracene	ug/Kg	1200	40.7%	14	9	11	27	150	U	150	U	130	U	100	U	46	J	250	
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22	150	U	150	U	130	U	100	U	220	U	36	J
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22	150	U	150	U	7.5	J	100	U	220	U	120	U
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	31	J	28	J	23	J	18	J	360		1900	E
Fluorene	ug/Kg	110	13.6%	50000	0	3	22	150	U	150	U	130	U	100	U	220	U	79	J
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	14	J	11	J	9.2	J	8.2	J	140	J	800	
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22	150	U	150	U	130	U	100	U	220	U	21	J
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	12	J	12	J	11	J	6	J	120	J	940	
Phenol	ug/Kg	93	4.5%	30	1	1	22	150	U	150	U	130	U	100	U	220	U	120	U
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22	24	J	19	J	18	J	14	J	240		1200	E
Organochlorine Pesticides																			
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22	3.8	U	3.8	U	3.3	U	2.6	U	5.7	U	3	U
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
							Matrix	SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.3		0.6		0.7		0.5		0.45		0.3	
							Sample Date	11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97	
							Location	63103		63104		63105		63106		63107		63108	
							Sample Number												
							SDG												
Volatile Organic Compounds																			
Metals/Cyanide																			
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	11600	*	11900	*	13000	*	12800	*	12300	*	10900	*
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5												
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	4.7		4.1	B	4.6		5.2		6.8		4.1	
Barium	mg/Kg	107	100.0%	300	0	27	27	85.1	B	76.2	B	90.5		64		105	B	59.8	B
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.64	B	0.63	B	0.65	B	0.59	B	0.47	B	0.48	B
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.13	U	0.13	U	0.08	U	0.08	U	0.19	U	0.1	U
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	7050	*	2650	*	3370	*	14400	*	55600	*	34800	*
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	18.4	*	18.5	*	18.8	*	21.8	*	22.4	*	17.5	*
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	10.7	B	7.6	B	8.5	B	12.7	B	14.4	B	9.3	B
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	24.7		20.4		21.9		32		[redacted]		28.8	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22	1.1	UN	1.2	UN	0.96	UN	0.76	UN	1.7	UN	0.92	UN
Iron	mg/Kg	30100	100.0%	38110	0	27	27	21800	*	18700	*	20100	*	26000	*	24700	*	17800	*
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	25.5	N*	23.2	N*	24.6	N*	20.8	N*	[redacted]	N*	31.2	N*
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	5010	*	3260	*	3330	*	5400	*	14800	*	6280	*
Manganese	mg/Kg.	995	100.0%	1095	0	27	27	284	*	222	*	344	*	346	*	760	*	344	*
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.11	UN	0.11	UN	0.13	BN	0.06	UN	0.16	UN	0.07	UN
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	29.4	*	22.7	*	25	*	42	*	39.6	*	30.1	*
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	1530	B	1580	B	1580		1460		2350	B	2290	
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	2	U	2	U	1.3	U	1.3	U	3	U	1.5	U
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	285	B	298	B	235	B	[redacted]	B	578	B	383	B
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	2.7	UN	2.7	UN	1.7	UN	1.7	UN	4	UN	2	UN
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	20.4	B	20.7	B	21.3		19.6		26.9	B	21.2	
Zinc	mg/Kg	534	100.0%	115	7	27	27	79.2	E	65.8	E	69.4	E	73.4	E	295	E	90.6	E
Others																			
Total Solids	%W/W	85.8	100.0%		0	5	5												

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
							Matrix	SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.5		0.4		0.4		0.4		0.4		0.3	
							Sample Date	11-Dec-97		11-Dec-97		12-Dec-97		12-Dec-97		12-Dec-97		12-Dec-97	
							Location	63109		63110		63111		12217		63112		63113	
							Sample Number												
							SDG												
Volatile Organic Compounds																			
Acetone	ug/Kg	150	29.6%	200	0	8	27	9	J	17		21	U	24	UJ	68	J	16	U
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	18	U	16	U	18	U	17	U	14	U	16	U
Benzene	ug/Kg	2	20.0%	60	0	1	5												
Toluene	ug/Kg	14	7.4%	1500	0	2	27	18	U	16	U	18	U	17	UJ	14	U	16	U
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5												
SemiVolatile Organic Compounds																			
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22	14	J	100	U	120	U	120	U	160	U	120	U
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	2000	E	180		110	J	120	J	25	J	75	J
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	2700	E	200		130	J	140		56	J	74	J
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	3500	E	240		160	YJ	170		72	J	130	
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	1900	E	200		120	U	120		160	U	63	J
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	20	J	12	J	120	JB	120	U	160	U	120	U
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22	150	U	100	U	120	J	15	U	160	U	120	U
Carbazole	ug/Kg	430	45.5%		0	10	22	430		28	J	19	U	24	J	160	U	17	J
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	2200	E	220		150	J	150		49	J	100	J
Di-n-butylphthalate	ug/Kg.	120	25.9%	8100	0	7	27	150	U	100	U	120	JB	120	U	160	U	120	U
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22	150	U	100	U	120	U	120	U	160	U	120	U
Dibenz(a,h)antnracene	ug/Kg	1200	40.7%	14	9	11	27	1200		84	J	28	J	34	J	160	U	12	J
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22	35	J	100	U	120	U	120	U	160	U	120	U
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22	150	U	100	U	8.2	JB	6.2	J	92	J	6.4	J
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	4300	E	400		250	J	250		43	J	180	
Fluorene	ug/Kg	110	13.6%	50000	0	3	22	110	J	10	J	120	U	120	U	160	U	120	U
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	2500	E	170		97	J	93	J	27	J	65	J
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22	23	J	100	U	120	U	120	U	160	U	120	U
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	1500	E	120		80	J	88	J	37	J	56	J
Phenol	ug/Kg	93	4.5%	30	1	1	22	150	U	100	U	120	U	11	U	160	U	120	U
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22	3200	E	290		180	J	200		45	J	120	J
Organochlorine Pesticides																			
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	7.7	U	5.2	U	6	U	5.9	U	2.1	U	6.2	U
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	7.7	U	5.2	U	6	U	5.9	U	3.1	J	6.2	U
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	12	U	5.2	U	6	U	5.9	U	8.3		6.2	U
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22	4	U	2.6	U	3.1	U	3	U	2.1	U	3.2	U
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22	12	U	6.1	U	6	U	5.9	U	4.1	U	6.2	U
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22	12	U	3.9	U	6	U	5.9	U	4.1	U	6.2	U

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Matrix								SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
Area								SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
Sample Depth (ft)								0.5		0.4		0.4		0.4		0.4		0.3	
Sample Date								11-Dec-97		11-Dec-97		12-Dec-97		12-Dec-97		12-Dec-97		12-Dec-97	
Location								63109		63110		63111		12217		63112		63113	
Sample Number																			
SDG																			
Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Metals/Cyanide																			
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	11000	*	6320	*	7030	*	9230	*	2600	*	12900	*
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5												
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	5.7		3.8		3.1		3.2		2.5		5	
Barium	mg/Kg	107	100.0%	300	0	27	27	81.3	B	34.7	B	48.8		63.9	B	26.8	B	70.9	
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.28	B	0.29	B	0.25	B	0.3	B	0.08	B	0.49	B
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.13	U	0.09	U	0.08	U	0.1	U	0.06	U	0.09	U
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	43300	*	90000	*	47400	*	69000		211000		27300	
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	18.8	*	12	*	12.4	*	17.3	*	7.9	*	23.1	*
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	12	B	7.5	B	8.2	B	11.2	B	2.7	B	12.8	B
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	31.2		20.2		22.1		30.5		7.4		33.4	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22	1.2	UN	0.78	UN	0.99	UN	0.89	UJ	0.63	UJ	1	UJ
Iron	mg/Kg	30100	100.0%	38110	0	27	27	20900	*	12600	*	12700	*	19800		6360		24600	
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	46.2	N*	19.6	N*	24.9	N*	[illegible]	*	3.4	*	34.7	*
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	9980	*	9640	*	7590	*	12300	*	16100	*	9460	*
Manganese	mg/Kg	995	100.0%	1095	0	27	27	995	*	315	*	475	*	746	J	315	J	559	J
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.1	UN	0.06	UN	0.09	UN	0.07	U	0.05	U	0.09	U
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	33.7	*	21.1	*	20.8	*	29		4.5	B	32.1	
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	2000	B	1360	B	1160		1180	B	509	B	1980	
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	2.1	U	1.4	U	1.3	U	1.7	B	0.94	U	2.1	
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	543	B	312	B	343	B	[illegible]	B	122	U	266	B
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	2.8	UN	1.8	UN	1.7	UN	2.1	U	1.3	U	2.3	B
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	28		15.5		15.8		20.9		11.7		24.3	
Zinc	mg/Kg	534	100.0%	115	7	27	27	534	E	120	E	87.4	E	118	*	24.7	*	432	*
Others																			
Total Solids	%W/W	85.8	100.0%		0	5	5												

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

							Matrix	SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.3		0.3		0.3	
							Sample Date	12-Dec-97		12-Dec-97		13-Dec-97	
							Location	63114		63115		63116	
							Sample Number						
							SDG						
Parameter	**Unit**	**Maximum Concentration Measured**	**Frequency of Detection**	**TAGM Level**	**Number of Samples above TAGM**	**Number of Samples where Detected**	**Number of Samples Collected**	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds													
Acetone	ug/Kg	150	29.6%	200	0	8	27	15	U	15	U	25	J
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	15	U	15	U	14	U
Benzene	ug/Kg	2	20.0%	60	0	1	5						
Toluene	ug/Kg	14	7.4%	1500	0	2	27	15	U	15	U	14	UJ
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5						
SemiVolatile Organic Compounds													
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22	94	U	120	U	93	U
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	9.2	J	33	J	93	
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	12	J	30	J	93	
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	18	J	51	J	93	
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	8.7	J	33	J	93	
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	94	U	120	U	93	U
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22	94	U	6.7	J	5.7	J
Carbazole	ug/Kg	430	45.5%		0	10	22	94	U	15	J	93	J
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	13	J	43	J	93	
Di-n-butylphthalate	ug/Kg.	120	25.9%	8100	0	7	27	94	U	120	U	93	U
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22	94	U	120	U	93	U
Dibenz(a,h)anthracene	ug/Kg	1200	40.7%	14	9	11	27	94	U	8.8	J	93	J
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22	94	U	120	U	93	U
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22	94	U	9.5	J	7.6	J
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	25	J	82	J	93	
Fluorene	ug/Kg	110	13.6%	50000	0	3	22	94	U	120	U	93	U
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	9.5	J	28	J	93	J
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22	94	U	120	U	93	U
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	11	J	35	J	6.4	J
Phenol	ug/Kg	93	4.5%	30	1	1	22	94	U	120	U	93	J
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22	17	J	58	J	93	
Organochlorine Pesticides													
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	4.7	U	5.9	U	4.6	U
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	4.7	U	5.9	U	4.6	U
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	4.7	U	5.9	U	4.6	U
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22	2.4	U	3	U	2.4	U
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22	4.7	U	5.9	U	4.6	U
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22	4.7	U	5.9	U	4.6	U

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

							Matrix	SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.3		0.3		0.3	
							Sample Date	12-Dec-97		12-Dec-97		13-Dec-97	
							Location	63114		63115		63116	
							Sample Number						
							SDG						
Parameter	**Unit**	**Maximum Concentration Measured**	**Frequency of Detection**	**TAGM Level**	**Number of Samples above TAGM**	**Number of Samples where Detected**	**Number of Samples Collected**	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds													
Metals/Cyanide													
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	9090	*	12700	*	15200	*
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5						
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	3.3		3		5.6	B
Barium	mg/Kg	107	100.0%	300	0	27	27	62.7		57.7		94.4	B
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.43	B	0.48	B	0.6	B
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.08	U	0.09	U	0.06	U
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	103000		3750		19600	
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	15.2	*	19.2	*	24.4	*
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	6.9	B	7	B	13.3	B
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	18.7		18.2		30.8	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22	0.72	UJ	1	UJ	0.8	UJ
Iron	mg/Kg	30100	100.0%	38110	0	27	27	17200		20000		29700	
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	17.2	*	18	*	15.7	*
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	5850	*	3820	*	7140	*
Manganese	mg/Kg	995	100.0%	1095	0	27	27	255	J	217	J	520	J
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.07	U	0.07	U	0.06	U
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	20.3		18.9		38.6	
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	1280	B	1380	B	1840	B
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	1.2	U	1.4	B	1	B
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	170	B	172	U	130	U
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	1.6	U	1.8	U	1.7	U
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	17.3		20.9		24	
Zinc	mg/Kg	534	100.0%	115	7	27	27	66.6	*	60.4	*	72.1	*
Others													
Total Solids	%W/W	85.8	100.0%		0	5	5						

TABLE F-2
INORGANICS ANALYSIS OF SOIL - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

	Average of Background Soils (mg/kg)	2 x Average of Background Soils (mg/kg)	Average of SEAD-63 Soils (mg/kg)	Is Average of Site data > than 2 x Average of Background data?
Aluminum	13340.53	26681.05	14641.67	No
Antimony	3.56	7.12	0.26	No
Arsenic	5.08	10.15	4.68	No
Barium	78.43	156.86	73.09	No
Beryllium	0.67	1.33	0.66	No
Cadmium	0.97	1.94	2.96	Yes
Calcium	45449.65	90899.30	19976.67	No
Chromium	20.32	40.64	25.31	No
Cobalt	11.39	22.79	12.43	No
Copper	20.99	41.97	33.15	No
Iron	24704.74	49409.47	28291.67	No
Lead	16.47	32.95	22.24	No
Magnesium	10290.18	20580.35	6735.83	No
Manganese	576.14	1152.28	441.00	No
Mercury	0.04	0.09	0.09	Yes
Nickel	30.39	60.79	38.08	No
Potassium	1487.25	2974.49	1640.83	No
Selenium	0.63	1.26	1.17	No
Sodium	99.42	198.85	94.67	No
Thallium	0.43	0.86	0.38	No
Vanadium	21.41	42.82	22.71	No
Zinc	67.80	135.60	83.28	No

Notes:
A "Yes" value indicates that site metal levels are higher than background levels and metal will be retained for risk assessment.
A "No" value indicates that levels are considered to be similar to background levels and metal will not be retained for risk assessment.

TABLE F-3
INORGANICS ANALYSIS OF GROUNDWATER - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

	Average of Background Groundwater (ug/L)	2 x Average of Background Groundwater (ug/L)	Average of SEAD-63 Groundwater (ug/L)	Is Average of Site data > than 2 x Average of Background data?
Aluminum	2923.01	5846.01	622.00	No
Barium	81.20	162.40	75.60	No
Calcium	115619.35	231238.71	172133.33	No
Chromium	8.67	17.35	1.04	No
Cobalt	6.84	13.68	4.93	No
Copper	5.39	10.79	2.03	No
Iron	4476.26	8952.53	961.00	No
Lead	6.59	13.18	1.10	No
Magnesium	28567.74	57135.48	30333.33	No
Manganese	231.41	462.82	675.33	Yes
Nickel	10.57	21.14	8.20	No
Potassium	4065.59	8131.17	3856.67	No
Sodium	15020.67	30041.33	52523.33	Yes
Vanadium	8.23	16.47	1.27	No
Zinc	25.37	50.74	8.30	No

Notes:
A "Yes" value indicates that site metal levels are higher than background levels and metal will be retained for risk assessment.
A "No" value indicates that levels are considered to be similar to background levels and metal will not be retained for risk assessment.

TABLE F-4
INORGANICS ANALYSIS OF SOIL/SEDIMENT - SEAD-63
Ecological Mini-risk Assessment Dataset
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

	Average of Background Soils (mg/kg)	2 x Average of Background Soils (mg/kg)	Average of SEAD-63 Soils (mg/kg)	Is Average of Site data > than 2 x Average of Background data?
Aluminum	13340.53	26681.05	11887.06	No
Antimony	3.56	7.12	0.26	No
Arsenic	5.08	10.15	4.29	No
Barium	78.43	156.86	68.28	No
Beryllium	0.67	1.33	0.53	No
Cadmium	0.97	1.94	2.37	Yes
Calcium	45449.65	90899.30	40367.94	No
Chromium	20.32	40.64	20.16	No
Cobalt	11.39	22.79	10.59	No
Copper	20.99	41.97	28.04	No
Iron	24704.74	49409.47	22336.76	No
Lead	16.47	32.95	23.44	No
Magnesium	10290.18	20580.35	7663.82	No
Manganese	576.14	1152.28	451.29	No
Mercury	0.04	0.09	0.08	No
Nickel	30.39	60.79	31.27	No
Potassium	1487.25	2974.49	1578.41	No
Selenium	0.63	1.26	1.24	No
Sodium	99.42	198.85	215.67	Yes
Thallium	0.43	0.86	0.83	No
Vanadium	21.41	42.82	21.31	No
Zinc	67.80	135.60	117.34	No

Notes:
A "Yes" value indicates that site metal levels are higher than background levels and metal will be retained for risk assessment.
A "No" value indicates that levels are considered to be similar to background levels and metal will not be retained for risk assessment.

TABLE F-5
EXPOSURE POINT CONCENTRATIONS FOR CHEMICALS OF POTENTIAL CONCERN - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

COMPOUNDS	Total Soil (1) mg/Kg	Surface Soil (1) mg/Kg	Groundwater (1) mg/L	Surface Water (1) mg/L	Sediment (1) mg/Kg	Surface Soil and Sediment (2) mg/Kg
Volatile Organics						
Acetone	0.16				0.15 J	0.15 J
2-Butanone	0.046					
Benzene	0.004 J	0.002 J				0.002 J
Chloroform				0.0008 J		
Methyl ethyl ketone					0.035 J	0.035 J
Toluene	0.023	0.006 J		0.001	0.014 J	0.014 J
Xylene (total)	0.014	0.014				0.014
Semivolatile Organics						
2-Methylnaphthalene					0.014 J	0.014 J
4-Methylphenol				0.00022 J		
Benzo(a)anthracene	0.03 J				2 E	2 E
Benzo(a)pyrene	0.045 J	0.024 J		0.001 J	2.7 E	2.7 E
Benzo(b)fluoranthene	0.038 J	0.021 J		0.0009 J	3.5 E	3.5 E
Benzo(g,h,i)perylene	0.031 J			0.0008 J		
Benzo(k)fluoranthene	0.043 J	0.021 J		0.001 J	1.9 E	1.9 E
bis(2-Ethylhexyl)phthalate	1.8 J	1.8 J		0.068	0.11 B	1.8 J
Butylbenzylphthalate				0.00023 JB	0.12 J	0.12 J
Carbazole					0.43	0.43
Chrysene	0.031 J	0.023 J			2.2 E	2.2 E
Dibenz(a,h)anthracene	0.028 J			0.0008 J	1.2	1.2
Di-n-butylphthalate	0.087 J			0.00015 JB	0.120 JB	0.120 JB
Di-n-octylphthalate					0.019 J	0.019 J
Dibenzofuran					0.036 J	0.036 J
Diethyl phthalate				0.00029 J	0.092 J	0.092 J
Fluoranthene	0.063 J	0.038 J		0.0007 J	4.3 E	4.3 E
Fluorene					0.11 J	0.11 J
Indeno(1,2,3-cd)pyrene	0.037 J			0.0009 J	2.5 E	2.5 E
Naphthalene					0.023 J	0.023 J
Pentachlorophenol				0.001 J		
Phenanthrene	0.031 J			0.000057 J	1.5 E	1.5 E
Phenol			0.002 J	0.0008 J	93	93
Pyrene				0.0005 J	3.2 E	3.2 E
Pesticides/PCBs						
4,4'-DDD	0.002 J				0.0039 J	0.0039 J
4,4'-DDE	0.0044 J				0.0092 J	0.0092 J
4,4'-DDT	0.0033 J				0.0083	0.0083
Endosulfan I					0.0075 J	0.0075 J
Endosulfan sulfate				0.000014 P	0.0052 J	0.0052 J
Endrin ketone				0.000046	0.0094 J	0.0094 J
Metals						
Aluminum				3.63		
Antimony						
Arsenic				0.0038 J		
Barium				0.0914 J		
Beryllium				0.00019 B		
Cadmium	24	0.56 J		0.00078 J	0.83 J	0.83 J
Calcium				220		
Chromium				0.0056 J		
Cobalt				0.0072 J		
Copper				0.0079 J		
Cyanide						
Iron				9.05		
Lead				0.02		
Magnesium				33.7		
Manganese			1.07	2.3		
Mercury	0.49	0.06 J		0.0001 J		
Nickel				0.0188 J		
Potassium				11.6		
Selenium						
Silver				0.00089 J		
Sodium			146	59.3	578 B	578 B
Thallium				0.0019 J		
Vanadium				0.0089 J		
Zinc				0.099		

climate, vegetation, soil characteristics, and surface and groundwater hydrology. All potentially exposed populations and sub-populations therein (receptors) are assessed relative to their potential for exposure. Additionally, locations relative to the site along with the current and potential future land use of the site are considered. This step is a qualitative one aimed at providing a general site perspective and offering insight on the surrounding population.

2) **Identify Exposure Pathways:** All exposure pathways, ways in which receptors can be exposed to contaminants that originate from the source, are reviewed in this step. Chemical sources and mechanisms for release along with subsequent fate and transport are investigated. Exposure points of human contact and exposure routes are discussed before quantifying the exposure pathways in step 3.

3) **Quantify Exposure:** In this final step, the exposure levels (COPC intakes or doses) are calculated for each exposure pathway and receptor. These calculations typically follow EPA guidance for assumptions of intake variables or exposure factors for each exposure pathway and EPA-recommended calculation methods.

Figure F-1 illustrates the exposure assessment process.

F.3.2 Physical Setting and Characteristics

The physical setting and characteristics of the site are described in **Sections 2.1, 2.5, and 2.6** of **Section 2 of Appendix A.**

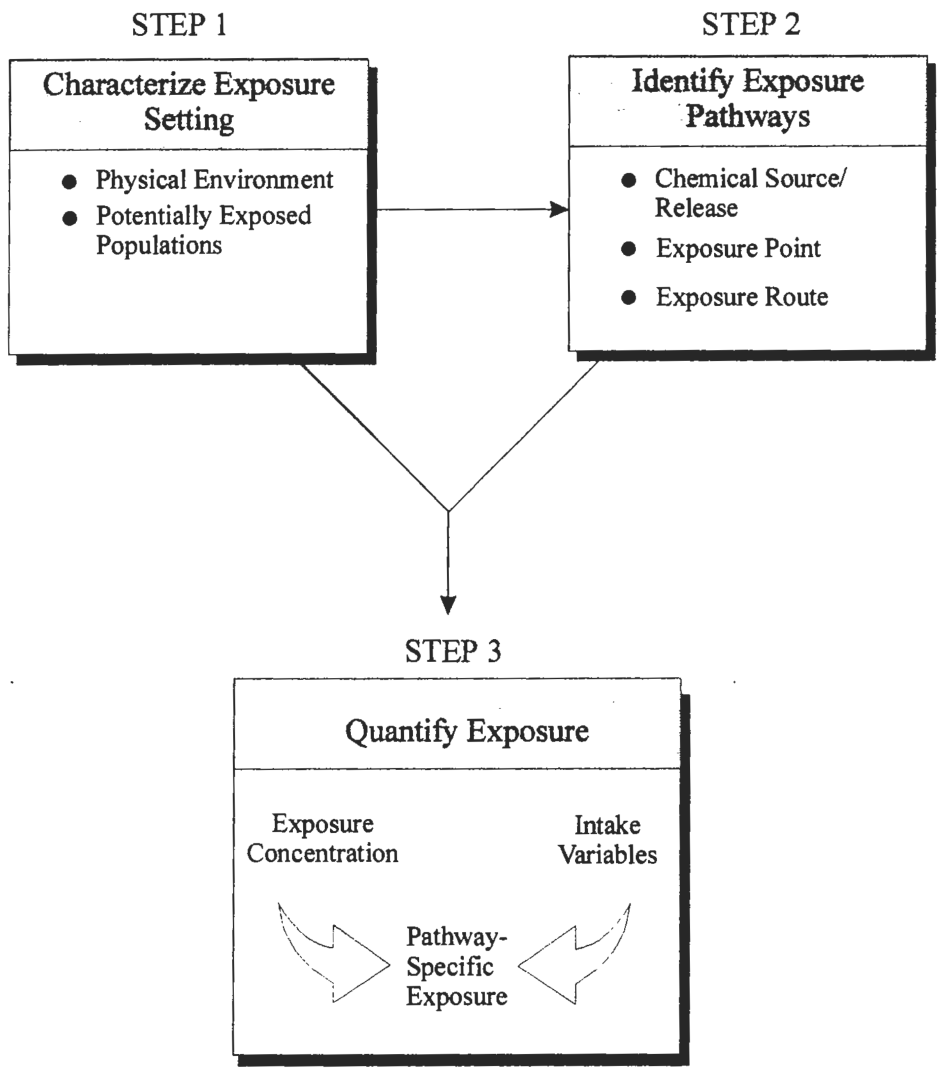
F.3.3 Land Use and Potentially Exposed Populations

F.3.3.1 Current Land Use

There is no current land use for SEAD-63. The site is abandoned and is no longer in use. This site is in the northwestern portion of SEDA. There are no drinking water supply wells at SEAD-63 and perimeter chain link fencing permits access to the site. The site has no actual site workers but is occasionally patrolled by site security personnel.

F.3.3.2 Potential Future Land Use

EPA guidance for determining future land uses recommends that, if available, master plans, which include future land uses, Bureau of Census projections and established land use trends in the general area should be utilized to establish future land use trends.



Source: USEPA, 1989a

PARSONS

PARSONS ENGINEERING SCIENCE, INC.

CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY

DEPT ENVIRONMENTAL ENGINEERING | DWG NO

FIGURE F-1

EXPOSURE ASSESSMENT PROCESS

SCALE Not Applicable | DATE April 2001

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In July 1995, the Base Realignment and Closure Act (BRAC) Commission voted to recommend closure of SEDA. Congress approved the recommendation, which became public law on October 1, 1995. According to BRAC regulations, the Army will determine future uses of the site.

In accordance with BRAC regulations, the Army will notify all appropriate regulatory agencies and will perform any additional investigations and remedial actions to assure that any changes in the intended use of the sites is protective of human health and the environment in accordance with CERCLA. Also, Army regulations (Regulation 200-1, paragraph 12-5, Real Property Transactions), require that the Army perform an Environmental Baseline Study (EBS) prior to a transfer of Army property. The EBS is an inventory and a comprehensive evaluation of the existing environmental conditions and consists of scope definition, survey, sampling, investigative and risk assessment

SEDA has been placed on the 1995 Base Realignment and Closure List (BRAC List). The President and the Congress have approved the list and it has become public law. As BRAC applies to SEDA, the Army will determine future land use of the sites. At the time this Action Memorandum was prepared, the Local Redevelopment Authority (LRA) had been given sole discretion in determining the future uses of the SEDA facility. This Land Reuse Plan is the basis for future land use assumptions for SEAD-63 included in this risk assessment. The LRA has established that the Q Area, which includes SEAD-63, will be used as a Wildlife Conservation Area. At the time when the SEDA facility is relinquished by the Army, the Army will ensure that SEAD-63 can be used for the intended purpose.

F.3.3.3 Potentially Exposed Populations

Three potentially exposed populations that are relevant to the future land use are evaluated in this risk assessment. Since current exposure is infrequent and limited, only future receptors under the future land use scenarios are considered in this mini-risk assessment.

The three (3) exposed populations are:

1. Park worker,
2. construction worker, and
3. recreational visitor (child).

Residential receptors (including adult and child) were considered for comparative purposes only. Future residential use of the land is highly unlikely.

F.3.4 Identification of Exposure Pathways

Exposures are estimated only for plausible completed exposure pathways. A completed exposure pathway has the following four elements:

- a source and mechanism for chemical release,
- an environmental transport medium,
- an exposure point, and
- a human receptor and a feasible route of exposure at the exposure point.

A pathway cannot be completed unless each of these elements is present. **Figure 2-12** in **Section 2** of **Appendix A** illustrates the completed exposure pathways for SEAD-63. Although not shown in Figure 2-12, risks for a residential receptor via the plausible exposure pathways (i.e., same exposure pathways as for a recreational visitor) were evaluated. Future residential use of the land is highly unlikely.

F.3.4.1 Sources and Receiving Media

The suspected source at SEAD-63 is buried miscellaneous components and soil associated with the components at SEAD-63. The primary release mechanisms from the site are surface water runoff and infiltration of precipitation. Groundwater, surface water, and sediment are secondary sources.

F.3.4.2 Summary of Exposure Pathways to be Quantified

The pathways presented reflect the projected future onsite use of SEAD-63. This section presents the rationale for including these exposure pathways in this risk assessment.

Inhalation of Particulate Matter in Ambient Air

Surface soil particles may become airborne via wind erosion, which in turn may be inhaled by individuals at the site. Construction workers may also be exposed to subsurface soil particles. Therefore, inhalation exposure to soil particulates in ambient air was assessed for all future receptors.

Incidental Ingestion and Dermal Contact to On-Site Surface Soils

During the course of daily activities, a park worker or recreational visitor could come into contact with site surface soils and involuntarily ingest and/or have their skin exposed to them. Therefore, exposure via dermal contact and soil ingestion was assessed for these two receptors.

Incidental Ingestion and Dermal Contact to On-Site Surface and Subsurface Soils

The laboratory analyses of all surface and subsurface soils show the presence of VOCs, semi-volatile organics, pesticides, and metals. During the course of daily activities, an on-site construction worker will come into contact with these surface and subsurface soils during intrusive activities and may involuntarily ingest and have his/her skin exposed to them. Therefore, exposure via both dermal contact and soil ingestion was assessed for the future construction worker.

Ingestion of Groundwater

There is no current use of groundwater as a potable water source at the Depot. Potable water is supplied to the Depot from a water supply line that passes through the Town of Varick. Varick's water is obtained from the water treatment plant at the Town of Waterloo. The source of this water is Lake Seneca. It is unlikely that a groundwater well would be installed for future drinking water use. The shallow groundwater aquifer at the site is inadequate for both yield and quality. Nonetheless, since this use is not prevented via an institutional control such as a deed restriction, it was assumed that wells would be installed on-site for potable water. Therefore, this is considered a complete pathway for receptors at the site.

Inhalation and Dermal Contact with Groundwater while Showering

Recreational visitors may come into contact with groundwater while taking daily showers. These receptors may be exposed to all chemicals contained in groundwater during showering by dermal contact, and volatile chemicals which partition into the air via inhalation. Therefore, this is considered a complete pathway and data from the on-site wells are used to calculated exposure concentrations.

Dermal Contact with Surface Water and Sediment while Wading

The drainage ditches in the area of SEAD-63 are dry most of the time during the year except when they carry storm-water runoff (e.g., during spring seasons when snow melts). The drainage ditches are shallow (generally less than 3 ft below the ground surface of the road). Recreational visitors may come into contact with surface water during a wading event. Recreational visitors may also contact with ditch sediment and be exposed to all chemicals contained in sediment. Therefore, this is considered a complete pathway and surface water and sediment data from the site are used to calculated exposure concentrations.

F.3.4.3 Quantification of Exposure

In this section, each receptor's potential exposures to chemicals of potential concern (COPCs) are quantified for each of the exposure pathways described above. In each case, the exposures are calculated following methods recommended in EPA guidance documents, such as the Risk Assessment Guidance for Superfund (EPA 1989). These calculations generally involve two steps. First, representative chemical concentrations in the environment, or exposure point concentrations (EPCs), are determined for each pathway and receptor. From these EPC values, the amount of chemical that an exposed person may take into his/her body is then calculated. This value is referred to as either the Human Intake or the Absorbed Dose, depending on the exposure route.

This section describes the exposure scenarios, exposure assumptions and exposure calculation methods used in this risk assessment. All calculations are shown in the tables included in **Attachment A** to this Appendix.

Risk assessment as a whole, and the exposure assessment step in particular, are designed to be health protective. The exposure calculations require estimates and assumptions about certain human exposure parameters, such as inhalation rates, ingestion rates, etc. Generally, values are selected which tend to overestimate exposure. USEPA (1993) recommends two types of exposure estimates to be used for Superfund risk assessments: a reasonable maximum exposure (RME) and central tendency exposure (CT). The RME is defined as the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site, and is intended to account for both uncertainty in the contaminant concentration and variability in the exposure parameters (such as exposure frequency or averaging time). The CT also may be evaluated for comparison purposes and is generally based on mean exposure parameters. Only RME scenarios have been evaluated in this mini-risk assessment.

Superfund risk assessments consider chronic exposures unless specific conditions warrant a short-term or an acute assessment. In this evaluation, long-term exposure to relatively low chemical concentrations is the greatest concern. Short-term (i.e., subchronic) and acute exposures were evaluated only for the construction worker.

Exposure-point concentrations (EPCs) were estimated for all pathways selected for quantitative evaluation. These concentrations are based on the highest measured values (for soil and groundwater) or on calculated estimates (for ambient air and showering). Steady-state conditions were assumed. Therefore, current and future chemical concentrations were assumed to be identical. This assumption may tend to overestimate long-term exposure concentrations because chemical concentrations are likely to decrease over time from natural processes such as dispersion, attenuation, degradation and dilution.

Estimates of pathway-specific human intakes or absorbed doses for each chemical involve assumptions about patterns of human exposure to contaminated media. These assumptions are integrated with exposure-point concentrations to calculate intakes. Intakes or doses are normally expressed as the amount of chemical at the environment-human receptor exchange boundary in milligrams per kilogram of body weight per day (mg/kg-day), which represents an exposure normalized for body weight over time. The total exposure is divided by the time period of interest to obtain an average exposure. The averaging time is a function of the toxic endpoint: for noncarcinogenic effects, it is the exposure time (specific to the scenario being assessed) and for carcinogenic effects, it is lifetime (70 years).

F3.5 Exposure Assessment

F.3.5.1 Exposure Assumptions

An important aspect of exposure assessment is the determination of assumptions regarding how receptors may be exposed to contaminants. USEPA guidance on exposure factors is extensive and was followed throughout this exposure assessment. Standard scenarios and EPA-recommended default assumptions were used where appropriate.

The exposure scenarios in this assessment involve the following future receptors: park worker, construction worker, and recreational visitor (child). The exposure assumptions for these scenarios are intended to approximate the frequency, duration and manner in which receptors are exposed to environmental media. For example, the worker scenarios are intended to approximate the exposure potential of those employed at the site.

Details of the exposure assumptions and parameters for each exposure scenario are presented in **Table F-6**.

TABLE F-6
EXPOSURE FACTOR ASSUMPTIONS FOR CONSERVATION/RECREATIONAL LAND
SEAD-63 EE/CA
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
PARK WORKER	**Inhalation of Dust in Ambient Air**	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Inhalation Rate	8	m3/day	Average inhalation rate for light activity is 1.0 m3/hr, 8 hr work day.	USEPA, 1997.
		Exposure Frequency	175	days/yr	Works on-site 5 days/wk, 8 months/yr (35 weeks).	BPJ.
	(Air EPC Calculated from Surface Soil Only)	Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Ingestion Rate	100	mg soil/day	Upper bound worker exposure to dirt and dust.	USEPA, 1993.
	(Soil EPC Calculated from Surface Soil Only)	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
		Exposure Frequency	175	days/yr	Works on-site 5 days/wk, 8 months/yr (35 weeks).	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999.
	(Soil EPC Calculated from Surface Soil Only)	Skin Contact Surface Area	5,700	cm2	RME value for residential scenario.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for industrial scenario.	USEPA, 1999.
		Exposure Frequency	175	days/yr	Works on-site 5 days/wk, 8 months/yr (35 weeks).	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Groundwater	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Ingestion Rate	1	liter/day	Standard occupational ingestion rate.	USEPA. 1991.
		Exposure Frequency	175	days/yr	Works on-site 5 days/wk, 8 months/yr (35 weeks).	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Surface Water	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Skin Contact Surface Area	1,980	cm2	Adult male hands and forearms.	USEPA, 1992.
		Exposure Time	1	hour/day	Contact time during occasional site maintenance work.	BPJ.
		Exposure Frequency	18	days/yr	Assumes activity occurs 10% of work days.	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Sediment	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999.
		Skin Contact Surface Area	5,700	cm2	RME value for residential scenario.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for industrial scenario.	USEPA, 1999.
		Exposure Frequency	18	days/yr	Assumes activity occurs 10% of work days.	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.

TABLE F-6
EXPOSURE FACTOR ASSUMPTIONS FOR CONSERVATION/RECREATIONAL LAND
SEAD-63 EE/CA
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
RECREATIONAL VISITOR (CHILD)	**Inhalation of Dust in Ambient Air**	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991 1993.
		Inhalation Rate	8.7	m3/day	Average inhalation rate for a child 1-12 years old.	USEPA, 1997.
	(Air EPC Calculated from Surface Soil Only)	Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the remaining 39 weeks of the year.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Ingestion Rate	200	mg soil/day	Maximum IR for a child.	USEPA, 1993.
	(Soil EPC Calculated from Surface Soil Only)	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the remaining 39 weeks of the year.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Absorption Factor	Compound	Specific		USEPA, 1999.
	(Soil EPC Calculated from Surface Soil Only)	Skin Contact Surface Area	2,800	cm2	RME value for residential child.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for residential child.	USEPA, 1999.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the remaining 39 weeks of the year.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Inhalation of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Inhalation Rate	0.08	m3/day	Inhalation rate for sedentary children ages 3-10, 0.3 m3/hr for 15 minutes.	USEPA, 1997.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the remaining 39 weeks of the year.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA. 1989.
	Ingestion of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Ingestion Rate	1	liter/day	Approximate 90th percentile value for children 1-11 years old.	USEPA. 1997.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the	BPJ.
		Exposure Duration			remaining 39 weeks of the year.	
		Averaging Time - Nc	5	years	Assumed.	BPJ.
		Averaging Time - Car	1,825	days	5 years.	
			25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Skin Contact Surface Area	6,600	cm2	RME value for showering/bathing scenario.	USEPA. 1999.
		Exposure Time	1	hour/day	RME value for showering/bathing scenario.	USEPA, 1999.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the	BPJ.
		Exposure Duration			remaining 39 weeks of the year.	
		Averaging Time - Nc	5	years	Assumed.	BPJ.
		Averaging Time - Car	1,825	days	5 years.	
			25,550	days	70 years, conventional human life span.	USEPA, 1989.

TABLE F-6
EXPOSURE FACTOR ASSUMPTIONS FOR CONSERVATION/RECREATIONAL LAND
SEAD-63 EE/CA
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
RECREATIONAL VISITOR (CHILD - CONTINUED)	**Dermal Contact of Surface Water**	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991.
		Skin Contact Surface Area	3,300	cm2	Assumes skin contact surface as half of the total body surface during a wading event.	BPJ.
		Exposure Time	1	hour/day	RME value for showering/bathing scenario.	USEPA, 1999.
		Exposure Frequency	20	days/yr	Assumes wading occurs every time during 13 spring visits and 10% of other visits.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Sediment	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999.
		Skin Contact Surface Area	2,800	cm2	RME value for soil contact by residential child.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for soil contact by residential child.	USEPA, 1999.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the remaining 39 weeks of the year.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.

TABLE F-6
EXPOSURE FACTOR ASSUMPTIONS FOR CONSERVATION/RECREATIONAL LAND
SEAD-63 EE/CA
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
CONSTRUCTION WORKER	**Inhalation of Dust in Ambient Air**	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Inhalation Rate	10.4	m3/day	Average inhalation rate for outdoor worker is 1.3 m3/hr, 8 hr work day.	USEPA, 1997.
		Exposure Frequency	250	days/yr	Site specific based on land area.	USEPA, 1991.
	(Air EPC Calculated	Exposure Duration	1	year	Upper bound time of employment for construction worker.	USEPA, 1991.
	from Surface and	Averaging Time - Nc	365	days	1 year.	
	Subsurface Soils)	Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Ingestion Rate	480	mg soil/day	Assumed IR for intensive construction work.	USEPA, 1991, 1993.
	(Soil EPC Calculated	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
	from Surface and	Exposure Frequency	250	days/yr	Site specific based on land area.	USEPA, 1991.
	Subsurface Soils)	Exposure Duration	1	year	Upper bound time of employment for construction worker.	USEPA, 1991.
		Averaging Time - Nc	365	days	1 year.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999.
	(Soil EPC Calculated	Skin Contact Surface Area	3,300	cm2	RME value for industrial scenario.	USEPA, 1999.
	from Surface and	Soil to Skin Adherence Factor	0.3	mg/cm2	RME value for construction workers.	USEPA, 1999.
	Subsurface Soils)	Exposure Frequency	250	days/yr	RME value for industrial scenario.	USEPA, 1999.
		Exposure Duration	1	year	Upper bound time of employment for construction worker.	USEPA, 1991.
		Averaging Time - Nc	365	days	1 year.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.

Notes:
RME = Reasonable Maximum Exposure
Car = Carcinogenic
Nc = Non-carcinogenic

Source References:
- BPJ: Best Professional Judgment.
- USEPA, 1988: Superfund Exposure Assessment Manual
- USEPA, 1989: Risk Assessment Guidance for Superfund, Volume I (RAGS)
- USEPA, 1991: Supplemental Guidance, Standard Default Exposure Factors
- USEPA, 1993: Superfund's Standard Default Exposure for the Central Tendency and Reasonable Maximum Exposure
- USEPA, 1997: Exposure Factors Handbook, Update to 1990 handbook
- USEPA, 1999: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Dermal Risk Assessment, Interim Guidance, 1999.

TABLE F- 6
EXPOSURE FACTOR ASSUMPTIONS FOR RESIDENTIAL SCENARIO
Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
RESIDENT (ADULT)	Inhalation of Dust in Ambient Air	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Inhalation Rate	20	m3/day	Assumed inhalation rate for adult receptors.	USEPA, 1991, 1993.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
	(Air EPC Calculated from Surface Soil Only)	Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Ingestion Rate	100	mg soil/day	Average residential adult exposure to indoor and outdoor dirt and dust.	USEPA, 1991, 1993.
	(Soil EPC Calculated from Surface Soil Only)	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999
	(Soil EPC Calculated from Surface Soil Only)	Skin Contact Surface Area	5,700	cm2	RME for residential adult exposed to soils.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.07	mg/cm2	RME for residential adult exposed to soils.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Inhalation of Groundwater	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Inhalation Rate	0.13	m3/day	Inhalation rate for sedentary adults, 0.5m3/hr for 15 minutes.	USEPA. 1997.
		Exposure Frequency	3.65	days/yr	Showers 15 min/day, 350 days/yr.	BPJ.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Groundwater	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Ingestion Rate	2	liter/day	90th percentile for adult residents.	USEPA. 1989.
		Exposure Frequency	350	days/yr	Assumes year round exposure to gw and vacation from home for 2 wks/yr.	BPJ.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Groundwater	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Skin Contact Surface Area	18,000	cm2	RME for residential adult for showering scenario.	USEPA. 1999.
		Exposure Time	0.58	hours/day	RME for residential adult for showering scenario.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to gw and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	6,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Surface Water	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Skin Contact Surface Area	4,500	cm2	Assumes 25% of the total body surface exposured to water during wading.	BPJ.
		Exposure Time	0.5	hours/day	Assumption.	BPJ.
		Exposure Frequency	35	days/yr	Assumes 10% of the time ditch accumulates water.	BPJ.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventioanl human life span.	USEPA, 1989.
	Dermal Contact of Sediment	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999
		Skin Contact Surface Area	5,700	cm2	RME for residential adult exposed to soil.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.07	mg/cm2	RME for residential adult exposed to soil.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventioanl human life span.	USEPA, 1989.

TABLE F- 6
EXPOSURE FACTOR ASSUMPTIONS FOR RESIDENTIAL SCENARIO
Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
RESIDENT (CHILD)	Inhalation of Dust in Ambient Air	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991 1993.
		Inhalation Rate	8.7	m3/day	Average inhalation rate for a child 1-12 years old.	USEPA, 1997.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
	(Air EPC Calculated from Surface Soil Only)	Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Ingestion Rate	200	mg soil/day	Maximum IR for a child.	USEPA, 1993
	(Soil EPC Calculated from Surface Soil Only)	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Absorption Factor	Compound	Specific		USEPA, 1999
	(Soil EPC Calculated from Surface Soil Only)	Skin Contact Surface Area	2,800	cm2	RME value for residential child skin surface exposed to soil.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for residential child exposed to soil.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Inhalation of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Inhalation Rate	0.08	m3/day	Inhalation rate for sedentary children ages 3-10, 0.3 m3/hr for 15 minutes.	USEPA, 1997.
		Exposure Frequency	3.65	days/yr	Showers 15 min/day, 350 days/yr.	BPJ.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Ingestion Rate	1	liter/day	Approximate 90th percentile value for children 1-11 years old.	USEPA, 1997.
		Exposure Frequency	350	days/yr	Assumes year round exposure to gw and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Skin Contact Surface Area	6,600	cm2	RME value for residential child during showering.	USEPA, 1999.
		Exposure Time	1.0	hours/day	RME value for residential child for showering scenario.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to gw and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Surface Water	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991.
		Skin Contact Surface Area	3,300	cm2	Assumes skin contact surface as half of total body surface while wading.	BPJ.
		Exposure Time	1	hours/day	RME value for showering/bathing scenario.	USEPA, 1999.
		Exposure Frequency	35	days/yr	Assumes 10% of the time ditch accumulates water.	BPJ.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993
		Averaging Time - Nc	2,190	days	6 years.	
		Averaging Time - Car	25,550	days	70 years, conventioanl human life span.	USEPA, 1989.
	Dermal Contact of Sediment	Body Weight	15	kg	Standard reference weight for adult males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999
		Skin Contact Surface Area	2,800	cm2	RME for residential adult exposed to soil.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME for residential adult exposed to soil.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventioanl human life span.	USEPA, 1989.

TABLE F- 6
EXPOSURE FACTOR ASSUMPTIONS FOR RESIDENTIAL SCENARIO
Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		

Notes:
RME = Reasonable Maximum Exposure
Car = Carcinogenic
Nc = Non-carcinogenic

Source References:
- BPJ: Best Professional Judgement.
- USEPA, 1988: Superfund Exposure Assessment Manual
- USEPA, 1989: Risk Assessment Guidance for Superfund, Volume I (RAGS)
- USEPA, 1991: Supplemental Guidance, Standard Default Exposure Factors
- USEPA, 1993: Superfund's Standard Default Exposure for the Central Tendency and Reasonable Maximum Exposure
- USEPA, 1997: Exposure Factors Handbook, Update to 1990 handbook
- USEPA, 1999: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Dermal Risk Assessment, Interim Guidance, 1999.

The primary sources for the RME and CT exposure factors are as follows:

- USEPA, 1988: Superfund Exposure Assessment Manual
- USEPA, 1989a: Risk Assessment Guidance for Superfund, Volume I (RAGS)
- USEPA, 1991a: Supplemental Guidance, Standard Default Exposure Factors
- USEPA, 1992: Dermal Exposure Assessment, Principles and Applications
- USEPA, 1993a: Superfund's Standard Default Exposure for the Central Tendency and Reasonable Maximum Exposure
- USEPA, 1997: Exposure Factors Handbook
- USEPA, 1999: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment, Interim Guidance

In the following sections, the methods used to calculate exposures by each pathway are explained. Tables, which show the human intake or absorbed dose values calculated for each exposure scenario, are contained in **Attachment A** of this appendix. These intakes and doses are used to assess overall carcinogenic and non-carcinogenic risk, as discussed later in the risk characterization section (**Section F.5**).

F3.5.2 Exposure Scenarios

The exposure scenarios for the four receptors and their respective exposure assumptions in this assessment are described below.

Construction Worker. Future construction workers are assumed to spend one year working at the site, which is a typical duration for a significant construction project. These workers spend each working day at the site. During this time, this worker inhales the ambient air at the site and may ingest or dermally contact the soil there. Since the construction worker may be digging onsite, the soil ingestion or dermal contact with both surface and subsurface soils was assumed.

Park Worker. The park worker's work schedule differs from other workers discussed above. The park worker is assumed to work onsite for only 8 months (35 weeks) per year from Spring through Autumn, when recreational visitors would use the conservation area. The workday (8 hours/day) and exposure duration (25 years) are the same as other workers. Like the industrial, warehouse and day care workers, the park worker inhales the ambient air, ingests groundwater, and ingests and dermally contacts surface soil. In addition, the park worker may occasionally dermally contact surface water and sediment in the conservation area.

Recreational Visitor (Child). While both adults and children may visit the conservation area, potential risks would be expected to be higher for children, due to their higher soil ingestion rates and lower body weights. To be conservative, a child recreational visitor receptor is assessed. The recreational visitor is assumed to visit the conservation area 3 days/week during 13 summer weeks, and 1 day/week for the remaining 39 weeks of the year for a total exposure frequency of 78 days/year for 5 years. During each visit, the child inhales the ambient air, ingests groundwater, inhales and dermally contacts groundwater during showering, ingests and dermally contacts surface soil, dermally contacts ditch sediment. In addition, the child recreational visitor may occasionally dermally contact surface water in the conservation area.

Resident. Potential risks for a residential adult and child were evaluated for comparative purposes only. Cancer risks for the residential adult and child were summed to present a lifetime cancer risk for a resident. Risks from exposure via dust inhalation, soil ingestion and dermal contact, groundwater ingestion, inhalation, and dermal contact, and surface water and sediment dermal contact were evaluated. Exposure factors are presented in **Table F-6**.

Complete exposure assumptions (exposure factors) for all receptors and exposure scenarios are summarized in Table F-6. Most exposure factors used in the exposure assessment were obtained from EPA guidance documents. Other exposure factors were based on conservative professional judgment where no data are available form EPA or other sources.

F.3.5.3 Inhalation of Particulate Matter in Ambient Air

This pathway consists of particulate matter (PM) being released from soils to the air and then being inhaled by future receptors. Ambient PM concentrations for a construction worker were estimated using an emission and dispersion model. PM concentrations for the park worker, recreational visitor, and residential receptors were based on existing site air measurements shown in **Table F-7.**

Construction Worker

During construction activities, construction workers may be exposed to chemicals in site soils via inhalation. Construction activities, such as excavation, have the potential to create dust, or suspended particulate matter (PM), originating from the soils being removed. This dust would contain the chemicals present in the soil. Construction workers in the construction area would breathe this PM in the ambient air.

TABLE F-7
SUSPENDED PARTICULATE CONCENTRATIONS MEASURED AT SEDA
SEAD-63 EE/CA
Seneca Army Depot Activity

PARTICULATE DATA	SITE #1 PM 10	SITE #2 PM 10	SITE #3 PM 10	SITE #4 PM 10
Peak Concentration (ug/m3)	37 on 23 July 95	37 on 23 July 95	37 on 5 July 95	37 on 5 July 95
Arithmetic Mean (ug/m3)	16.9	16.6	16.4	15.8
Standard Deviation	21.4	21.1	23.0	23.0
Geometric Mean (ug/m3)	15.1	14.8	14.8	14.2
No. of 24-hr. Avgs. Above 150 ug/m3	0	0	0	0
Number of Valid Samples	29	32	29	31
Percent Data Recovery	90.6	100.0	90.6	96.9

ulative Summary for April 1, 1995 through July 31, 1995

Air concentrations of site chemicals of concern were estimated for this exposure pathway using excavation models recommended in the USEPA's "Models for Estimating Air Emission Rates from Superfund Remedial Actions" (EPA 451/R-93-001). Particulate emissions from soil excavation and loading into trucks are estimated with the following equation:

$$E = \frac{k\,(0.0016)\,(M)\,[U/2.2]^{1.3}}{[X/2]^{1.4}}$$

Where:

E	=	emissions (g)
k	=	particle size multiplier (unitless)
0.0016	=	empirical constant (g/kg)
M	=	mass of soil handled (kg)
U	=	mean wind speed (m/sec)
2.2	=	empirical constant (m/sec)
X	=	percent moisture content (%)

The construction worker receptor is assumed to work at the site for a one year period. To conservatively estimate potential particulate emissions from construction activities during this period, it was assumed that the entire area of the site (an approximate 4 acre area) is excavated to a depth of two meters over the course of one year as part of the site construction. This results in the following mass of soil removed:

Mass = Area x Depth x Soil Bulk Density

= 16,188 square meters x 2 meters x 1.5 g/cm^3 x 10^6 cm^3/m^3
= 4.856 x 10^{10} grams
= 4.856 x 10^7 kg

Other parameter values for the model are as follows:

k	=	0.35 for PM_{10} (EPA 1993)
U	=	4.4 m/sec, average wind speed for Syracuse, NY (EPA 1985)
X	=	10%, recommended default (EPA 1993)

With these values for M, k, U and X, the emission rate (E) from excavation activities is calculated 7,035 grams of PM_{10} over the course of a year. This emission rate would be representative if all soil excavated at the site were contaminated, and if local climatic factors did not suppress emissions. For example, precipitation, snow cover and frozen soil in the winter will minimize emissions. To account for these climatic/seasonal factors, it was assumed that emissions occur only half of the construction time. This results in a representative emission rate (E) of 3,517 grams/year. This is equivalent to an average emission rate of 14 g/day, 1.75 g/hr or 0.49 mg/sec, assuming emission occurs only during work days: 250 days/yr, 8 hr/day.

Much greater short-term emissions are estimated for site grading with a bulldozer or tractor. This type of activity is assumed to occur for 90 work days (8-hour day) over the course of a year. The model equation for grading emissions is:

$$E = \frac{0.094\,(s)^{1.5}}{X^{1.4}}$$

Where:

E	=	emission rate (g/sec)
0.094	=	empirical constant (g/sec)
s	=	percent silt content (%)
X	=	percent moisture content (%)

Assuming the EPA-recommended default values of 8% for s, and 10% for X, the emission rate (E) from grading is calculated as 0.085 g/sec. Averaged over the course of a year with 90 8-hour days of grading emissions, this is 38.1 g/hr or 10.6 mg/sec of PM_{10} emissions, assuming all emissions occur during working hours.

Total annual average emissions from excavation and grading are estimated as 0.49 mg/sec + 10.6 mg/sec = 11.09 mg/sec.

Localized exposure concentrations for construction workers are estimated with a simple box model. The model treats a defined surface area as a uniform emission source over the time period of interest. The box, or mixing volume, is defined by this surface area and an assumed mixing height. The emitted PM_{10} is assumed to mix uniformly throughout the box, with dilution from surface winds.

The general model equation is:

$$C = \frac{E}{(U)(W)(H)}$$

Where:

E	=	emission rate, mg/sec
U	=	wind speed, m/sec
W	=	crosswind width of the area source, m
H	=	mixing height, m

E and U are the same as defined or calculated above. The mixing area is based upon the area of the site estimated to be excavated during one hour. The area of SEAD-63, 16,188 square meters, may be excavated during 2000 hours of construction activity. The average hourly area worked then is: 16,188 ÷ 2000 = 8 square meters. This area is assumed to be square, and W is the square root of 8 m^2, or 2.8 meters. H is assumed to be the height of the breathing zone, or 1.75 meters.

With these values, the PM_{10} exposure concentration for a construction worker is calculated as 0.51 mg/m^3. All of this PM_{10} was assumed to be airborne soil released from the site as represented by total soils (surface and subsurface).

The concentration of particulate-associated chemicals in ambient air, then, is:

$$\mathbf{CA = CS \times PM_{10} \times CF}$$

Where:

CA	=	chemical concentration in air (mg/m^3)
CS	=	chemical concentration in soil (mg/kg soil)
PM_{10}	=	PM_{10} concentration (ug/m^3)
CF	=	conversion factor (10^{-9} kg/ug)

These calculated CA values are the inhalation EPCs for the dust inhalation scenarios. **Table A-1** (in **Attachment A**) show the inhalation EPCs for the future construction workers.

Park Worker, Recreational Visitor, and Residential Receptors

Ambient air normally contains particulate matter derived from various natural and anthropogenic sources, including soil erosion, fuel burning, automobiles, etc. The concentrations of airborne particulate matter were measured at SEDA over a four month period (April-July) in 1995. A summary of the data collected in this air sampling program is shown in **Table F-7**. Both Total Suspended Particulate Matter (TSP) and particulate matter less than 10µm aerodynamic diameter (PM_{10}) were measured. TSP includes all particles that can remain suspended in air, while PM_{10}

includes only smaller particles that can be inhaled (particles larger than 10μm diameter typically cannot enter the narrow airways in the lung).

For this assessment, the highest 4-month average PM_{10} concentration measured at any of the four monitoring stations was assumed to represent ambient air at the site. The entire particulate loading was assumed to be airborne soil released from SEAD-63 as represented by the surface soil EPCs for the site.

The concentration of particulate-associated chemicals in ambient air, (CA), was calculated with the same equation [CA = CS x PM_{10} x CF] used for the construction worker, above.

The ambient air exposure point concentrations used in the intake calculations are shown in **Attachment A.**

The equation for intake is as follows (EPA, 1989a):

$$\textbf{Intake (mg/kg/day)} = \frac{\textbf{CA x IR x EF x ED}}{\textbf{BW x AT}}$$

Where:

CA	=	Chemical concentration in air (mg/m^3)
IR	=	Inhalation Rate (m^3/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Bodyweight (kg)
AT	=	Averaging Time (days)

The results of these calculations are shown in **Attachment A**.

F.3.5.4 Incidental Ingestion of Soil

The soil data collected from SEAD-63 were compiled and the EPCs were selected for each compound. For the park worker, recreational visitor, and residential receptor exposures, soil data collected from the 0 to 2 foot interval were used in this analysis, since no surface soil samples were collected. For the construction worker exposure, all soil data were used as it is assumed that the construction worker will engage in intrusive activities.

The equation for intake is as follows (EPA 1989a):

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical Concentration in Soil (mg/kg soil)
IR	=	Ingestion Rate (mg soil/day)
CF	=	Conversion Factor (1 Kg/10^6 mg)
FI	=	Fraction Ingested from Contaminated Source (unitless)
EF	=	Exposure Frequency (days/years)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged -- days)

The results of these calculations are shown in **Attachment A.**

F.3.5.5 Dermal Contact with Soils/Sediments

The same receptors considered to have the potential to ingest soil may also contact the same soils dermally. These receptors include the park worker, construction worker, recreational visitor, and residential receptors. Risks due to exposure to sediments via dermal contact for park workers, recreational visitors, and residential receptors were also evaluated.

As with the soil ingestion scenarios, the chemical concentration of the soils taken from the 0 to 2 foot depth were used as the exposure point concentrations for the park worker and recreational visitor. The chemical concentration of all soils was used as the exposure point concentration for the construction worker scenario. The measured maximum sediment concentrations were used as exposure point concentrations for the park worker and recreational visitor.

The equation for the absorbed dose from dermal exposure is as follows, based on guidance in EPA 1992:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times CF \times AF \times ABS \times SA \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical Concentration in Soil/Sediment (mg/kg soil)
CF	=	Conversion Factor (10^{-6} kg/mg)
AF	=	Soil to Skin Adherence Factor (mg/cm^2)

ABS	=	Absorption Factor (unitless)
SA	=	Skin Surface Area Available for Contact (cm^2)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged -- days)

The product of the terms CS, AF, and ABS represents the absorbed dose per event as defined in the EPA 1992 guidance.

The exposure calculations are summarized in **Attachment A.**

Dermal exposure involves several unique exposure factors discussed briefly here. Specifically, the dermal exposure calculation considers the amount of exposed skin, the amount of soil/sediment that adheres to the skin and the degree to which a chemical may be adsorbed through the skin.

The surface area of exposed skin depends on the size of an individual (especially adult vs. child), clothing worn, and the specific parts of the body that may directly contact the medium of concern (e.g., soil or groundwater during showering). USEPA recommendations were followed to select exposed skin surface areas for each scenario in this assessment.

The assumptions for dermal exposure are listed in Table F-6. Selected assumptions regarding skin surface areas for dermal exposure for construction worker, park worker, and recreational visitor receptors are presented as follows:

Construction Worker (Soil): The construction worker was assumed to wear a short-sleeved shirt, long pants, and shoes; therefore, the exposed skin surface is limited to the head, hands, and forearms. The USEPA's recommended surface area exposed to contaminated soil for the adult commercial/industrial receptor, 3300 cm^2 (USEPA, 1999), was used to represent the RME scenario for the construction worker.

Park Worker (Soil/Sediment): The park worker was conservatively assumed to address the same as an adult resident, wearing a short-sleeved shirt, shorts and shoes. Therefore, the exposed skin surface is limited to the head, hands, forearms, and lower legs. The USEPA (1999) recommended value of 5700 cm^2 for the adult residential receptor was used to represent the RME scenario for the parker worker.

Recreational Visitor - Child (Soil/Sediment): The recreational child was assumed to wear a short-sleeved shirt and shorts (no shoes) and therefore, the exposed skin is limited to the head, hands, forearms, lower legs, and feet. The recommended surface area exposed to contaminated soil for the child is 2800 cm^2 for a RME scenario (USEPA, 1999).

The potential magnitude of exposure depends on the amount of soil that adheres to the exposed skin. Certain chemicals may be readily absorbed through the skin while others penetrate much more slowly or not at all. In the case of soil, some chemicals may be strongly bound to the matrix, which reduces their ability to absorb through the skin. Chemical-specific absorption factors as provided by USEPA (1999) were used in this assessment. USEPA (1999) recommends dermal absorption fraction from soil for cadmium, arsenic, chlordane, DDT, Lindane, PAHs, PCBs, dioxins/furans, 2,4-Dichlorophenoxyacetic acid, and pentachorophenol. The USEPA 1999 guidance also provides default dermal absorption factors for semivolatile organic compounds of 10% as a screening method for the majority of SVOCs without dermal absorption factors. There are no default dermal absorption values presented for volatile organic compounds nor inorganic classes of compounds. The uncertainty related to the dermal exposure route will be addressed in the uncertainty assessment section (F.5.4).

F.3.5.6 Groundwater Ingestion

All future receptors may drink groundwater. The groundwater data collected from the site were compiled and the EPCs were selected for each compound.

The equation for intake is as follows (EPA, 1989a):

$$\textbf{Intake (mg/kg-day)} = \frac{\textbf{CW x IR x EF x ED}}{\textbf{BW x AT}}$$

Where:

CW	=	Chemical Concentration in Water (mg/liter)
IR	=	Ingestion Rate (liters/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
BW	=	Bodyweight (kg)
AT	=	Averaging time (days)

The results of these calculations are shown in **Attachment A.**

F.3.5.7 Dermal Contact to Groundwater or Surface Water while Showering/Bathing/Wading

Recreational visitors may be exposed to groundwater while showering/bathing. Risks to residential receptors via dermal contact with groundwater or surface water while showering/bathing/wading were evaluated for comparative purposes only. The EPCs developed for ingestion of groundwater were used for this exposure route. Recreational visitors may also be exposed to surface water in the ditches during a wading event. The measured maximum surface water concentrations were used as EPCs for this scenario. The equation for the absorbed dose, taken from RAGS (EPA, 1989a) is as follows:

$$\textbf{Absorbed Dose (mg/kg-day)} = \frac{\textbf{DA x SA x EF x ED}}{\textbf{BW x AT}}$$

Where:

DA	=	Absorbed dose per event per area of skin exposed (mg/cm^2 - event)
SA	=	Skin surface area available for Contact (cm^2)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (period over which exposure is averaged, days)

DA (mg/cm^2 - event) was calculated as described in USEPAs Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Dermal Risk Assessment Interim Guidance (USEPA, 1999). The following equations were used to evaluate the dermal absorbed dose per event per area of skin exposed:

For organic compounds:

If $ET \leq t^*$, then:

$$\textbf{DA} = 2\, \textbf{K}_p \textbf{ x CW x CF} \sqrt{\frac{6 \times \tau \times ET}{\pi}}$$

If $ET > t^*$, then:

$$\textbf{DA}_{event} = \textbf{K}_p \textbf{ x CW x CF} \left[\frac{ET}{1+B} + 2\tau\left(\frac{1+3B+3B^2}{(1+B)^2}\right) \right]$$

where for both equations:

K_p	=	Dermal permeability coefficient (cm/hr)
CW	=	Chemical Concentration in Water (mg/l)
ET	=	Exposure Time (hours/event)
B	=	Dimensionless ratio of the permeability of the stratum corneum relative to the permeability across the viable epidermis (and any other limitations to chemical transfer through the skin, including clearance into the cutaneous blood).
τ	=	Lag time per event (hours/event)
t*	=	Time to reach steady-state (hr) = 2.4τ
CF	=	Volume Conversion Factor = 0.001L/cm^3

The exposure time for showering or wading was assumed to be 1 hour/day for the RME, as recommended in the Dermal Risk Assessment Interim Guidance (USEPA, 1999) for the showering scenario. The entire body surface may be exposed during showering. EPA 1999 recommends a surface area value of 6600 cm^2 for the RME as representative of the entire body of a child. For the wading scenario, skin contact surface was conservatively assumed to be as half of the total body surface, 3300 cm^2.

Lag times per event (τ), B, and Kp were taken from a list in Table B.2 of the Dermal Risk Assessment Interim Guidance. All chemicals not having lag times were derived using the following equation:

$$\tau = \frac{l_{sc}^2}{6D_{sc}}$$

where:

l_{sc}	=	Apparent thickness of skin, assumes 0.001 cm
D_{sc}	=	Effective diffusivity for chemical transfer through the skin (cm^2/hr), $D_{sc} = l_{sc} \times 10^{(-2.80-0.0056MW)}$
MW	=	Molecular weight of the compound.

When no organic K_p value was available, a value was calculated using the following equation:

$$\text{Log } K_p = -2.80 + 0.67 \log K_{ow} - 0.0056 \text{ MW}$$

Where:

Kow = Octanol/water partition coefficient

For inorganics, DA was calculated by:

$$DA = K_p \times CW \times ET \times CF$$

Kp values for inorganic chemicals were taken from Table 3.1 of the Dermal Risk Assessment Interim Guidance (USEPA, 1999). As recommended by USEPA (1999), a default value of 1 x 10^{-3} cm/hr was used for all inorganics with no specific Kp values.

Exposure to chemicals in groundwater during showering occurs via two routes: inhalation of volatile chemicals, which partition into the air from the hot shower water, and dermal contact. The analysis of these two exposure routes assumes that release of volatile chemicals to the air occurs quickly, and that only the quantities which remain in the water stream are available for dermal contact. The calculations of exposure from inhalation assume that the water from the shower nozzle has the same concentration as groundwater, and the groundwater EPC is used. However, for dermal contact, the EPCs are most correctly first adjusted to subtract the amount of each chemical that partitions into the air. This adjustment prevents "double counting" the potential effect of the portion of certain chemicals that escape the water into the air of the shower.

For SEAD-63, the groundwater EPC was not adjusted to account for volatile losses during showering before considering dermal exposure. Although inhalation and dermal exposures from showering were assessed for SEAD-63, volatile losses during showering were determined to be one percent or less for any compound, and there were no toxicity factors for any compounds which might be inhaled during showering. For simplicity, the groundwater EPC was used directly to assess dermal exposures from shower water for this site.

The dermal exposure calculations, where applicable, are summarized in **Attachment A.**

F.3.5.8 Inhalation of Groundwater or Surface Water while Showering/Bathing

While showering, a receptor may inhale organic compounds released from the hot water supply. Most inorganic compounds potentially found in groundwater, such as metals, are nonvolatile. Therefore, this pathway is not complete for inorganics in water.

No volatile organic compounds were detected in the groundwater at SEAD-63. Therefore, this pathway was not evaluated further in this risk assessment.

F.4 Toxicity Assessment

The objective of the toxicity assessment is to weigh available evidence regarding the potential of the chemicals to cause adverse effects in exposed individuals, and to provide, where possible, an estimate of the relationship between the extent of exposure to a chemical and the increased likelihood and/or severity of adverse effects. The types of toxicity information considered in this assessment include the reference dose (RfD) and reference concentration (RfC) used to evaluate noncarcinogenic effects, and the slope factor and unit risk to evaluate carcinogenic potential. Most toxicity information used in this evaluation was obtained from the Integrated Risk Information System (IRIS). If values were not available from IRIS, the *Health Effects Assessment Summary Tables* (HEAST) (EPA, 1997) were consulted. Finally, the toxicity values withdrawn from IRIS and other values quoted by EPA Region III RBC table USEPA were consulted to provide any additional values not included in these two sources. The toxicity factors used in this evaluation are summarized in **Table F-8** for both noncarcinogenic and carcinogenic effects.

F.4.1 Noncarcinogenic Effects

For chemicals that exhibit noncarcinogenic (i.e., systemic) effects, authorities consider organisms to have repair and detoxification capabilities that must be exceeded by some critical concentration (threshold) before the health effect is manifested. For example, an organ can have a large number of cells performing the same or similar functions that must be significantly depleted before the effect on the organ is seen. This threshold view holds that a range of exposures from just above zero to some finite value can be tolerated by the organism without an appreciable risk of adverse effects. Health criteria for chemicals exhibiting noncarcinogenic effects for use in risk assessment are generally developed using USEPA RfDs and RfCs developed by the RfD/RfC Work Group and included in the IRIS. In general, the RfD/RfC is an estimate of an average daily exposure to an individual (including sensitive individuals) below

TABLE F-8
TOXICITY VALUES
SEAD-63 EE/CA
Seneca Army Depot Activity

Analyte	Oral RfD (mg/kg-day)		Inhalation RfD (mg/kg-day)		Carc. Slope Oral (mg/kg-day)-1		Rank Wt. of Evidence	Carc. Slope Inhalation (mg/kg-day)-1		Dermal RfD (mg/kg-day)		Carc. Slope Dermal (mg/kg-day)-1		Oral Absorption Factor	
Volatile Organics															
Acetone	1.00E-001	a	NA	a	NA	a	D	NA	a	1.00E-001	f	NA		1.00	j
Benzene	3.00E-003	i	1.71E-003	i	2.90E-002	a	A	2.73E-002	a	3.00E-003	f	2.90E-002	g	1.00	j
Chloroform	1.00E-002	a	NA	a	6.10E-003	a	B2	8.05E-002	a	1.00E-002	f	6.10E-003	g	1.00	j
Methyl ethyl ketone	6.00E-001	a	2.86E-001	a	NA	a	D	NA	a	6.00E-001	f	NA		1.00	j
Toluene	2.00E-001	a	1.14E-001	a	NA	a	D	NA	a	2.00E-001	f	NA		1.00	j
Total Xylenes	2.00E+000	a	NA	e	NA	a	D	NA	a	2.00E+000	f	NA		1.00	j
Semivolatiles*															
4-Methylphenol	5.00E-003	b	NA	a	NA	a	C	NA	a	NA		NA		1.00	j
Benzo(a)anthracene	NA	a	NA	a	7.30E-001	c	B2	NA	a	NA		7.30E-001	g	1.00	j
Benzo(a)pyrene	NA	a	NA	a	7.30E+000	a	B2	NA	a	NA		7.30E+000	g	1.00	j
Benzo(b)fluoranthene	NA	a	NA	a	7.30E-001	c	B2	NA	a	NA		7.30E-001	g	1.00	j
Benzo(ghi)perylene	NA	a	NA	a	NA	a	D	NA	a	NA		NA		1.00	j
Benzo(k)fluoranthene	NA	a	NA	a	7.30E-002	c	B2	NA	a	NA		7.30E-002	g	1.00	j
Butylbenzylphthalate	2.00E-001	b	NA	a	NA	a	C	NA	a	2.00E-001	f	NA		1.00	j
Carbazole	NA	a	NA	a	2.00E-002	b	B2	NA	a	NA		2.00E-002	g	1.00	j
Chrysene	NA	a	NA	a	7.30E-003	c	B2	NA	a	NA		7.30E-003	g	1.00	j
Dibenz(a,h)anthracene	NA	a	NA	a	7.30E+000	c	B2	NA	a	NA		7.30E+000	g	1.00	j
Dibenzofuran	NA	a	NA	a	NA	a	D	NA	a	NA		NA		1.00	j
Diethyl phthalate	8.00E-001	b	NA	a	NA	a	D	NA	a	8.00E-001	f	NA		1.00	j
Di-n-butylphthalate	1.00E-001	a	NA	a	NA	a	D	NA	a	1.00E-001	f	NA		1.00	j
Di-n-octylphthalate	2.00E-002	b	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Fluoranthene	4.00E-002	a	NA	a	NA	a	D	NA	a	4.00E-002	f	NA		1.00	j
Fluorene	4.00E-002	a	NA	a	NA	a	D	NA	a	4.00E-002	f	NA		1.00	j
Indeno(1,2,3-cd)pyrene	NA	a	NA	a	7.30E-001	c	B2	NA	a	NA		7.30E-001	g	1.00	j
Naphthalene	2.00E-002	a	8.60E-004	a	NA	a	C	NA	a	2.00E-002	f	NA		1.00	j
Pentachlorophenol	3.00E-002	a	NA	a	1.20E-001	a	B2	NA	a	3.00E-002	f	1.20E-001	g	1.00	j
Phenanthrene	NA	a	NA	a	NA	a	D	NA	a	NA		NA		1.00	j
Phenol	6.00E-001	a	NA	a	NA	a	D	NA	a	6.00E-001	f	NA		1.00	j
Pyrene	3.00E-002	a	NA	a	NA	a	D	NA	a	3.00E-002	f	NA		1.00	j
bis(2-Ethylhexyl)phthalate	2.00E-002	a	NA	a	1.40E-002	a	B2	NA	a	2.00E-002	f	1.40E-002	g	1.00	j
Pesticides/PCBs															
4,4'-DDD	NA	a	NA	a	2.40E-001	a	B2	NA	a	NA		2.40E-001	g	1.00	j
4,4'-DDE	NA	a	NA	a	3.40E-001	a	B2	NA	a	NA		3.40E-001	g	1.00	j
4,4'-DDT	5.00E-004	a	NA	a	3.40E-001	a	B2	3.40E-001	a	5.00E-004	f	3.40E-001	g	1.00	j
Aroclor-1260	2.00E-005	l	NA	a	2.00E+000	a	B2	4.00E-001	a	2.00E-005	f	2.00E+000	g	1.00	j
Endosulfan I	6.00E-003	n	NA	a	NA	a	NA	NA	a	6.00E-003	f	NA		1.00	j
Endosulfan sulfate	6.00E-003	n	NA	a	NA	a	NA	NA	a	6.00E-003	f	NA		1.00	j
Endrin	3.00E-004	a	NA	a	NA	a	D	NA	a	3.00E-004	f	NA		1.00	j
Endrin aldehyde	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Endrin ketone	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Heptachlor epoxide	1.30E-005	a	NA	a	9.10E+000	a	B2	9.10E+000	a	1.30E-005	f	9.10E+000	g	1.00	j
alpha-Chlordane	5.00E-004	o	2.00E-004	o	3.50E-001	o	B2	3.50E-001	o	5.00E-004	f	3.50E-001	g	1.00	j
gamma-Chlordane	5.00E-004	o	2.00E-004	o	3.50E-001	o	B2	3.50E-001	o	5.00E-004	f	3.50E-001	g	1.00	j
Metals															
Aluminum	1.00E+000	i	1.00E-003	i	NA	a	D	NA	a	1.00E+000	f	NA		1.00	j
Arsenic	3.00E-004	a	NA	e	1.50E+000	d	A	1.51E+001	a	3.00E-004	f	1.50E+000	g	1.00	j
Barium	7.00E-002	a	1.43E-004	b	NA	a	D	NA	a	4.90E-003	f	NA		0.07	j
Beryllium	2.00E-003	a	6.00E-006	a	NA	a	B2	8.40E+000	a	1.40E-005	f	NA		0.007	j
Cadmium	5.00E-004	p	NA	a	NA	a	B1	6.30E+000	a	1.25E-005	f	NA		0.025	k,j
Calcium	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Chromium	3.00E-003	q	2.86E-005	q	NA	a	A	4.20E+001	q	7.50E-005	f	NA		0.025	q,j
Cobalt	2.00E-002	m	5.00E-006	a	NA	a	NA	NA	a	2.00E-002		NA		1.00	j
Copper	4.00E-002	b	NA	a	NA	a	D	NA	a	4.00E-002	f	NA		1.00	j
Iron	3.00E-001	e	NA	a	NA	a	NR	NA	a	3.00E-001	f	NA		1.00	j
Lead	NA	a	NA	a	NA	a	B2	NA	a	NA		NA		1.00	j
Magnesium	NA	a	NA	a	NA	a	D	NA	a	NA		NA		1.00	j
Manganese	5.00E-002	r	1.40E-005	a	NA	a	D	NA	a	2.00E-003	f	NA		0.04	j
Mercury	3.00E-004	s	8.57E-005	a	NA	a	D	NA	a	2.10E-005	f	NA		0.07	s,j
Nickel	2.00E-002	a	NA	a	NA	a	NR	NA	a	8.00E-004	f	NA		0.04	j
Potassium	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Selenium	5.00E-003	a	NA	a	NA	a	D	NA	a	5.00E-003	f	NA		1.00	j
Silver	5.00E-003	a	NA	a	NA	a	D	NA	a	2.00E-004	f	NA		0.04	j
Sodium	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Thallium	8.00E-005	t	NA	a	NA	a	D	NA	a	8.00E-005	f	NA		1.00	j
Vanadium	7.00E-003	b	NA	a	NA	a	D	NA	a	1.82E-004	f	NA		0.026	j
Zinc	3.00E-001	a	NA	a	NA	a	D	NA	a	3.00E-001	f	NA		1.00	j

a = Taken from the Integrated Risk Information System (IRIS) (Online October 2001)
b = Taken from HEAST 1997
c = Calculated using TEF
d = Calculated from proposed oral unit risk value

TABLE F-8
TOXICITY VALUES
SEAD-63 EE/CA
Seneca Army Depot Activity

Analyte	Oral RfD (mg/kg-day)	Inhalation RfD (mg/kg-day)	Carc. Slope Oral (mg/kg-day)-1	Rank Wt. of Evidence	Carc. Slope Inhalation (mg/kg-day)-1	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Oral Absorption Factor

e = Provisional health guideline from EPA Risk Assessment Issue Papers (1999) provided by EPA Technical Support Center.
(Inhalation RfD's were derived from EPA RfC's based on the assumption of 20 m3/day inhalation rate and 70 kg body weight.)
f = Calculated from oral RFD value. (Dermal Rfd = Oral Rfd * Oral Absorption Factor)
g = Calculated from oral slope factor (Dermal Slope Factor = Oral Slope Factor/Oral Absorption Factor)
i = Provisional health guideline from EPA Risk Assessment Issue Papers (1996-1997) provided by EPA Technical Support Center.
(Inhalation RfD's were derived from EPA RfC's based on the assumption of 20 m3/day inhalation rate and 70 kg body weight.)
j = Based upon EPA Human Health Evaluation Manual Supplemental Guidance: Dermal Risk Assessment Interim Guidance, 1999.
k = More than 1 oral absorption factor values are available and the most conservative, i.e., the lowest value is presented.
l = Value for Aroclor-1254.
m = EPA-NCEA provisional value, quoted by EPA Region III RBC Table
n = Value for Endosulfan.
o = Value for Chlordane.
p = Two RfDs are available for cadmium and the most conservative is presented.
q = Values for Chromium VI.
r = For managenese. for dietary intake, a RfD of 0.14 mg/kg/day is presented in IRIS. For non-dietary intake (groundwater/soil), IRIS recommends applying a modifying factor of 3, resulting in an RfD of 0.05 mg/kg/day.
s = Value for mercuric chloride.
t = Value for thallium chloride.
NA = Not Available

which there will not be an appreciable risk of adverse health effects. The RfD/RfC is derived using uncertainty factors (e.g., to adjust from animals to humans and to protect sensitive subpopulations) to ensure that it is unlikely to underestimate the potential for adverse noncarcinogenic effects to occur. The purpose of the RfD/RfC is to provide a benchmark against which an intake (or an absorbed dose in the case of dermal contact) from human exposure to various environmental conditions might be compared. Intake of doses that are significantly higher that the RfD/RfC may indicate that an inadequate margin of safety could exist for exposure to that substance and that an adverse health effect could occur.

F.4.1.1 References Doses for Oral and Inhalation Exposure

The types of toxicity values used to evaluate the noncarcinogenic effects of chemicals include RfDs for oral exposure, and RfCs for inhalation exposure. RfDs and RfCs represent thresholds for toxicity. They are derived such that human lifetime exposure to a given chemical via a given route at levels at or below the RfD or RfC, as appropriate, should not result in adverse health effects, even for the most sensitive members of the population. The chronic RfD or RfC for a chemical is ideally based on studies where either animal or human populations were exposed to a given chemical by a given route of exposure for the major portion of the life span (referred to as a chronic study). Various effect levels may be determined in a study; however, the preferred effect level for calculating noncarcinogenic toxicity values is the no-observed-adverse-effect level, or NOAEL. Second to the NOAEL is the lowest-observed-adverse-effect level, or LOAEL.

The oral RfD is derived by determining dose-specific effect levels from all the available quantitative studies, and applying uncertainty factors and/or a modifying factor to the most appropriate effect level. Uncertainty factors are intended to account for 1) the variation in sensitivity among members of the human population, 2) the uncertainty in extrapolating animal data to humans, 3) the uncertainty in extrapolating from data obtained in a study that is less than lifetime exposure, 4) the uncertainty in using LOAEL data rather than NOAEL data, and 5) the uncertainty resulting from inadequacies in the data base. The modifying factor may be used to account for other uncertainties such as inadequacy of the number of animals in the critical study. Usually each of these uncertainty factors is set equal to 10, while the modifying factor varies between one and 10. RfDs are reported as doses in milligrams of chemical per kilogram body weight per day (mg/kg-day).

The inhalation RfC is derived by determining concentration-specific effect levels from all of the available literature and transforming the most appropriate concentration to a human RfC. Transformation usually entails converting the concentration and exposure duration used in the study to an equivalent continuous 24-hour exposure, transforming the exposure-adjusted value to account for differences in animal and human inhalation, and then applying uncertainty factors and/or a modifying factor to the adjusted human exposure concentration to arrive at an RfC. The uncertainty factors potentially used are the same ones used to arrive at an RfD (see above). RfCs are reported as concentrations in milligrams of chemical per cubic meter of air (mg/m^3). To use the RfCs in calculating risks, they were converted to inhalation reference doses in units of milligrams of chemical per kilogram of body weight per day (mg/kg/day). This conversion was made by assuming an inhalation rate of 20 m^3/day and an adult body weight of 70 kg. Thus:

$$\textbf{Inhalation Reference Dose (mg/kg/day)} = RfC\left(\frac{mg}{m^3}\right)x\left(\frac{20m^3}{day}\right)x\left(\frac{1}{70kg}\right)$$

F.4.1.2 Reference Doses for Dermal Exposure

At this time, chemical specific dermal toxicity factors are not available. This risk assessment evaluated risks from dermal contact with contaminants according to the most recent EPA guidance on dermal risk assessment (USEPA, 1999). The guidance provides an approach which accounts for the fact that most oral RfDs are expressed as the amount of substance administered per unit time and body weight, whereas exposure estimates for the dermal pathway are expressed as absorbed dose. Primarily, a dermal RfD was estimated from the oral RfD by adjusting for the gastrointestinal absorption efficiency. For compounds recommended by Table 4.1 of the guidance for adjustment of toxicity factors, the GI absorption efficiency values in the table were used to calculate the dermal RfD. For all other compounds, oral RfDs were used to evaluate dermal exposure risks, i.e., a GI absorption efficiency value of 1 was used. Oral absorption factors and the calculated dermal RfDs are shown in **Table F-8**.

F.4.1.3 Exposure Periods

As mentioned earlier, chronic RfDs and RfCs are intended to be set at levels such that human lifetime exposure at or below these levels should not result in adverse health effects, even for the most sensitive members of the population. These values are ideally based on chronic exposure studies in humans or animals. Chronic exposure for humans is considered to be exposure of roughly seven years or more, based on exposure of rodents for one year or more in animal toxicity studies. For day care children and construction workers, chronic RfDs and RfCs were used to conservatively assess risks for shorter exposure periods.

F.4.2 Carcinogenic Effects

For chemicals that exhibit carcinogenic effects, most authorities recognize that one or more molecular events can evoke changes in a single cell or a small number of cells that can lead to tumor formation. This is the non-threshold theory of carcinogenesis, which purports that any level of exposure to a carcinogen can result in some finite possibility of generating the disease. Generally, regulatory agencies assume the non-threshold hypothesis for carcinogens in the absence of information concerning the mechanisms of action for the chemical of concern.

USEPA's Carcinogen Risk Assessment Verification Endeavor (CRAVE) has developed slope factors and unit risks (i.e., dose-response values) for estimating excess lifetime cancer risks associated with various levels of lifetime exposure to potential human carcinogens. The carcinogenic slope factors can be used to estimate the lifetime excess cancer risk associated with exposure to a potential carcinogen. Risks estimated using slope factors are considered unlikely to underestimate actual risks, but they may overestimate actual risks. Excess lifetime cancer risks are generally expressed in scientific notation. An excess lifetime cancer risk of 1×10^{-6} (one in a million), for example, represents the probability of an individual developing cancer over a lifetime as a result of exposure to the specific carcinogenic chemical. USEPA considers total excess lifetime cancer risks within the range of 10^{-4} (one in ten thousand) to 10^{-6} (EPA, 1989a) to be acceptable when developing remedial alternatives for cleanup of Superfund Sites.

In practice, slope factors are derived from the results of human epidemiology studies or chronic animal bioassays. The data from animal studies are fitted to the linearized, multistage model and a dose-response curve is obtained. The upper limit of the 95th percentile confidence-interval slope of the dose-response curve is subjected to various adjustments, and an interspecies scaling factor is applied to conservatively derive the slope factor for humans. This linearized multistage procedure leads to a plausible upper limit of the risk that is consistent with some proposed mechanisms of carcinogenesis. Thus, the actual risks associated with exposure to a potential carcinogen are not likely to exceed the risks estimated using these slope factors, but they may be much lower. Dose-response data derived from human epidemiological studies are fitted to dose-time-response curves on an ad-hoc basis. These models provide rough but plausible estimates of the upper limits on lifetime risk. Slope factors based on human epidemiological data are also derived using very conservative assumptions and, as such, are considered unlikely to underestimate risks. In summary, while the actual risks associated with exposures to potential carcinogens are unlikely to be higher than the risks calculated using a slope factor, they could be considerably lower.

In addition, there are varying degrees of confidence in the weight of evidence for carcinogenicity of a given chemical. The USEPA system involves characterizing the overall weight of evidence for a chemical's carcinogenicity based on availability of animal, human, and other supportive data. The weight-of-evidence classification is an attempt to determine the likelihood that the agent is a human carcinogen, and thus qualitatively affects the estimation of potential health risks. Three major factors are considered in characterizing the overall weight of evidence for carcinogenicity: (1) the quality of evidence from human studies, (2) the quality of evidence from animal studies, which are combined into a characterization of the overall weight of evidence for human carcinogenicity; and (3) other supportive information which is assessed to determine whether the overall weight of evidence should be modified. USEPA's final classification of the overall weight of evidence includes the following five categories:

Group A - Human Carcinogen – There is sufficient evidence from epidemiological studies to support a causal association between an agent and cancer.

Group B - Probable Human Carcinogen – There is at least limited evidence from epidemiological studies of carcinogenicity to humans (Group B1) or that, in the absence of adequate data on humans, there is sufficient evidence of carcinogenicity in animals (Group B2).

Group C - Possible Human Carcinogen – There is limited evidence of carcinogenicity in animals in the absence of data on humans.

Group D - Not Classified – The evidence for carcinogenicity in animals is inadequate.

Group E - No Evidence of Carcinogenicity to Humans – There is no evidence for carcinogenicity in at least two adequate animal tests in different species, or in both epidemiological and animal studies.

Slope factors and unit risks are developed by the USEPA based on epidemiological or animal bioassay data for a specific route of exposure, either oral or inhalation. For some chemicals, sufficient data are available to develop route-specific slope factors for inhalation and ingestion. For chemicals with only one route-specific slope factor but for which carcinogenic effects may also occur via another route, the available slope factor may be used by the USEPA to evaluate risks associated with several potential routes of exposure (EPA, 1989b).

A number of the chemicals of potential concern have been classified as carcinogens or potential carcinogens by USEPA, and each of these has also been assigned a carcinogenicity weight-of-evidence category, as shown in **Table F-8**. These chemicals are:

Group A - Human Carcinogens

Arsenic
Benzene

Chromium VI
Nickel

Group B - Probable Human Carcinogens

Chloroform
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Carbazole
Chrysene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
bis(2-Ethylhexyl)phthalate
DDD, 4,4'-
DDE, 4,4'-
DDT, 4,4'-
Dieldrin
Heptachlor epoxide
Chlordane
Antimony
Beryllium
Cadmium
Lead
Aroclor-1260
Pentachlorophenol

Group C - Possible Human Carcinogens

4-Methylphenol
naphthalene

All remaining chemicals of concern are either not found to have weight of evidence rankings or are Group D or E. Group D classification means that the data are insufficient to make a determination regarding carcinogenic potential while Group E compounds have been conclusively found to be non-carcinogenic. Chemicals of potential concern found at the AOCs with potential carcinogenic effects are shown in **Table F-8** along with their cancer slope factors.

F.4.2.1 Cancer Slope Factors for Oral and Inhalation Exposure

The types of toxicity values used to evaluate the carcinogenic effects of chemicals include slope factors (SFs) for oral exposure, and unit risk factors (URFs) for inhalation exposure. Oral slope factors are reported as risk per dose $(mg/kg\text{-}day)^{-1}$. Inhalation unit risk factors are reported in units of risk per concentration $(mg/m^3)^{-1}$. To make use of the unit risk factors in calculating risks they first had to be converted to inhalation slope factors in units of $(mg/kg\text{-}day)^{-1}$. This conversion was made by assuming an inhalation rate of 20 m^3/day and an adult bodyweight of 70 kg. Thus:

$$\textbf{Inhalation slope factor (mg/kg-day)}^{-1} = UnitRisk\left(\frac{ug}{m^3}\right)^{-1} \times \frac{day}{20m^3} \times 70kg \times \frac{1000ug}{mg}$$

F.4.2.2 Cancer Slope Factors for Dermal Exposure

As discussed above. USEPA has not derived toxicity values for the dermal route of exposure. In the absence of dermal reference toxicity values. USEPA has suggested (EPA, 1999) that it is appropriate to modify an oral slope factor so it can be used to estimate the risk incurred by dermal exposure. The oral slope factors were converted to dermal slope factors by dividing by the oral absorption efficiency recommended by EPA. The same values presented in Section 5.4.1.2 were used. however, if chemical specific modification factors were unavailable. oral values were used without adjustment.

F.4.2.3 Toxic Equivalency Factors

When slope factors and unit risks were not available for all potentially carcinogenic members of a chemical class. toxicity values were calculated using toxicity equivalency factors (TEFs). TEFs are values that compare the carcinogenic potential of a given chemical in a class to the carcinogenic potential of a chemical in the class that has a verified slope factor and/or unit risk. USEPA has provided TEFs for PAHs (EPA. 1993b). TEF values are as follows:

PAH	TEF
Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Dibenzo(a,h)anthracene	1.0
Chrysene	0.001

Indeno(1,2,3-cd)pyrene	0.1

To calculate a slope factor or unit risk for a given PAH the appropriate TEF value is multiplied by the slope factor or unit risk for benzo(a)pyrene.

F.5 Risk Characterization

F.5.1 Introduction

To characterize risk, toxicity and exposure assessments were summarized and integrated into quantitative and qualitative expressions of risk. To characterize potential noncarcinogenic effects, comparisons were made between projected intakes of substances and toxicity values. To characterize potential carcinogenic effects, probabilities that an individual will develop cancer over a lifetime of exposure are estimated from projected intakes and chemical-specific dose-response information. Major assumptions, scientific judgments, and, to the extent possible, estimates of the uncertainties embodied in the assessment are also presented.

F.5.1.1 Noncarcinogenic Effects

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period with an RfD derived for a similar exposure period. This ratio of exposure to toxicity is called a hazard quotient according to the following equation:

$$\textit{Noncancer Hazard Quotient} = E/RfD$$

Where:

E = Exposure level or intake (mg/kg-day), and
RfD = Reference Dose (mg/kg-day)

The noncancer hazard quotient assumes that there is a level of exposure (i.e., an RfD) below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level (E) exceeds the threshold (i.e., If E/RfD exceeds unity) there may be concern for potential noncancer effects.

To assess the overall potential for noncarcinogenic effects posed by more than one chemical, a hazard index (HI) approach has been developed by the USEPA. This approach assumes that simultaneous sub-threshold exposures to several chemicals could result in an adverse health effect. It also assumes that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures to respective acceptable exposures.

This is expressed as:

$$HI = E_1/RfD_1 + E_2/RfD_2 + ... + E_i/RfD_i$$

Where:

E_i	=	the exposure level or intake of the I toxicant, and
RfD_i	=	reference dose for the i^{th} toxicant.

While any single chemical with an exposure level greater than the toxicity value will cause the HI to exceed unity, for multiple chemical exposures, the HI can also exceed unity even if no single chemical exposure exceeds its RfD. The assumption of dose additivity reflected in the HI is best applied to compounds that induce the same effects by the same mechanisms. Applying the HI to cases where the known compounds do not induce the same effect may overestimate the potential for effects. To assess the overall potential for noncarcinogenic effects posed by several exposure pathways, the total HI for chronic exposure is the sum of the HI's for each pathway, for each receptor.

F.5.1.2 Carcinogenic Effects

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen (i.e., excess individual lifetime cancer risk). The slope factor converts estimated daily intakes averaged over a lifetime of exposure directly to incremental risk of an individual developing cancer. It can generally be assumed that the dose-response relationship will be linear in the low-dose portion of the multistage model dose-response curve. Under this assumption, the slope factor is a constant, and risk will be directly related to intake. Thus, the following linear low-dose equation was used in this assessment:

$$Risk = CDI \times SF$$

Where:

Risk	=	A unitless probability of an individual developing cancer,
CDI	=	Chronic Daily Intake over 70 years (mg/kg-day), and
SF	=	Slope Factor $(mg/kg\text{-}day)^{-1}$

Because the slope factor is often an upper 95th-percentile confidence limit of the probability of a response and is based on animal data used in the multistage model, the carcinogenic risk will generally be an upper-bound estimate. This means that the "true risk" is not likely to exceed the risk estimate derived through this model and is likely to be less than predicted.

For simultaneous exposure to several carcinogens, the USEPA assumes that the risks are additive. That is to say:

$$\mathbf{Risk_T = Risk1 + Risk2 + ... + Risk_i}$$

Where:

$Risk_T$ = Total cancer risk, expressed as a unitless probability, and
$Risk_i$ = Risk estimate for the ith substance.

Addition of the carcinogenic risks is valid when the following assumptions are met:

- doses are low,
- no synergistic or antagonistic interactions occur, and
- similar endpoints are evaluated.

According to guidance in the National Contingency Plan, the target overall lifetime carcinogenic risks from exposures for determining clean-up levels should range from 10^{-4} to 10^{-6}.

F.5.2 Risk Summary

Human health risks were calculated for three future exposure scenarios at SEAD-63. The receptors and exposure scenarios were based on the expected future land use for SEAD-63, which is as a conservation and recreation area. The potential exposure pathways associated with each receptor are summarized in **Figure 2-12** in **Section 2** of **Appendix A.**

The potential exposure routes associated with each exposure scenario are as follows:

Park worker: Inhalation of ambient air, ingestion of soil, dermal contact with soil, ingestion of groundwater, dermal contact with ditch water, and dermal contact with ditch sediment.

Construction worker: Inhalation of ambient air, ingestion of soil, and dermal contact with soil.

Recreational visitor (child): Inhalation of ambient air, ingestion of soil, dermal contact with soil, ingestion of groundwater, dermal contact with groundwater while showering, dermal contact with ditch water, and dermal contact with ditch sediment.

In addition, inhalation of ambient air, ingestion of soil, dermal contact with soil, ingestion of groundwater, dermal contact with groundwater while showering, dermal contact with ditch water, and dermal contact with ditch sediment were evaluated for residential receptors for comparative purposes only. Future residential use of the site is highly unlikely.

Cancer and non-cancer risks at SEAD-63 were calculated for all applicable exposure routes and are presented in **Table F-9**. The table also serves as a guide to the tables in **Attachment A** that show risk calculations for each exposure route. The USEPA defined targets for lifetime cancer risk range from 10^{-4} to 10^{-6}; the non-cancer hazard index is less than one. The total cancer risk for the Park worker (5E-05), the Construction worker (9E-08), and the recreational visitor (child) (8E-05) is within the USEPA target risk range. The total non-cancer hazard index from all

TABLE F-9
CALCULATION OF TOTAL NONCARCINOGENIC AND CARCINOGENIC RISKS
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	EXPOSURE/RISK CALCULATIONS Table Number	HAZARD INDEX	CANCER RISK
PARK WORKER	Inhalation of Dust in Ambient Air	Table A-1	7E-07	1E-09
	Ingestion of Soil	Table A-4	1E-03	5E-08
	Dermal Contact to Soil	Table A-6	4E-04	8E-08
	Ingestion of Groundwater	Table A-9	1E-01	NQ
	Dermal Contact to Surface Water	Table A-13	4E-03	5E-05
	Dermal Contact to Sediment	Table A-14	1E-03	1E-06
	TOTAL RECEPTOR RISK (Nc & Car)		**2E-01**	**5E-05**
RECREATIONAL VISITOR (CHILD)	Inhalation of Dust Ambient Air	Table A-1	1E-06	5E-10
	Ingestion of Soil	Table A-4	4E-03	4E-08
	Dermal Contact to Soil	Table A-6	4E-04	2E-08
	Ingestion of Groundwater	Table A-8	3E-01	NQ
	Dermal Contact to Groundwater	Table A-11	5E-02	NQ
	Dermal Contact to Surface Water	Table A-13	4E-02	8E-05
	Dermal Contact to Sediment	Table A-15	1E-02	3E-06
	TOTAL RECEPTOR RISK (Nc & Car)		**4E-01**	**8E-05**
CONSTRUCTION WORKER	Inhalation of Dust in Ambient Air	Table A-1	9E-05	3E-08
	Ingestion of Soil	Table A-4	2E-01	4E-08
	Dermal Contact to Soil	Table A-6	2E-02	1E-08
	TOTAL RECEPTOR RISK (Nc & Car)		**3E-01**	**9E-08**
ADULT RESIDENT (Hazard Index)	Inhalation of Dust Ambient Air	Table A-2	3E-06	See risk below
	Ingestion of Soil	Table A-5	2E-03	
	Dermal Contact to Soil	Table A-7	3E-04	
	Ingestion of Groundwater	Table A-9	6E-01	
	Dermal Contact to Groundwater	Table A-12	1E-01	
	Dermal Contact to Surface Water	Table A-14	5E-03	
	Dermal Contact to Sediment	Table A-16	1E-03	
	TOTAL RECEPTOR RISK (Nc & Car)		**7E-01**	
CHILD RESIDENT (Hazard Index)	Inhalation of Dust Ambient Air	Table A-2	7E-06	See risk below
	Ingestion of Soil	Table A-5	2E-02	
	Dermal Contact to Soil	Table A-7	2E-03	
	Ingestion of Groundwater	Table A-9	1E+00	
	Dermal Contact to Groundwater	Table A-12	2E-01	
	Dermal Contact to Surface Water	Table A-14	4E-02	
	Dermal Contact to Sediment	Table A-16	1E-02	
	TOTAL RECEPTOR RISK (Nc & Car)		**2E+00**	
RESIDENT (Total Lifetime Cancer Risk)	Inhalation of Dust Ambient Air	Table A-2	See risk above	8E-09
	Ingestion of Soil	Table A-5		3E-07
	Dermal Contact to Soil	Table A-7		1E-08
	Ingestion of Groundwater	Table A-9		NQ
	Dermal Contact to Groundwater	Table A-12		NQ
	Dermal Contact to Surface Water	Table A-14		1E-04
	Dermal Contact to Sediment	Table A-16		4E-06
	TOTAL RECEPTOR RISK (Nc & Car)			**1E-04**

NQ = Not Quantified due to lack of toxicity data
Non-cancer risk is reported for adults and child residents separately. Cancer risk is considered over a lifetime, therefore the adult and child values are summed.

exposure routes is less than one for the Park worker, Construction worker, and Recreational visitor (child). The total non-cancer hazard index for a child resident and the lifetime cancer risk for a resident slightly exceed USEPA target risk range (non-cancer hazard index of 2 for the child and cancer risk of 1E-4 for the resident). The total non-cancer hazard index for an adult resident is 0.7, which is within the USEPA target risk range.

The driven risks for recreational visitor (child) and resident receptors are exposure to benzo(a)pyrene and dibenz(a,h)anthracene in surface water. These two constituents were only detected in one out of 22 samples. In addition, the ditch at the site is usually dry except during storm period. The vegetation observed in the ditches, i.e., cattail, verifies this conclusion since cattails prefer saturated soil conditions to flooded conditions. Therefore, risks driven by these two constituents are most likely significantly lower than indicated by the mini-risk assessment.

F.5.3 Risk Characterization for Lead

Lead was not detected above background levels in soil or groundwater. Therefore, lead is not a compound of concern.

F.5.4 Uncertainty Assessment

All risk assessments involve the use of assumptions, judgements, and imperfect data to varying degrees. This results in uncertainty in the final estimates of risk. There are uncertainties associated with each component of the risk assessment from data collection through risk characterization. For example, there is uncertainty in the initial selection of substances used to characterize exposures and risk on the basis of the sampling data and available toxicity information. Other sources of uncertainty are inherent in the toxicity values for each substance and the exposure assessments used to characterize risk. Finally, additional uncertainties are incorporated into the risk assessment when exposures to several substances across multiple pathways are summed. Areas of uncertainty in each risk assessment step are discussed below.

F.5.4.1 Uncertainty in Data Collection and Evaluation

Uncertainties in the data collection/evaluation step of the risk assessment focus on determining whether enough samples were collected to adequately characterize the risk, and if sample analyses were conducted in a qualified manner to maximize the confidence in the results. Results of the sample analyses were used to develop a database, which includes a complete list of the chemicals, by media and their representative concentrations used in the risk assessment. The sampling and analysis addressed various objectives in addition to the risk assessment. Therefore, the samples were not collected randomly but were collected from areas of the site with the greatest likelihood to be contaminated. This type of non-random sampling biases the data collected toward overestimating chemical concentrations from the site.

All chemicals detected that were potentially site-related were retained in this assessment. Chemicals that were never detected were eliminated from the assessment. This practice may slightly underestimate risks due to low levels (i.e., below the sample quantitation limit) of eliminated chemicals. Since samples were collected at areas where concentrations were expected to be high and the maximum concentrations were used for the assessment, it is very unlikely that any chemicals were present at the site at health-significant levels and not detected in at least one sample. However, if this did occur, this assumption will underestimate risk. The maximum concentrations were used to calculate site-related risks. Since that assumption implies chronic exposure to the maximum concentration, this assumption is likely to overestimate risk.

F.5.4.2 Uncertainty in Exposure Assessment

There are inherent uncertainties in predicting future land uses and future chemical concentrations. Future land use scenarios were based on current plans to develop this portion of SEDA into a recreation and conservation area.

A large part of the risk assessment is the estimation of risks for a broad set of exposure scenarios and pathways. If exposure does not occur, no risks are present. This assessment does not factor in the probability of the exposure occurring. For certain pathways, exposure may be extremely unlikely. For example, the future receptors are assumed to drink groundwater. It is unlikely that this will occur, since the aquifer beneath the site is not believed to be productive enough to supply a continuous source of potable water. This assumption yields an overestimate of risk for this scenario.

Once pathways are identified, exposure point concentrations must be estimated. There is always some doubt as to how well an exposure model approximates the actual conditions receptors will be exposed to at a given site. Key assumptions in estimating exposure point concentrations and exposure assumptions and their potential impact on the assessment are described in the following paragraphs.

As summarized in **Table F-9**, there are many factors that determine the level of exposure for each exposure pathway. These factors include inhalation rates, ingestion rates, exposure frequencies, exposure durations, body weight, etc. The values for these exposure factors must be selected by the risk assessor to represent each receptor. For the scenarios in this risk assessment, upper bound values were selected for each exposure factor. In the calculations of exposure, these multiple upper-bound exposure factor estimates compound to yield intakes and absorbed doses that overestimate likely exposure levels.

The EPCs (i.e., maximum concentrations) derived from the measured chemical concentrations are assumed to persist without change for the entire duration of each exposure scenario. It is likely that some degradation would occur over time, particularly for some of the organic compounds, which would reduce the current concentrations. Therefore, this steady state assumption tends to overestimate exposure levels.

F.5.4.3 Uncertainty in Toxicity Assessment

Of the chemicals of potential concern, a number had no reference dose or slope factors. They are:

- dibenzofuran
- phenanthrene
- calcium
- lead
- magnesium
- potassium
- sodium

Several of these compounds have toxicity information such as weight of evidence classification indicating a strong potential for adverse health effects, particularly lead. The absence of toxicity values for these chemicals tends to underestimate risks.

There is considerable uncertainty inherent in the toxicity values for both carcinogens and noncarcinogens. Many of the studies are based on animals and extrapolated to humans, and in some cases, subchronic studies must be used to assess chronic effects. Most cancer slope factors are calculated using a model that extrapolates low dose effects from high dose animal studies. Because toxicity constants are generally based on the upper limit of the 95th-percentile confidence interval or incorporate safety factors to compensate for uncertainty, chemical-specific risks may be overestimated.

For dermal exposure, a default dermal absorption factor of 0.1 was used for semivolatile organic compounds, and therefore led to the uncertainty of risks associated with dermal exposure. Oral toxicity values were used to evaluate risks associated with dermal exposure by adjusting gastrointestinal absorption efficiency recommended by USEPA (1999). EPA recommends a 100% gastrointestinal absorption efficiency value for chemicals not listed in Table 4.1 of the Dermal Risk Assessment Interim Guidance (USEPA, 1999). This assumption may contribute to an underestimate of risks for compounds that are actually poorly absorbed. In addition, dermal contact with a chemical may also result in direct dermal toxicity, such as allergic contact dermatitis, urticarial reactions, chemical irritations, and skin cancer, which was not evaluated using the USEPA's recommended approach. Therefore, dermal risks evaluated in the report does not address potential dermal toxicity associated with direct contact.

F.5.4.4 Uncertainty in Risk Characterization

Uncertainties in the toxicity assessment are compounded under the assumption of dose additivity for multiple substance exposure. That assumption ignores possible synergisms and antagonisms among chemicals, and assumes similarity in mechanisms of action and metabolism. Overall, these assumptions would tend to overestimate risk. Similarly, risks summed for chemicals having various weight-of-evidence classifications as well as different target organs may also tend to overestimate risk.

F.6 Ecological Risk Assessment (ERA)

F.6.1 Objectives and Overview

In addition to the evaluation of human health, this mini-risk assessment considers the risk posed by the site to its ecological communities. This ecological risk assessment (ERA) is intended to indicate the potential, if any, of chemicals found at the site to pose a risk or stress to plants or animals that may inhabit or visit the land proposed to be developed into a conservation and recreation area.

An ecological field survey specific to SEAD-63 has not been performed. However, other areas of SEDA have been studied to characterize the ecological communities at SEDA in general and at specific SEADs (e.g. SEADs 16, 17, 25 and 26). Field surveys during the Remedial Investigations of these SEADs produced an understanding of the habitat, vegetative communities and wildlife species present at the site. Since the land at SEAD-63 is environmentally similar to the other areas at SEDA studied in depth, the existing ecological characterizations are considered to apply as well to SEAD-63, and this mini-ERA is based upon the findings of these prior field surveys.

As preceding sections of this report have indicated, the existing SEAD-63-specific database of chemical and physical information was developed to characterize the types, locations, and concentrations of chemicals in soil, groundwater, surface water and sediment. Calculations in this mini-ERA are conservatively based on the maximum concentrations of each chemical detected in each medium of potential concern to ecological receptors (soil for SEAD-63).

The ERA addresses potential risks to the following biological groups and special-interest resources associated with the site: vascular vegetation, wildlife, aquatic life, endangered and threatened species, and wetlands. The focus of the ERA lies in the evaluation of the potential toxicity of each constituent of potential concern (COPC) in soil and defines toxicity benchmark values that will be used to calculate the ecological risk quotient.

The purpose of the ERA is to evaluate the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to chemicals associated with the site based on a weight-of-evidence approach. An ecological risk does not exist unless a given contaminant has the ability to cause one or more adverse effects and it is contacted by, an ecological receptor for a sufficient length of time, or at a sufficient intensity to elicit the identified adverse effect(s) (EPA, 1994b).

In this ERA, ecological receptors were determined based on prior studies at SEDA. Impacts from exposure to these receptors are determined using conservative assumptions to assure that a reasonable degree of protection is maintained. Ecological risk is then presented in terms of a hazard quotient (HQ), which is defined as the ratio of the estimated exposure point concentration to an appropriate toxicity reference value (TRV). Separate HQs are calculated for each contaminant/receptor pair and are summed, if appropriate, to derive a site-wide hazard index (HI). Uncertainties are the greatest and arise from extrapolation of the available toxicity data and inference regarding exposure. In general, ratios of exposure point concentration to TRV greater than 1 are considered to indicate a potential risk. Due to the uncertainties associated with using this approach, safety factors are considered in interpreting the findings. HQs between 1 and 10 are interpreted as having some potential for adverse effects; whereas, HQs between 10 and 100 indicate a significant potential for adverse effects. HQs greater than 100 indicate that adverse effects can be expected.

F.6.2 Problem Formulation

Problem formulation establishes the goals, breadth, and focus of the ERA through the following:

- Identification of the ecological COPCs
- Characterization of ecological communities
- Selection of assessment endpoints
- Presentation of an ecological conceptual site model
- Selection of an analysis plan (including measures of effects).

Each of these steps is described in the following sections.

F.6.2.1 Identification of Ecological Constituents of Potential Concern

Samples of four environmental media, soil, groundwater, surface water, and sediment were collected during the investigations of SEAD-63. However, only the chemicals detected found in soil and sediment have been evaluated to determine their potential effect on the ecological community. Chemicals detected in the groundwater have not been considered because there is no indication of a direct link between the selected ecological receptors and the groundwater. The effects of chemicals detected in surface water have also not been evaluated because the surface water bodies found at SEAD-63 are highly intermittent in nature, resulting only from storm run-off events, and are identified as incapable of supporting ecological communities.

The potential effects of chemicals found in shallow (i.e., collected at sample depths of less than 2 feet below grade) soil and sediment samples have been assessed by combining the two datasets into a single composite dataset. **Table F-1** presents a summary of the combined dataset. The maximum concentration of any chemical, other than metals where a preliminary screening of the combined dataset against the existing background dataset was completed, was then considered as constituents of potential concern (COPCs) for the ERA. The results of the screening of metals found in SEAD-63 shallow soil and sediments versus site background soils are presented in **Table F-4**.

The highest concentration for each remaining COPC measured at the site was used as the exposure point concentration (EPC) in the calculations presented later in this section.

F.6.2.2 Site Habitat Characterization

Characterizations of site habitat and ecological communities developed as part of the RIs for SEADs-16, 17, 25 and 26 and the Open Burning (OB) Grounds were assumed to be representative of SEAD-63 discussed in this mini-ERA. Key aspects of these characterizations relevant to this mini-risk assessment are presented here.

Ecological site characterizations were based on compilation of existing ecological information and on-site reconnaissance activities. The methods used to characterize the ecological resources included site walkovers for the evaluation of existing wildlife and vegetative communities; interviews with local, state, and SEDA resource personnel; and review of environmental data obtained from previous Army reports. SEDA has a strong wildlife management program that is reviewed and approved by the New York Fish and Game Agency. The depot manages an annual white-tailed deer (Odocoileus virginiana) harvest and has constructed a large wetland called the "duck pond" in the northeastern portion of the facility to provide a habitat for migrating waterfowl. Winter deer counts estimate the hard size at approximately 600 animals, between 250-300 animals are harvested each fall.

The NYSDEC Natural Heritage Program Biological and Conservation Data System identifies no known occurrences of federal- or state-designated threatened or endangered plant or animal species within a 2-mile radius of the site. No species of special concern are documented within the depot property.

Significant Terrestrial Wildlife Resources and Resources Used by Humans

The only significant terrestrial resource known to occur at SEDA is the population of white-pelaged white-tailed deer (Odocoileus virginiana), which inhabits the fenced Depot. Annual deer counting at the depot indicate the herd size is approximately 600 animals, approximately one-third (200) are white-pelaged. Since the depot is totally enclosed, the white-pelaged deer is thought to occur as a result of inbreeding within the herd. To prevent overgrazing and starvation of the deer, the depot maintains the herd through an annual hunting season on the depot. The New York State DFW conducts the management plan of the herd. The normal brown-pelaged deer are also common. White-tailed deer are not listed as a rare or endangered species.

In the vicinity of SEDA, agricultural crops and deciduous forests comprise the vegetative resources used by humans. Although no crops are grown on the Depot, farmland is the predominant land use in the surrounding private lands. Crops including corn, wheat, oats, beans and hay mixtures, are grown primarily for livestock feed. Deciduous forestland on the depot and surrounding private lands is under active forest management. Timber and firewood are harvested from private woodlots. No timber harvesting occurs on the Depot.

In the vicinity of SEDA, there are several wildlife species that are hunted and trapped on private lands. Game species hunted include the eastern cottontail, white-tailed deer, ruffed grouse, ring-necked pheasant and various waterfowl. Gray squirrel and wild turkey are hunted to a lesser extent. Fur-bearing species trapped in this study area include red and gray fox and raccoon. Muskrat and beaver are trapped to a lesser extent (Woodruff 1992). On the Depot, deer, waterfowl and small game hunting is allowed, although the designated waterfowl hunting area is outside the study area. Trapping is also permitted (SEDA 1992).

Commonly occurring small game mammals in the installation include eastern cottontail and gray squirrel, raccoon, snowshoe hare, muskrat, beaver, eastern coyote, red fox, and gray fox. Mourning doves, American Robin, Ruffed grouse, ring-necked pheasant, and wild turkey also inhabit the depot. Waterfowl are attracted to wetlands on and around the depot, particularly the

87-acre "duck ponds" created in the northeast corner of the property during the 1970s. Many non-game species also are present in the depot and potentially utilize available habitat.

F.6.2.3 Ecological Assessment Endpoint(s)

EPA's draft Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA, 1994b) states that the selection of assessment endpoints depends on the following:

1. The constituents present and their concentrations.
2. Mechanisms of toxicity to different groups of organisms.
3. Potential species present, and
4. Potential complete exposure pathways.

The constituents and concentrations are discussed in detail in **Section F.2.** Mechanisms of toxicity are evaluated conceptually in the analysis plan in **Section F.6.2.4**. Potential species present were discussed in **Section F.6.2.2**. Potential complete exposure pathways and receptor selection are described below.

To assess whether adverse ecological effects have occurred or may occur at the site as a result of ecological receptors' exposure to COPCs, ecological endpoints were selected. An ecological endpoint is a characteristic of an ecological component that may be affected by exposure to a stressor, such as a chemical. Assessment endpoints represent environmental values to be protected and generally refer to characteristics of populations and ecosystems (EPA, 1994b). Unlike the human health risk assessment process, which focuses on individual receptors, the ERA focuses on populations or groups of interbreeding non-human, non-domesticated receptors. In the ERA process, risks to individuals are assessed only if they are protected under the Endangered Species Act, as well as species that are candidates for protection or are considered rare.

Given the diversity of the biological world and the multiple values placed on it by society, there is no universally applicable list of assessment endpoints. Therefore, EPA, in the *Proposed Guidelines for Ecological Risk Assessment* (EPA, 1996a) has suggested three criteria that should be considered in selecting assessment endpoints suitable for a specific ecological risk assessment. These criteria are: ecological relevance, susceptibility to the contaminant(s), and representation of management goals.

- Ecological relevance. The assessment endpoint should have biological/ecological significance to a higher level of the ecological hierarchy. Relevant endpoints help sustain the natural structure, function, and biodiversity of an ecosystem. For example, an increase in mortality or a decrease in fecundity of individuals is ecologically significant if it affects the size or productivity of the population. Likewise, a decrease in the size of a population is ecologically significant if it affects the number of species, the productivity, or some other property of the ecosystem.

- Susceptibility to the contaminant(s). The assessment endpoint should be susceptible to exposure to the contaminant(s) and should be responsive/sensitive to such exposure. That is, assessment endpoints should be chosen that are likely to be exposed to contaminants at the site, either directly or indirectly (e.g., through the food chain), and they should be sensitive enough that such exposure may elicit an adverse response. Ideally, this sensitivity should be at such a level that other site-related receptors of potential concern are adequately protected under the selected endpoint's response threshold.

- Representation of management goals. The value of a risk assessment depends on whether it can support quality management decisions. Therefore the assessment is based on values and organisms that reflect management goals. The protection of ecological resources (e.g., habitats and species of plants and animals) is a principal motivation for conducting ERAs. Key aspects of ecological protection are presented as policy goals, which are general goals established by legislation or agency policy based on societal concern for the protection of certain environmental resources. For example, environmental protection is mandated by a variety of legislation and government agency policies (e.g., CERCLA, National Environmental Policy Act). Other legislation includes the Endangered Species Act, 16 U.S.C. 1531-1544 (1993, as amended) and the Migratory Bird Treaty Act, 16 U.S.C. 703-711 (1993, as amended). **Table F-10** shows the policy goals established for the site. To determine whether these protection goals are met at the site, assessment and measurement endpoints are formulated that define the specific ecological values to be protected and the degree to which each may be protected.

The Depot does not provide habitat for any threatened or endangered species; therefore, the assessment endpoint of no reduction in numbers of any threatened/endangered species is met. However, the available field surveys indicate that the site is likely to be used by mammal populations. Accordingly, the assessment endpoint that has been selected to represent the policy

TABLE F-10
POLICY GOALS, ECOLOGICAL ASSESSMENT AND MEASUREMENT ENDPOINTS, AND DECISION RULES
SEAD-63 EE/CA
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Policy Goals	Assessment Endpoint	Measurement Endpoint	Decision Rule
Policy Goal 1: The conservation of threatened and endangered species (TES) and their critical habitats	**Assessment Endpoint 1:** No reduction in numbers of any state- or federally-designated TES	**Measurement Endpoint 1:** Biosurveys for TES plants and animals; COPC concentration in physical media and predicted concentration in prey species	**Decision Rule for Assessment Endpoint 1:** If TES are not present, or COPC Maximum concentrations in the media do not exceed toxicity screening thresholds or dietary NOAELS (i.e., HQ<1), the assessment endpoint is met and TES are not at risk
Policy Goal 2: The protection of terrestrial populations and ecosystems	**Assessment Endpoint 2:** No substantial adverse effect on populations of small mammals (i.e., deer mouse)	**Measurement Endpoint 2:** Lowest chronic, dietary, non-lethal effect level of COPCs on mice	**Decision Rule for Assessment Endpoint 2:** If ratios of estimated exposure concentrations predicted from COPC Maximum concentrations in soil to dietary limits corresponding to LOAEL toxicity reference values for adverse effects on deer mice (HQs) are <1, th

COPC = constituent of potential concern.
TES = threatened and endangered species.
NOAEL = no observed adverse effect level.
LOAEL = lowest observed adverse effect level.
HQ = hazard quotient.

goal of protection of terrestrial populations and ecosystems is "no substantial adverse effect on survival, growth, and reproduction of resident mouse populations."

Surface water as it exists intermittently in drainage ditches at the site does not directly support aquatic life. Sediment sampled from the drainage ditches is more similar to soil than sediment associated with a surface water body (e.g., river or lake), from an ecological exposure standpoint. Therefore, these media do not pose an ecological risk to aquatic life. Exposure to chemicals found in surface water was not quantitatively assessed for potential impacts to terrestrial receptors. As is discussed above in **Section F6.2**, exposure to chemicals found in site sediments was assessed by combining the SEAD-63 sediment and shallow soil datasets.

Receptor Selection

Site-specific receptors were selected to represent assessment endpoints based principally on their importance in the community food web; their susceptibility (through exposure and sensitivity) to the site-related constituents, the amount of available data describing their potential for exposure and the toxicological effects that may result from exposure; and the extent to which they represent management goals. The native mouse species inhabiting areas of SEDA are the most appropriate receptor species for soil, and the relevant assessment endpoint was defined as "no substantial adverse effect on resident mouse populations." Given the predominately herbaceous nature of the site, the deer mouse (*Peromyscus maniculatus*) was selected as the species with the niche best met by conditions present at the site. These are the vertebrate receptors most likely to be maximally exposed to contaminants in soil at the site. They also represent a significant component of the food chain, feeding on seeds and berries and soil invertebrates and providing prey for predators. Therefore, the deer mouse was selected as the receptor species at this site and measures of effects (measurement endpoints) were selected that could be extrapolated to predict effects on the assessment endpoints. Databases and available literature were searched for toxicity data for deer mice or other native rodent species. In the absence of site-specific data, laboratory-derived data on mortality or reproductive effects were used as measurement endpoints. In the absence of data on native species, data for laboratory rodents such as laboratory mice (*Mus musculus*) and laboratory rats (*Rattus norvegicus*) were used.

A second terrestrial receptor, the short-tail shrew, was also evaluated. The shrew was selected because more of its diet is derived from soil invertebrates than the deer mouse. Therefore, the shrew may be more susceptible than the mouse to the effects of COPCs that bioaccumulate in soil biota. The shrew is a more conservative receptor than the mouse for COPCs that may bioaccumulate.

A raptor, such as a red-tailed hawk, was initially considered as a potential receptor for this ERA. However, the home range of a hawk, approximately 1800 acres or more (USEPA 1993, Wildlife Exposure Factors Handbook), is much greater than the area of the site considered in this assessment. SEAD-63 is approximately 4 acres in area. Therefore, it is unlikely that a hawk would derive a significant portion of its diet from prey at the site. As a result, the raptor was not further evaluated in this ERA.

In order to further evaluate the potential effects of contaminants uptaken by plants, a seed eating species was selected. The mourning dove, a granivorous bird, was selected. It was assumed that the majority of the doves diet consists of plant matter with minor contributions from surface soil and animal matter. The dove was considered to be representative of the maximum exposure for seed-eating birds.

A second bird receptor, the American robin, was also evaluated. The American robin was selected because a larger portion of its diet is derived from soil invertebrates than the mourning dove. Therefore, the robin may be more susceptible than the dove to the effects of COPCs that bioaccumulate in soil biota. The robin is a more conservative receptor than the mouse for COPCs that may bioaccumulate.

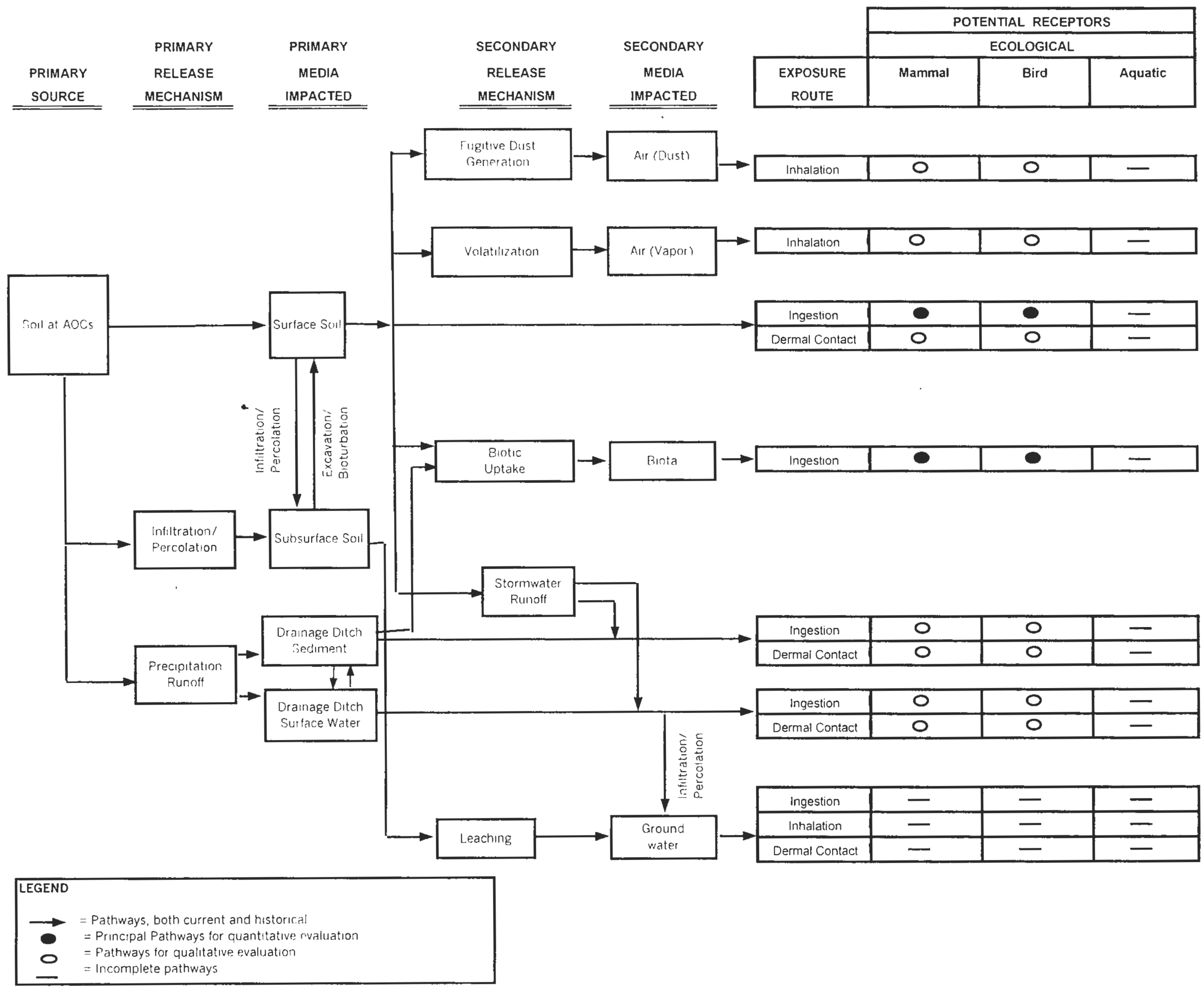
Ecological Conceptual Site Model

The conceptual site model (CSM) presents the ecological receptors at the site that are potentially exposed to hazardous substances in soil across several pathways (**Figure F-2**). A complete exposure pathway consists of the following four elements:

- A source and mechanism of contaminant release to the environment
- An environmental transport mechanism for the released contaminants
- A point of contact with the contaminated medium
- A route of contaminant entry into the receptor at the exposure point.

If any of these elements is missing, the pathway is incomplete and is not considered further in the ERA. A pathway is complete when all four elements are present and permit potential exposure of a receptor to a source of contamination. Quantification of some potentially complete pathways may not be warranted because of minimal risk contribution relative to other major pathways. The dominant pathways from sources and exposure media through the food web to ecological receptors potentially exposed to ecological COPCs at the site are presented in **Figure F-2**.

Figure 5.6-1 Ecological Conceptual Site Model
SENECA ARMY DEPOT ACTIVITY



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The CSM will serve as a conceptual hypothesis for the exposure characterization, the objective of which is to gather information from which to determine the pathways and media through which ecological receptors may be exposed to COPCs. The exposure characterization typically involves determining the following (EPA, 1994b):

1. The ecological setting of the site
2. The inventory of constituents that are or may be present at the site
3. The extent and magnitude of the constituent concentrations present, along with spatial and temporal variability of those concentrations
4. The environmental fate and transport of the constituents.

The ecological setting was described in **Section F.6.2.2** and the extent and magnitude of contaminants is presented in **Section F.2**. Environmental fate of the COPCs and the potential exposure pathways are discussed in the following paragraphs.

The primary source of contaminants at the site is the residues that may be present in the soil from prior activities at the site. Contamination, if present, can migrate due to bioturbation or excavation. Volatile compounds can move through the soils. Infiltrating rainwater can leach contaminants and transport them into groundwater, and surface water runoff can also carry contaminants onto adjacent soils or drainage ditches.

Exposure to surface soil contaminants may occur directly through ingestion, inhalation, and/or dermal contact. Chemicals also may migrate further in the environment by a variety of pathways following secondary release from surface soil and deeper soil. The following pathways result from these secondary release mechanisms:

- Suspension and dispersal by the wind of particulate contaminants or contaminants adsorbed to surface soil particles
- Direct volatilization of volatile organic compounds from surface soil to air
- Uptake of soil contaminants by terrestrial organisms
- Transport of chemicals to surface water and sediment by surface runoff of water and soil particles

As shown in the CSM, there are five media through which ecological receptors could be exposed to site-related contaminants: air (dust and vapor), soil, surface water, sediment, and organisms in the food chain. An exposure point is a location where a receptor could potentially come into contact with a contaminated medium. An exposure route is the means by which a receptor comes into contact with a contaminated medium at an exposure point. Exposure to COPCs may occur through the routes of ingestion, inhalation, and dermal contact.

Probable exposure routes (i.e., potentially complete pathways) were identified for each medium based on the physical characteristics of the site and the potential ecological receptors that may occur there. Exposure routes were also identified for ecological receptors. Principal pathways for which analytical data were available for quantitative evaluation of soil COPCs include: ingestion of soil and ingestion of other animals and plants that have accumulated contaminants.

Terrestrial animals could potentially be directly exposed to soil contaminants through ingestion of, dermal contact with, and/or inhalation from site soils. For species such as deer, raccoon, opossum, rabbits, rodents, and birds, such exposures would likely be associated with foraging activities. Burrowing species, such as rabbits, mice, moles, and shrews, would probably receive the greatest exposures among vertebrates. Invertebrates living on and within the soil also may experience significant exposures. Although ingestion is the principal soil exposure route, dermal contact also may be important, particularly for burrowing species. However, the limited dermal permeability database available for ecological receptors and surrogate species precluded quantitative evaluation of the dermal exposure pathway.

Ecological receptors could potentially be exposed to site-related contaminants via the air medium. Contaminants in air may be in the form of vapor from volatile organic compounds, or in particulate form (as dusts or adsorbed to soil particles) suspended by wind. In either form, ecological receptors could be exposed to contaminants through inhalation. However, the lack of applicable inhalation toxicity data for ecological receptors or similar species precluded quantitative evaluation of potential risks.

Plants may be considered ecological receptors as well as a pathway or medium through which wildlife receptors can be exposed to contaminants. Plants may absorb site-related contaminants from soil through their roots. Contaminants absorbed by plants may then be transferred to wildlife when the plants are ingested for food. This exposure pathway was addressed by use of chemical-specific soil-to-plant uptake factors (obtained from the scientific literature) in the animal receptor exposure calculations. No plants on or near the site showed visible signs of stress during the field reconnaissance.

Under the future land use scenarios for the site, it is assumed that contaminated soils may be excavated during construction and distributed on the ground surface. As under current conditions, ecological receptors could potentially be exposed to chemicals in soil through ingestion and dermal contact. Other exposure pathways also were assumed to remain essentially the same as under current conditions, except that possible inhalation exposures are likely to be reduced by paving and vegetation (e.g., lawns). The abundance and diversity of some ecological receptors on the site may likely be reduced due to the development.

F.6.2.4 Analysis Plan

The analysis plan is the final stage of problem formulation. In this step, risk hypotheses presented in the CSM are evaluated to determine how these hypotheses will be assessed using site-specific data. The analysis plan includes three categories of measures to evaluate the risk hypotheses identified in the CSM: measures of effect (also termed measurement endpoints), measures of exposure, and measures of ecosystem and receptor characteristics.

Measures of Effect

Measurement endpoints are measurable responses to a stressor that are related to the valued characteristics chosen as assessment endpoints (EPA, 1992). Assessment endpoints generally refer to characteristics of populations and ecosystems. It is usually impractical to measure changes in these characteristics as part of an assessment. Consequently, measurement endpoints are selected that can be measured and extrapolated to predict effects on assessment endpoints (EPA, 1992). The most appropriate measurement endpoint relating to the assessment endpoint is the lowest concentration of the constituent that, in chronic toxicity tests, is associated with non-lethal effects to a deer mouse or short-tailed shrew. Because the assessment endpoint focuses on maintenance of the population of deer mice, shrews, robins and doves, a measure of effect equivalent to "no effect" would be overly conservative, in that it would reflect protection of the individual, not the population. A more appropriate measure of effect, reflecting population level response, is the lowest non-lethal effect level. Toxicity data from tests that measure responses that influence reproduction, health, and longevity of the mouse will conform to the assessment endpoint. Therefore, the lowest concentration of the constituent that produces such effects will be used as a measure of effects.

Reliable measures of effects are not available for each exposure route for each constituent. Effects from exposure through inhalation and dermal contact are not well developed for ecological receptors; consequently, these exposure routes are analyzed qualitatively.

The measures of ecosystem and receptor characteristics include such characteristics as the behavior and location of the receptor and the distribution of a contaminant, both of which may affect the receptor's exposure to the contaminant. The typical foraging area of the receptor as well as the quality of the habitat in the site have been considered in the estimation of exposure, as discussed in **Section F.6.3.**

Measures of Exposure

Measures of exposure are the amounts, in dosage or concentration, that the receptors are hypothesized to receive. These include concentrations of constituents in the impacted media and concentrations or dosages of the constituents to which the receptor is exposed.

Decision rules are specified for evaluating effects on the assessment endpoints. **Table F-10** shows the decision rules that describe the logical basis for choosing among alternative actions for the assessment endpoints based on the results of the measurement endpoints. Together, the assessment endpoint, measurement endpoint, and decision rule define the following:

- An entity (e.g., deer mouse population)
- A characteristic of the entity (e.g., health of the individuals in the population)
- An acceptable amount of change in the entity (e.g., loss of no more than 20 percent of a population)
- A decision whether the protection goal is or is not met.

For soil exposures, the results of the assessment will be presented in terms of hazard quotients (HQs). The HQ is the ratio of the measured or predicted concentration of an ecological COPC to which the receptors are exposed in an environmental medium, and the measured concentration that adversely affects an organism based on a toxicity threshold. If the measured concentration or estimated dose is less than the concentration or dose expected to have the potential to produce an adverse effect (i.e., the ratio of the two is less than 1), the risk is considered acceptable (protective of the ecological receptor). Any quotient greater than or equal to 1 indicates that the ecological COPC warrants further evaluation to determine the actual likelihood of harm. COCs are selected only after an additional weight-of-evidence evaluation of the conservatism of the exposure assumptions, toxicity values, and uncertainties is conducted.

Due to the ephemeral nature of surface water accumulation in the drainage ditches and the limited exposure of valued ecological receptors to surface water or sediment in the ditches, these media are not quantitatively assessed in this ERA.

Measures of Ecosystem and Receptor Characteristics

Section F.6.3.3 discusses the toxicity values associated with the COPCs. Endpoints stated in terms of specific ecological receptors or exposure classes (groups of species exposed by similar pathways) often require data on the processes that increase or decrease the exposure concentration below or above the measured or predicted environmental concentration. Thus, some quotients incorporate exposure factors (e.g., dietary soil fractions and bioaccumulation factors). **Section F.6.3** discusses exposure factors for the site.

F.6.3 Exposure Assessment

The exposure assessment evaluates potential exposure of ecological receptors to site-related constituents through evaluation of the following:

- Description of the spatial distribution of COPCs
- Description of spatial and temporal distribution of ecological receptors
- Quantification of exposure that may result from overlap of these distributions

Each of these components is discussed below.

F.6.3.1 Constituent Distribution

The extent of measured chemical contamination at the site is restricted to the areas sampled within the site. The area of the SEAD-63 is approximately 4 acres, which is less than 1 percent of the 10,000 acre Depot property. Soil located outside this site is presumed to be relatively clean.

The magnitude of constituent exposures that may be experienced by ecological receptors is affected by the degree of their spatial and temporal associations with the site, as discussed in the following sections.

F.6.3.2 Receptor Distribution

A variety of factors may affect the extent and significance of potential exposures. Receptor exposures are affected by the degree of spatial and temporal association with the site. For example, the receptors' mobility may significantly affect their potential exposures to site-related contaminants. Many species may only inhabit the study area during seasonal periods (e.g., breeding season, non-migratory periods). Non-migratory species may remain in the vicinity throughout the year. These species, particularly those with longer life spans (and usually larger home ranges), have the greatest potential duration of exposure. However, species with small home range sizes have the greatest potential frequency of exposure. Other factors affecting exposures include habitat preference, behavior (e.g., burrowing, rooting, foraging), individual home range size (larger home ranges correspond to far less frequent use of study area), and diet. Diet is of particular importance in exposure as related to (1) food source availability (larger amount of preferred food sources equals a greater potential for receptor usage) and (2) bioaccumulative contaminants. Contaminants that bioaccumulate may also tend to biomagnify in the food chain. This discussed in more detail in the following sections. As a result, predatory species at higher trophic levels may receive their most significant exposures through their prey. However, the possibility of a population of an upper trophic-level predator, or even an individual predator, utilizing the site as a primary source of food is considered extremely remote.

The deer mouse and short-tailed shrew each have a typical home range of approximately 0.15 acres (EPA, 1993). The area of the site is approximately 4 acres, which could constitute 100 percent of the home range of a deer mouse or shrew.

The mourning dove has a typical home range of approximately 29 acres (EPA, 1993). The area of the site is 4 acres; thus, SEAD-63 could represent roughly 12 percent of a mourning dove's home range. Comparatively, a robin's home range is roughly 1 to 2 acres (EPA, 1993), which would suggest that SEAD-63 could constitute 100 percent of its exposure.

F.6.3.3 Quantification of Exposure

Evaluation of the degree to which contaminant and receptor distributions (described in the previous two sections) coincide at the site indicated that the two mammals (i.e., deer mouse and short-tailed shrew) and the two birds (i.e., mourning dove and American robin) are the receptors likely to have the greatest potential exposures to COPCs in soil.

To quantify exposures of terrestrial receptors to each COPC, a daily intake of each constituent was calculated. Conversion of the environmental concentration of each COPC to an estimated daily intake for a receptor at the site was necessary prior to evaluation of potentially toxic effects. For terrestrial animal receptors, calculation of exposure intake rates relied upon determination of an organism's exposure to COPCs found in soil. Exposure rates for the deer mouse and shrew receptors were based upon ingestion of contaminants from this medium and also from consumption of other organisms. The ERA did not attempt to measure potential risk from dermal and/or inhalation exposure pathways given the insignificance of these pathways relative to the major exposure pathways (e.g., ingestion) and due to the scarcity of data available for these pathways.

The first step in measuring exposure rates for terrestrial wildlife was the calculation of food ingestion rates for four indicator species (i.e., the deer mouse, short-tailed shrew, mourning dove, and American robin). The EPA's *Wildlife Exposure Factors Handbook* (EPA, 1993) includes a variety of exposure information for a number of avian, herptile, and mammalian species. Data are directly available for body weight, ingestion rate, and dietary composition for the deer mouse, short-tailed shrew, and the American robin. Data provided for the northern bobwhite were used as a surrogate for the mourning dove.

To provide conservative exposure rate calculations for the deer mouse, the mean body weight of 0.02 kg for the female deer mouse and the maximum food ingestion rate of 0.22 g/g-day (0.0044 kg/day) for a non-lactating mouse were used (EPA, 1993).

To provide conservative exposure rate calculations for the short-tailed shrew, the lowest reported mean body weight of 0.015 kg and the maximum food ingestion rate of 0.6 g/g-day (0.009 kg/day) for a short-tailed shrew were used (EPA, 1993).

For exposure rate calculations for the American robin, the average reported body weight of 0.077 kg and the average food ingestion rate of 1.205 g/g-day (0.093 kg/day) for an American robin were used (EPA, 1993).

For exposure rate calculations for the mourning dove, the average reported body weight of the northern bobwhite of 0.174 kg and the average food ingestion rate of 0.0777 g/g-day (0.01347 kg/day) were used (EPA, 1993).

A site foraging factor (SFF) is calculated to account for the reasonably expected use of an exposure group. Because of the small area of their home ranges and their year-round residence, mice and other small mammals living at most of the sites could potentially use contaminated areas 100 percent of the time. Therefore, a SFF of 1 was used for both the shrew and the mouse. The American Robin is a seasonal visitor to the New York area (mid-April to early November or approximately 7 months). Its home range is approximately 1 acre, and as a result a SFF of 0.583 has been applied to it. Conversely, the Mourning Dove is a year round visitor to New York, but its home range encompasses approximately 29 acres. Given these two factors, a SFF of 0.12 has been used in the calculations completed for the dove.

The *Wildlife Exposure Factors Handbook* (EPA, 1993) also presents average values for intake of animal matter and plant matter for the deer mouse as well as incidental soil ingestion. Soil ingestion has been measured at less than 2 percent of diet (Beyer et al., 1994). As might be expected based on the opportunistic habits of mice, the proportion of animal to plant matter in the diet varies from around 65 percent animal : 35 percent plant to 25 percent animal : 75 percent plant depending on season and region of the country. For this ERA, an approximate average of 50 percent animal : 50 percent plant was used, after subtracting the 2 percent for incidental soil ingestion. The dietary intakes calculated for this assessment are as follows:

Total Dietary Intake = 0.0044 kg food/day

Plant Matter Intake	=	0.00216 kg plant matter/day
Animal Matter Intake	=	0.00216 kg animal matter/day
Incidental Soil Intake	=	0.000088 kg soil/day

The short-tailed shrew is primarily carnivorous, with its diet consisting largely of insects and other invertebrates found in the soil. Based on information provided in EPA 1993, 5.3 percent of the shrew's diet is vegetative, with most of the remainder comprised of soil invertebrates. To be conservative in terms of potential bioaccumulation, it was assumed that 94.7 percent of the shrew's intake is animal matter (small insects, etc.) and none of the intake is soil. Accordingly, the shrew's dietary intakes calculated for this assessment are as follows:

Total Dietary Intake	=	0.009 kg food/day
Plant Matter Intake	=	0.00048 kg plant matter/day
Animal Matter Intake	=	0.00852 kg animal matter/day
Incidental Soil Intake	=	0 kg soil/day

The American Robin's diet includes ground dwelling invertebrates, foliage dwelling insects and fruits. The robin's diet varies significantly throughout the year, exhibiting a high insect and invertebrate intake in the spring and a high plant material intake characteristic in the fall. Averaging the dietary characteristics over these three seasons results in an average invertebrate intake of 44 % and an average plant material intake of 56%. Soil ingestion for the American woodcock (surrogate species) has been measured at approximately 10.4 percent of diet (Beyer et al., 1994). For this ERA, an approximate average of 44 percent invertebrate : 56 percent plant was used, after subtracting the 10.4 percent for incidental soil ingestion. The dietary intakes calculated for this assessment are as follows:

Total Dietary Intake	=	0.093 kg food/day
Plant Matter Intake	=	0.0466 kg plant matter/day
Invertebrate Matter Intake	=	0.0366 kg animal matter/day
Incidental Soil Intake	=	0.0096 kg soil/day

The dietary habits of the mourning dove are based on information provided in EPA 1993 for the northern bobwhite. Over the course of the year, the average food ingestion rate for the mourning dove is 0.0778 g/g-day (0.0122 kg/day). Of this material, approximately 85 percent of it is derived from plant matter while the balance is derived from invertebrates. Soil ingestion is estimated at approximately 10.4 percent of diet (Beyer et al., 1994). For this ERA, an approximate average of 15 percent invertebrate : 85 percent plant was used, after subtracting the 1.3 percent for incidental soil ingestion. The dietary intakes calculated for this assessment are as follows:

Total Dietary Intake	=	0.01221 kg food/day
Plant Matter Intake	=	0.00164 kg plant matter/day
Invertebrate Matter Intake	=	0.00931 kg animal matter/day
Incidental Soil Intake	=	0.00125 kg soil/day

A summary of species intake factors used for the subject mammals and birds is provided in **Table F-11**.

A site-specific exposure dose of each COPC was calculated using a food chain uptake model consistent with EPA Region IV guidance (EPA, 1995). This algorithm accounts for exposure via incidental ingestion of contaminated soil, ingestion of plants grown in contaminated soil, and ingestion of lower trophic level animals associated with contamination. The exposure equation for soil is as follows:

$$ED_{soil} = [(C_s \times SP \times CF \times I_p) + (C_s \times BAF \times I_a) + (C_s \times I_s)] \times SFF / BW$$

where:

ED_{soil}	=	Soil exposure dose for terrestrial receptor (mg/kg/day)
C_s	=	RME concentration in soil (mg/kg)
SP	=	Soil-to-plant uptake factor (unitless)
CF	=	Plant wet-weight-to-dry-weight conversion factor (unitless) = 0.2 (used for SP values based on plant dry weight)
I_p	=	Receptor-specific ingestion rate of plant material (kg/day)
BAF	=	Constituent-specific bioaccumulation factor (unitless)
I_a	=	Receptor-specific ingestion rate of animal material (kg/day)
I_s	=	Receptor-specific ingestion rate of soil (kg/day)
SFF	=	Site foraging factor (unitless) = 1 (see explanation below)
BW	=	Body weight (kg)

In evaluating the potential for a contaminant to pose ecological risk, it is important to consider its propensity for bioaccumulation even though its concentration in an environmental medium may be below toxic levels. Therefore, all COPCs were evaluated with regard to their ecological persistence and tendency to bioaccumulate.

Bioaccumulation is the process of absorption and retention of a substance by an organism due to both uptake from water (or other surrounding media) and uptake from ingested residues in food, soil, and/or sediment. It is quantified by the calculation of a bioaccumulation factor (BAF).

TABLE F-11
WILDLIFE INTAKE FACTORS
SEAD-63 EE/CA
Seneca Army Depot Activity

Receptor Seneca Army Depot	Body Weight (kg) (3)	Trophic Level(1)	Foraging Factor(2)	Dietary Intake Breakdown (3)			
				Plant (kg/day) Ip	Animal (kg/day) Ia	Soil (kg/day) Is	Surface Water (L/day) Iw
SEAD-63							
Deer Mouse (3)	0.020	3	1	0.00216	0.00216	0.000088	--
Short-tailed Shrew (3)	0.015	3	1	0.00048	0.00852		0.00330
American Robin (3)	0.077	3	0.583	0.03658	0.04656	0.00965	0.0106
Mourning Dove (3)	0.157	2	0.1204	0.00931	0.00164	0.00125	--

(1) Trophic level: organisms are assigned to trophic levels of 1 (producer), 2 (herbivore), 3 (1st order carnivore), and 4 (top carnivore) within the food web.

(2) Foraging factor: adjustment factor (from 0 to 1) based upon an organism's total time of exposure to unit-based contaminants. Foraging factor includes consideration of foraging range and period of occupancy in an area. If the foraging range is smaller than the identified size of the SEAD (~ 3.44 acres), a factor of 1 is applied. If the species is only present in an area during part of the year a seasonal occupancy factor is applied. Based on information provided in Wildlife Exposure Factors Handbook US EPA 1993 and 1997.
Deer Mouse is a year round resident; Home range = less than 1 acre
Deer Mouse SFF = (3.44 acre / 1 acre home range mouse) or 1 x (12 months/ 12 months/year) = 1.0
Short-tailed shrew is a year round resident; Home range = less than 1 acre
Deer Mouse SFF = (3.44 acre / 1 acre home range mouse) or 1 x (12 months/ 12 months/year) = 1.0
American Robin in New York mid-April through early November (7 months); Home range = 1.1 acres. SFF = 1 x 7/12 = .583
American Robin SFF = (3.44 acre / 1 acre home range robin) or 1 x (7 months/ 12 months/year) = 0.583
Mourning Dove in New York all year (12 months); Home range = 28.6 acres
Mourning Dove SFF = (3.44 acre / 28.6 acre home range dove) X (12 months /12 months) = 0.1204

(3) Deer Mouse body weight and plant matter, animal matter, and surface water ingestion rates from Wildlife Exposure Factors Handbook USEPA 1993 and USEPA 1997; soil intake rate based on Beyer et al. (1994).
Short-tail Shrew body weight and plant matter, animal matter, and surface water ingestion rates from Wildlife Exposure Factors Handbook USEPA 1993 and USEPA 1997.
American Robin body weight and plant matter, animal matter, and surface water ingestion rates from Wildlife Exposure Factors Handbook USEPA 1993 and USEPA 1997; soil intake rate (I.e., 10.4%) based on American woodcock in Beyer et al. (1994).
Mourning Dove body weight and plant matter and animal matter ingestion rates based on northern bobwhite in USEPA (1998); soil intake rate (i.e., 10.4%) based on American woodcock in Beyer et al. (1994).

Bioconcentration is a component of bioaccumulation, accounting only for the process of uptake from the surrounding medium (usually water). It is quantified by the calculation of a bioconcentration factor (BCF). Both BAFs and BCFs are proportionality constants relating the concentration of a contaminant in the tissues of an organism to the concentration in the surrounding environment (Amdur et al., 1991; EPA, 1989).

Bioaccumulation and bioconcentration may be a significant component of exposure to COPCs for the terrestrial receptors. For the species considered in this ERA (i.e., deer mouse, short-tailed shrew, American robin, and mourning dive), bioaccumulation was evaluated by means of contaminant-specific soil-to-plant uptake factors and BAFs. The soil-to-plant uptake factors were obtained from NRC (1992) for metals and for organic compounds by using a regression equation from Travis and Arms (1988). The latter is based on the contaminant-specific octanol/water partition coefficient (log K_{OW}). BAFs were obtained from the scientific literature. Factors reflecting accumulation of COPCs in earthworms were preferentially selected, based on the feeding habits of the deer mouse, shrew and robin. **Table F-12** shows values for soil-to-plant uptake factors and BAFs.

F.6.3.4 Effects Assessment

The effects assessment defines and evaluates the potential ecological response to ecological COPCs in terms of the selected assessment and measurement endpoints. The effects assessment for soil exposure includes the derivation of toxicity reference values (TRVs) that are the basis of the comparison. **Section F.6.4** uses the results of the toxicity assessment to identify ecological COCs and characterize ecological risk.

For soil, the methodology for assessing the potentially toxic effects of COPCs was based on the derivation of a TRV for each COPC. The TRVs were derived to represent reasonable estimates of the constituent concentrations that, if exceeded, may produce toxicity effects in ecological receptors exposed to soil. Ideally, TRV values would be based on site-specific toxicity data. However, in the absence of site-specific data, toxicity data from the literature were used by establishing data selection criteria such that TRVs would be as relevant as possible to assessment endpoints for this site. Furthermore, the conservativeness of the TRVs was reinforced by using the lowest available, appropriate toxicity values and modifying them by uncertainty factors when necessary. The derivation of TRVs for soil is shown in **Table F-13** for mammals and **Table F-14** for birds.

The toxicity benchmarks used as effects thresholds for the evaluation of the assessment endpoint (maintenance of healthy populations of small mammals) are based on NOAELs for test organisms (Sample et al., 1996). The NOAEL (no observed adverse effect level) is the highest

Table F-12

ENVIRONMENTAL FATE AND TRANSPORT PROPERTIES FOR CHEMICALS OF POTENTIAL CONCERN

Action Memorandum/EE/CA - SEAD-63

Seneca Army Depot Activity

Constituent	Soil to Plant Transfer Factors (STP)			Trophic Level 2 BAF (invertebrates)	
	logKow (1)	STP(2)	Source	BAF	Source
Volatile Organics					
Acetone	-0.24	5.33E+01	Travis & Arms 1988	3.90E-01	Sample et al., 1996
Benzene	2.11	2.34E+00	Travis & Arms 1988	2.45E+01	Sample et al., 1996
Methyl ethyl ketone	0.26	2.74E+01	Travis & Arms 1988	9.60E-01	Sample et al., 1996
Toluene	2.5	1.39E+00	Travis & Arms 1988	7.24E+01	Sample et al., 1996
Total Xylenes	3.18	5.62E-01	Travis & Arms 1988	6.00E+00	ATSDR 1990
Semivolatile Organics					
Benzo(a)anthracene	5.9	1.51E-02	Travis & Arms 1988	1.25E-01	Beyer 1990
Benzo(a)pyrene	6.04	1.02E+00	USEPA 1994	4.50E+00	Beyer 1990
Benzo(b)fluoranthene	6.57	6.17E-03	Travis & Arms 1988	3.20E-01	Beyer 1990
Benzo(k)fluoranthene	6.85	4.25E-03	Travis & Arms 1988	2.53E-01	Beyer 1990
Chrysene	5.61	2.22E-02	Travis & Arms 1988	1.75E-01	Beyer 1990
Dibenz(a,h)anthracene	6.36	8.16E-03	Travis & Arms 1988	3.68E-01	Beyer 1990
Fluoranthene	5.22	3.72E-02	Travis & Arms 1988	7.92E-01	Beyer 1990
Fluorene	4.12	1.61E-01	Travis & Arms 1988	3.42E-01	Beyer 1990
Indeno(1,2,3-cd)pyrene	7.7	1.37E-03	Travis & Arms 1988	4.19E-01	Beyer 1990
2-Methylnaphthalene	4.11	1.63E-01	Travis & Arms 1988	3.42E-01	Beyer 1990 (BAP as surrogate)
Naphthalene	3.36	4.43E-01	Travis & Arms 1988	3.42E-01	Beyer 1990 (BAP as surrogate)
Phenanthrene	4.46	1.02E-01	Travis & Arms 1988	1.22E-01	Beyer 1990
Pyrene	5.09	4.43E-02	Travis & Arms 1988	9.20E-02	Beyer 1990
Semi-volatiles					
bis(2-Ethylhexyl)phthalate	4.2	5.10E-03	USEPA 1994	1.20E+01	USEPA 1994
Butylbenzylphthalate	4.78	5.60E-02	Calculated	1.00E+00	Default
Carbazole	1	1.00E+00	Default	1.15E+02	AQUIRE 1997
Dibenzofuran	4.17	1.51E-01	Travis & Arms 1988	1.00E+00	Default
Diethyl phthalate	3	7.14E-01	Travis & Arms 1988	1.17E+00	AQUIRE 1997
Di-n-butylphthalate	4.31	1.25E-01	Travis & Arms 1988	1.25E+00	USEPA 1994 (BEHP as surrogate)
Di-n-octylphthalate	9.2	1.60E-04	USEPA 1994	4.90E+03	USEPA 1994
Phenol	1.48	5.40E+00	Travis & Arms 1988	1.00E+00	Default
Pesticides					
4,4'-DDD	5.99	1.34E-02	Travis & Arms 1988	1.00E-01	USEPA 1994 (DDT as surrogate)
4,4'-DDE	5.766	1.80E-02	Travis & Arms 1988	2.50E-02	Menzie et al., 1992
4,4'-DDT	5.9	1.00E-02	USEPA 1994	1.00E-01	USEPA 1994
Endosulfan I	3.55	3.44E-01	Travis & Arms 1988	2.50E-01	Menzie et al., 1992
Endosulfan sulfate	3.66	2.97E-01	Travis & Arms 1988	2.50E-01	Menzie et al., 1992
Endrin ketone	5.06	2.20E-02	USEPA 1995	1.80E-01	USEPA 1994 (endrin as surrogate)
Metals					
Cadmium	NA	5.50E-01	NRC 1992	2.15E-02	Ash and Lee, 1980
Sodium	NA	1.00E+00	Default	1.00E+00	Default

Notes

(1) Logarithmic value of octonol-water partition coefficient LogKow source Montgomery J H and L M Welkom *Groundwater Chemicals Desk Reference* 1989

(2) Soil to plant uptake factor For organic chemicals without reported STP values the STP was estimated from the Kow as follows logSTP = 1 588 - 0 578 x logKow (Travis and Arms 1988)

(3) This table includes STP and BAF factor information available from Parsons ES-Tampa current database (8/99)

(4) BAF = Bioaccumulation factor

(5) For chemicals without reported STP or BAF values, surrogate or default values were assigned based on best professional judgement

Table F-13
NOAEL TOXICITY REFERENCE VALUES - MAMMALS
Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

Constituent	Test Organism	Endpoint/Duration/Effect	Source	Effect Dose (mg/kg/day)	Endpoint CF(1)	Study Duration CF(1)	Total CF(1)	TRV(2) (mg/kg/day)
Volatile Organics								
Acetone	rat	NOAEL, gavage, 90-day, liver and kidney damage	Sample et al. 1996	100	1	10	10	10
Benzene	mouse	LOAEL, oral gavage, days 6-12 gestation crit lifestage, reproduction	Sample et al. 1996	263.6	10	1	10	26.36
Methyl ethyl ketone	rat	NOAEL, water, 2 generations, reproduction	Sample et al 1996	1771	10	1	10	177.1
Toluene	mouse	LOAEL, gavage, day 6-12 gestation crit. lifestage, reproduction	Sample et al. 1996	260	10	1	10	26
Total Xylenes	mouse	NOAEL, gavage, day 6-15 gestation crit. lifestage, reproduction	Sample et al. 1996	2.1	1	1	1	2.1
PAHs								
Benzo(a)anthracene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Benzo(a)pyrene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction	Sample et al. 1996	10	10	1	10	1
Benzo(b)fluoranthene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Benzo(k)fluoranthene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Chrysene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Dibenz(a,h)anthracene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Fluoranthene	mouse	LOAEL, oral gavage, 13 wks., hepatic effects	ATSDR 1995	125	10	10	100	1.25
Fluorene	mouse	LOAEL, oral gavage, 13 wks., hepatic effects	ATSDR 1995	125	10	10	100	1.25
Indeno(1,2,3-cd)pyrene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
2-Methylnaphthalene	mouse	LOAEL, diet, 81 wks., respitory (naphthalene used as surrogate)	ATSDR 1995	71.6	10	1	10	7.16
Naphthalene	mouse	LOAEL, diet, 81 wks., respitory	ATSDR 1995	71.6	10	1	10	7.16
Phenanthrene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1

Table F-13
NOAEL TOXICITY REFERENCE VALUES - MAMMALS
Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

Constituent	Test Organism	Endpoint/Duration/Effect	Source	Effect Dose (mg/kg/day)	Endpoint CF(1)	Study Duration CF(1)	Total CF(1)	TRV(2) (mg/kg/day)
Pyrene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Semi-volatiles								
bis(2-ethylhexyl)phthalate	mouse	NOAEL, diet, 105 days crit. lifestage, reproduction	Sample et al. 1996	18.33	1	1	1	18.33
Butlybenzylphthalate	rat	NOAEL, diet, 6 months, reproduction, liver weight, blood chemistry	IRIS, 1999	159	1	1	1	159
Carbazole	rat	LD50, oral		500	10	10	100	5
Dibenzofuran	mammal	No data available					--	no data
Diethylphthalate	mouse	NOAEL, diet, 105 day crit. lifestage, reproduction	Sample et al. 1996	4583	1	1	1	4583
Di-n-butylphthalate	mouse	NOAEL, diet, 105 days crit. lifestage, reproduction	Sample et al. 1996	550	1	1	1	550
Di-n-octylphthalate	mouse	NOAEL, diet, 105 days crit. lifestage, reproduction (BEHP as surrogate)	Sample et al. 1996	18.33	1	1	1	18.33
Phenol		No data available					--	no data
Pesticides/PCBs								
4,4'-DDD	rat	NOAEL, diet, 2 year crit. lifestage, reproduction (DDT used as surrogate)	Sample et al. 1996	0.8	1	1	1	0.8
4,4'-DDE	rat	NOAEL, diet, 2 year crit. lifestage, reproduction (DDT used as surrogate)	Sample et al. 1996	0.8	1	1	1	0.8
4,4'-DDT	rat	NOAEL, diet, 2 year crit. lifestage, reproduction	Sample et al. 1996	0.8	1	1	1	0.8
Endosulfan I	mouse	NOAEL, diet, 78-week, renal effects	ATSDR, 1990e	0.5	1	1	1	0.5
Endosulfan sulfate	mouse	Used endosulfan as surrogate		2.5	10	1	10	0.25
Endrin ketone	mouse	LOAEL, diet, 120-day, reproduction (Endrin)		0.92	10	1	10	0.092
Metals								
Cadmium	rat	NOAEL, gavage, 6 weeks mating and gestation crit. lifestage, reproduction	Sample et al. 1996	1	1	1	1	1
Sodium		No data available					--	no data

Notes:
(1) CF = conversion factor. Conversion factors - endpoint (non-NOAEL = 10) and study duration (non-chronic = 10)
(2) The toxicity reference value was derived by dividing the effect dose by the total conversion factor.
(3) This table includes TRV factor information available from Parsons ES-Tampa current database (8/99).
(4) V = Volatile (MW<200, H>1E-05); SV = Semi-Volatile; PAH = Polynuclear Aromatic Hydrocarbon; PES = Pesticide; PCB = Polychlorinated Biphenyl; ING = Inorganic
(5) Mammals: acute = <90days, subchronic = 90days - 1yr, chronic = >1yr. Birds: acute = <18days, subchronic = 18days - 10wks, chronic = >10wks. Source: Sample et al. 1996
If the study is during a critical life stage (gestation or development), the study may be considered a chronic exposure.
(6) The product of the appropriate uncertainty factors from each uncertainty category becomes the total uncertainty factor applied to develop the constituent-specific TRV.

TABLE F-14
NOAEL Toxicity Reference Values - Soil Receptors (Birds)
SEAD 63
Seneca Army Depot Activity

Constituent	Test Organism	Endpoint/Duration/Effect	Source	Effect Dose (mg/kg/day)	Endpoint CF[1]	Study Duration CF[1]	Total CF[1]	TRV[2] (mg/kg/day)
Volatiles								
Acetone	Japanese quail	NOAEL, 14-day old, diet, 5 days, survival	Hill and Camardese 1986	6.10E+03	1	10	10	6.10E+02
Benzene		No data available						
Methyl ethyl ketone		No data available						
Toluene		No data available						
Total Xylenes	Japanese quail	NOAEL, 14-day old chicks, diet, 5 days, survival	Hill and Camardese 1986	3.06E+03	1	10	10	3.06E+02
PAHs								
Benzo(a)anthracene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Benzo(a)pyrene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Benzo(b)fluoranthene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Benzo(k)fluoranthene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Chrysene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Dibenz(a,h)anthracene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Fluoranthene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Fluorene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Indeno(1,2,3-cd)pyrene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
2-Methylnaphthalene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Naphthalene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Phenanthrene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Pyrene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Semi-volatiles								
Bis(2-ethylhexyl)phthalate	ringed dove	NOAEL, diet, 4 wks. crit. lifestage, reproduction	Sample et al. 1996	1.10E+00	1	10	10	1.10E-01
Butylbenzylphthalate		No data available						
Carbazole		No data available						
Dibenzofuran	red-winged blackbird	LC50, diet, 18 hours, survival	Schafer et al. 1983.	2.18E+01	10	10	100	2.18E-01
Diethyl phthalate	ringed dove	NOAEL, diet, 4 wks. crit. lifestage, reproduction (di-n-butyl-phthalate used as surrogate)	Sample et al. 1996	1.10E-01	1	10	10	1.10E-02
Di-n-butylphthalate	ringed dove	NOAEL, diet, 4 wks. crit. lifestage, reproduction	Sample et al. 1996	1.10E-01	1	10	10	1.10E-02
Di-n-octylphthalate	ringed dove	NOAEL, diet, 4 wks. crit. lifestage, reproduction (Di-n-butylphthalate as surrogate)	Sample et al. 1996	1.10E-01	1	10	10	1.10E-02
Phenol		No data available						

TABLE F-14
NOAEL Toxicity Reference Values - Soil Receptors (Birds)
SEAD 63
Seneca Army Depot Activity

Constituent	Test Organism	Endpoint/Duration/Effect	Source	Effect Dose (mg/kg/day)	Endpoint CF[1]	Study Duration CF[1]	Total CF[1]	TRV[2] (mg/kg/day)
Pesticides								
4,4'-DDD	Japanese quail	NOAEL, diet, 10 week, reproduction (DDT used as surrogate)	Sample et al. 1996	5.60E-01	1	10	10	5.60E-02
4,4'-DDE	Japanese quail	NOAEL, diet, 12 wks, reproduction, liver effects	Sample et al. 1996	5.60E-01	1	10	10	5.60E-02
4,4'-DDT	Japanese quail	NOAEL, diet, 10 week, reproduction	Sample et al. 1996	5.60E-01	1	10	10	5.60E-02
Endosulfan I	gray partridge	NOAEL, diet, 4 wks crit. lifestage, reproduction (endosulfan as surrogate)	Sample et al. 1996	1.00E+01	1	10	10	1.00E+00
Endosulfan sulfate	gray partridge	NOAEL, diet, 4 wks crit. lifestage, reproduction (endosulfan as surrogate)	Sample et al. 1996	1.00E+01	1	10	10	1.00E+00
Endrin ketone	mallard	NOAEL, diet, >200 days, crit. lifestage, reproduction (endrin as surrogate)	Sample et al. 1996	3.00E-01	1	1	1	3.00E-01
Metals								
Cadmium	mallard	NOAEL, diet, 90 days, reproduction	Sample et al. 1996	1.45E+00	1	1	1	1.45E+00
Sodium		No data available						

1 CF conversion factor.
2 The toxicity reference value was derived by dividing the effect dose by the total conversion factor.

exposure concentration at which no harmful effects were observed. Use of the NOAEL as the toxicity benchmark is more conservative than use of the LOAEL (lowest observed adverse effect level). Exposure of receptors to the LOAEL has been predicted to translate into less than 20 percent reduction in population size (Suter et al., 1994) or Lowest Observed Effects Concentrations.

For the terrestrial receptor, the order of taxonomic preference when choosing TRVs was data from studies using (1) native small mammal species potentially present at the site, or (2) proxy species, such as commonly studied laboratory species. The preferred toxicity test endpoint was the NOAEL from an appropriate chronic study for non-lethal or reproductive effects. When NOAEL values were not available, LOAELs for were used, as available. Values based on chronic studies were preferred. Studies were considered to provide chronic toxicity data if conducted for a minimum duration of 1 year in mammals. Studies longer than acute but shorter than chronic are considered subchronic. Studies shorter than 90 days in mammals were considered acute. Studies on developmental effects were considered chronic if conducted during a critical gestation period.

The toxicity values selected by this approach were modified through the application of uncertainty factors, as applicable, to derive a TRV for each COPC. The TRVs represent NOAELs with uncertainty factors incorporated for toxicity information derived from studies other than chronic studies and studies on species other than the receptors selected for this risk assessment. Where only a LOAEL was available, an uncertainty factor of 10 was applied, as recommended by EPA Region II, to represent a surrogate NOAEL. In addition, where toxicity information for a surrogate contaminant was used, an uncertainty factor of 10 was applied. Uncertainty factors were applied by dividing the initial toxicity value by the product of the necessary uncertainty factors. Uncertainty factors are listed in **Tables F-13** and **F-14** with the TRVs developed for shallow soil/sediment COPCs.

F.6.4 Risk Characterization

Risk characterization integrates exposure(s) and effect(s) on receptors using hazard quotients (HQs) (ratios of exposure and effect concentrations). The resulting data are used to define the magnitude of risk from ecological COPCs at the site and to assess the risk to ecological receptors. Risk characterization uses the results of the exposure and effects assessments to calculate an HQ for each COPC. The HQs are based on relevant measurement endpoints and are indicative of the COPC's potential to pose ecological risk to receptors. Any COPCs for a given exposure group and medium that were identified as likely to pose significant risk to receptors based on their HQs were classified as ecological chemicals of concern (COCs). Risk assessment related uncertainties are also analyzed and discussed.

Estimation of a COPC's potential to pose significant risk to receptors is based on the magnitude of the HQ value calculated for each constituent, as well as other factors such as the bioaccumulation/biomagnification potential, mechanism of toxicity, physicochemical characteristics, environmental fate, and ecological relevance of each contaminant. The HQ is a ratio of the estimated exposure dose (for terrestrial receptors) of a constituent to the TRV. Generally, a higher ratio or quotient indicates a greater likelihood of an effect. Typically, a quotient of 1 is considered the threshold level at which effects may occur. The TRVs on which the HQs were based were derived to be conservative and representative of chronic exposures, as described previously in **Section F.6.3.3.**

The calculated HQs were used to assess the potential that toxicological effects will occur among the site's receptors. The HQs were compared to HQ guidelines for assessing the risk posed from contaminants (Menzie et al., 1993). These guidelines suggest that HQs less than or equal to 1 present no probable risk; HQs from 1 up to, but less than, 10 present a small potential for environmental effects; HQs from 10 up to, but less than 100 present a significant potential for ecological effects, and HQs greater than 100 present the highest potential for expected effects. The likelihood that a population of deer mice or short-tailed shrews could be significantly impacted by the toxicological effect(s) produced by a given COPC was a major factor in the subsequent determination (in **Section F.6.3.3**) of whether that contaminant should be classified as an ecological COC.

Ecological risk from COPCs was characterized for potential future land use at the site. Risks from constituents found in soil available to terrestrial receptors were assessed quantitatively. Complete exposure calculations for the site are included in **Tables F-15** (mammals) and **F-16** (birds). The hazard quotients calculated for the site are also summarized in **Table F-17** (mammals) and **Table F-18** (birds). Significant findings are summarized in the sections below.

TABLE F-15
CALCULATED SURFACE SOIL/SEDIMENT (0-2' bls) EXPOSURE - MAMMALS
SEAD-63
Seneca Army Depot Activity

Constituent	Max Detected Conc. (mg/kg)	SP[1] (unitless)	BAF[2] (unitless)	Deer Mouse Max Exposure[3] (mg/kg/day)	Shrew Max Exposure[3] (mg/kg/day)
Volatiles					
Acetone	1.50E-01	5.33E+01	3.90E-01	8.70E-01	2.87E-01
Benzene	2.00E-03	2.34E+00	2.45E+01	5.81E-03	2.80E-02
Methyl ethyl ketone	3.50E-02	2.74E+01	9.60E-01	1.07E-01	4.96E-02
Toluene	1.40E-02	1.39E+00	7.24E+01	1.12E-01	5.77E-01
Total Xylenes	1.40E-02	5.62E-01	6.00E+00	9.98E-03	4.80E-02
PAHs					--
Benzo(a)anthracene	2.00E+00	1.51E-02	1.25E-01	3.91E-02	1.43E-01
Benzo(a)pyrene	2.70E+00	1.02E+00	4.50E+00	1.62E+00	6.99E+00
Benzo(b)fluoranthene	3.50E+00	6.17E-03	3.20E-01	1.39E-01	6.37E-01
Benzo(k)fluoranthene	1.90E+00	4.25E-03	2.53E-01	6.11E-02	2.73E-01
Chrysene	2.20E+00	2.22E-02	1.75E-01	5.65E-02	2.20E-01
Dibenz(a,h)anthracene	1.20E+00	8.16E-03	3.68E-01	5.40E-02	2.51E-01
Fluoranthene	4.30E+00	3.72E-02	7.92E-01	4.04E-01	1.94E+00
Fluorene	1.10E-01	1.61E-01	3.42E-01	6.46E-03	2.19E-02
Indeno(1,2,3-cd)pyrene	2.50E+00	1.37E-03	4.19E-01	1.25E-01	5.95E-01
2-Methylnaphthalene	1.40E-02	1.63E-01	3.42E-01	8.25E-04	2.79E-03
Naphthalene	2.30E-02	4.43E-01	3.42E-01	2.05E-03	4.79E-03
Phenanthrene	1.50E+00	1.02E-01	1.22E-01	4.29E-02	1.09E-01
Pyrene	3.20E+00	4.43E-02	9.20E-02	6.12E-02	1.72E-01
Semi-volatiles					--
Bis(2-ethylhexyl)phthalate	1.80E+00	5.10E-03	1.20E+01	2.34E+00	1.23E+01
Butylbenzylphthalate	1.20E-01	5.60E-02	1.00E+00	1.42E-02	6.84E-02
Carbazole	4.30E-01	1.00E+00	1.15E+02	5.39E+00	2.81E+01
Dibenzofuran	3.60E-02	1.51E-01	1.00E+00	4.63E-03	2.06E-02
Diethyl phthalate	9.20E-02	7.14E-01	1.17E+00	1.91E-02	6.33E-02
Di-n-butylphthalate	1.20E-01	1.25E-01	1.25E+00	1.83E-02	8.57E-02
Di-n-octylphthalate	1.90E-02	1.60E-04	4.90E+03	1.01E+01	5.29E+01
Phenol	9.30E-02	5.40E+00	1.00E+00	6.47E-02	6.88E-02
Pesticides					--
4,4'-DDD	3.90E-03	1.34E-02	1.00E-01	6.49E-05	2.23E-04
4,4'-DDE	9.20E-03	1.80E-02	2.50E-02	8.32E-05	1.36E-04
4,4'-DDT	8.30E-03	1.00E-02	1.00E-01	1.35E-04	4.74E-04
Endosulfan I	7.50E-03	3.44E-01	2.50E-01	5.14E-04	1.15E-03
Endosulfan sulfate	5.20E-03	2.97E-01	2.50E-01	3.30E-04	7.88E-04
Endrin ketone	9.40E-03	2.20E-02	1.80E-01	2.46E-04	9.68E-04
Metals					--
Cadmium	8.30E-01	5.50E-01	2.15E-02	1.54E-02	1.30E-02
Sodium	5.78E+02	1.00E+00	1.00E+00	7.75E+01	3.32E+02

1 SP: soil-to-plant uptake factor.
2 BAF: bioaccumulation factor.
3 Exposure calculated as

ED = [(Cs * SP * CF * Ip) + (Cs * BAF * Ia) + (Cs * Is)] * SFF / BW

Where, ED = exposure dose

Cs = maximum or mean concentration in soil (mg/kg)
CF = plant dry-to-wet-weight conversion factor (0.2) for inorganics only
SP = soil-to-plant uptake factor for vegetative matter
Ip = plant-matter intake rate; Mouse = 0.00216 kg/day, Shrew = 0.000477 kg/day.
BAF = invertebrate bioaccumulation factor (unitless)
Ia = animal-matter intake rate; Mouse = 0.00216 kg/day, Shrew = 0.008523 kg/day.
Is = incidental soil intake rate; Mouse = 0.000088 kg/day, Shrew = 0 kg/day.
SFF = site foraging factor = 1
BW = body weight; Mouse = 0.02 kg, Shrew = 0.015 kg

TABLE F-16
CALUCULATED SURFACE SOIL/SEDIMENT (0-2' bls) EXPOSURE - BIRDS
SEAD 63
Seneca Army Depot Activity

Constituent	Max Detected Conc. (mg/kg)	SP[1] (unitless)	BAF[2] (unitless)	Robin Max Exposure[3] (mg/kg/day)	Dove Max Exposure[3] (mg/kg/day)
Volatiles					
Acetone	1.50E-01	5.33E+01	3.90E-01	2.25E+00	5.83E-02
Benzene	2.00E-03	2.34E+00	2.45E+01	1.87E-02	1.10E-04
Methyl ethyl ketone	3.50E-02	2.74E+01	9.60E-01	2.80E-01	7.15E-03
Toluene	1.40E-02	1.39E+00	7.24E+01	3.64E-01	1.52E-03
Total Xylenes	1.40E-02	5.62E-01	6.00E+00	3.28E-02	2.66E-04
PAHs					
Benzo(a)anthracene	2.00E+00	1.51E-02	1.25E-01	2.43E-01	1.53E-02
Benzo(a)pyrene	2.70E+00	1.02E+00	4.50E+00	5.24E+00	5.50E-02
Benzo(b)fluoranthene	3.50E+00	6.17E-03	3.20E-01	6.56E-01	2.75E-02
Benzo(k)fluoranthene	1.90E+00	4.25E-03	2.53E-01	3.10E-01	1.47E-02
Chrysene	2.20E+00	2.22E-02	1.75E-01	3.10E-01	1.71E-02
Dibenz(a,h)anthracene	1.20E+00	8.16E-03	3.68E-01	2.46E-01	9.51E-03
Fluoranthene	4.30E+00	3.72E-02	7.92E-01	1.56E+00	3.73E-02
Fluorene	1.10E-01	1.61E-01	3.42E-01	2.62E-02	9.88E-04
Indeno(1,2,3-cd)pyrene	2.50E+00	1.37E-03	4.19E-01	5.53E-01	1.98E-02
2-Methylnaphthalene	1.40E-02	1.63E-01	3.42E-01	3.34E-03	1.26E-04
Naphthalene	2.30E-02	4.43E-01	3.42E-01	7.27E-03	2.53E-04
Phenanthrene	1.50E+00	1.02E-01	1.22E-01	2.17E-01	1.24E-02
Pyrene	3.20E+00	4.43E-02	9.20E-02	3.77E-01	2.51E-02
Semi-volatiles					
Bis(2-ethylhexyl)phthalate	1.80E+00	5.10E-03	1.20E+01	7.75E+00	4.06E-02
Butylbenzylphthalate	1.20E-01	5.60E-02	1.00E+00	5.29E-02	1.09E-03
Carbazole	4.30E-01	1.00E+00	1.15E+02	1.76E+01	6.86E-02
Dibenzofuran	3.60E-02	1.51E-01	1.00E+00	1.68E-02	3.50E-04
Diethyl phthalate	9.20E-02	7.14E-01	1.17E+02	3.82E+00	1.47E-02
Di-n-butylphthalate	1.20E-01	1.25E-01	1.25E-01	1.82E-02	1.01E-03
Di-n-octylphthalate	1.90E-02	1.60E-04	4.90E+03	3.28E+01	1.17E-01
Phenol	9.30E-02	5.40E+00	1.00E+00	1.79E-01	4.39E-03
Pesticides					
4,4'-DDD	3.90E-03	1.34E-02	1.00E-01	4.37E-04	2.97E-05
4,4'-DDE	9.20E-03	1.80E-02	2.50E-02	7.99E-04	6.96E-05
4,4'-DDT	8.30E-03	1.00E-02	1.00E-01	9.22E-04	6.31E-05
Endosulfan I	7.50E-03	3.44E-01	2.50E-01	1.92E-03	7.63E-05
Endosulfan sulfate	5.20E-03	2.97E-01	2.50E-01	1.27E-03	5.11E-05
Endrin ketone	9.40E-03	2.20E-02	1.80E-01	1.34E-03	7.32E-05
Metals					
Cadmium	8.30E-01	5.50E-01	2.15E-02	9.22E-02	6.82E-03
Sodium	5.78E+02	1.00E+00	1.00E+00	2.78E+02	5.83E+00

1 SP: soil-to-plant uptake factor
2 BAF: bioaccumulation factor.
3 Exposure calculated as
ED = [(Cs * SP * CF * Ip) + (Cs * BAF * Ia) + (Cs * Is)] * SFF / BW
Where, ED = exposure dose
Cs = maximum or mean concentration in soil (mg/kg)
CF = plant dry-to-wet-weight conversion factor (0.2) for inorganics only
SP = soil-to-plant uptake factor for vegetative matter
Ip = plant-matter intake rate; Robin = 0.0366 kg/day, Dove = 0.00931 kg/day
BAF = invertebrate bioaccumulation factor (unitless)
Ia = animal-matter intake rate; Robin = 0.0466 kg/day, Dove = 0.00164 kg/day
Is = incidental soil intake rate; Robin = 0.00965 kg/day, Dove = 0.00125 kg/day
SFF = Robin = 0.583, Dove = 0.120
BW = body weight, Robin = 0.077 kg, Dove = 0.157 kg

TABLE F-17
CALCULATED SURFACE SOIL/SEDIMENT HAZARD QUOTIENTS - MAMMALS
SEAD-63
Seneca Army Depot Activity

Constituent	Deer Mouse Exposure (mg/kg/day) [1]	Short-tailed Shrew Exposure (mg/kg/day) [1]	Toxicity Reference Value (mg/kg/day) [2]	Deer Mouse Hazard Quotient [3]	Short-tailed Shrew Hazard Quotient [3]
Volatiles					
Acetone	8.70E-01	2.87E-01	1.00E+01	0.09	0.03
Benzene	5.81E-03	2.80E-02	2.64E+01	0.00	0.00
Methyl ethyl ketone	1.07E-01	4.96E-02	1.77E+02	0.00	0.00
Toluene	1.12E-01	5.77E-01	2.60E+01	0.00	0.02
Total Xylenes	9.98E-03	4.80E-02	2.10E+00	0.00	0.02
PAHs					
Benzo(a)anthracene	3.91E-02	1.43E-01	1.00E+00	0.04	0.14
Benzo(a)pyrene	1.62E+00	6.99E+00	1.00E+00	**1.62**	**6.99**
Benzo(b)fluoranthene	1.39E-01	6.37E-01	1.00E+00	0.14	0.64
Benzo(k)fluoranthene	6.11E-02	2.73E-01	1.00E+00	0.06	0.27
Chrysene	5.65E-02	2.20E-01	1.00E+00	0.06	0.22
Dibenz(a,h)anthracene	5.40E-02	2.51E-01	1.00E+00	0.05	0.25
Fluoranthene	4.04E-01	1.94E+00	1.25E+00	0.32	**1.55**
Fluorene	6.46E-03	2.19E-02	1.25E+00	0.01	0.02
Indeno(1,2,3-cd)pyrene	1.25E-01	5.95E-01	1.00E+00	0.12	0.60
2-Methylnaphthalene	8.25E-04	2.79E-03	7.16E+00	0.00	0.00
Naphthalene	2.05E-03	4.79E-03	7.16E+00	0.00	0.00
Phenanthrene	4.29E-02	1.09E-01	1.00E+00	0.04	0.11
Pyrene	6.12E-02	1.72E-01	1.00E+00	0.06	0.17
Semi-volatiles					
Bis(2-ethylhexyl)phthalate	2.34E+00	1.23E+01	1.83E+01	0.13	0.67
Butylbenzylphthalate	1.42E-02	6.84E-02	1.59E+02	0.00	0.00
Carbazole	5.39E+00	2.81E+01	5.00E+00	**1.08**	**5.62**
Dibenzofuran	4.63E-03	2.06E-02	no data	--	--
Diethyl phthalate	1.91E-02	6.33E-02	4.58E+03	0.00	0.00
Di-n-butylphthalate	1.83E-02	8.57E-02	5.50E+02	0.00	0.00
Di-n-octylphthalate	1.01E+01	5.29E+01	1.83E+01	0.55	**2.89**
Phenol	6.47E-02	6.88E-02	no data	--	--
Pesticides					
4,4'-DDD	6.49E-05	2.23E-04	8.00E-01	0.00	0.00
4,4'-DDE	8.32E-05	1.36E-04	8.00E-01	0.00	0.00
4,4'-DDT	1.35E-04	4.74E-04	8.00E-01	0.00	0.00
Endosulfan I	5.14E-04	1.15E-03	5.00E-01	0.00	0.00
Endosulfan sulfate	3.30E-04	7.88E-04	2.50E-01	0.00	0.00
Endrin ketone	2.46E-04	9.68E-04	9.20E-02	0.00	0.01
Metals					
Cadmium	1.54E-02	1.30E-02	1.00E+00	0.02	0.01
Sodium	7.75E+01	3.32E+02	no data	--	--

(1) Receptor exposure from Table I-15
(2) Toxicity reference value from Table A-10
(3) Hazard quotient calculated as HQ = exposure rate / toxicity reference value
with HQ < 1, no effects expected
1 < HQ =< 10, small potential for effects
10 < HQ =< 100, potential for greater exposure to result in effects, and
HQ > 100, highest potential for effects

TABLE F-18
CALCULATED SURFACE SOIL/SEDIMENT HAZARD QUOTIENTS - BIRDS
SEAD 63
Seneca Army Depot Activity

Constituent	Robin Max Exposure[1] (mg/kg/day)	Dove Max Exposure[1] (mg/kg/day)	NOAEL Toxicity Reference Value[2] (mg/kg/day)	Robin NOAEL Max Hazard Quotient[3]	Dove NOAEL Max Hazard Quotient[3]
Volatiles					
Acetone	2.25E+00	5.83E-02	6.10E+02	0.00	0.00
Benzene	1.87E-02	1.10E-04	No data	--	--
Methyl ethyl ketone	2.80E-01	7.15E-03	No data	--	--
Toluene	3.64E-01	1.52E-03	No data	--	--
Total Xylenes	3.28E-02	2.66E-04	3.06E+02	0.00	0.00
PAHs					
Benzo(a)anthracene	2.43E-01	1.53E-02	2.85E+01	0.01	0.00
Benzo(a)pyrene	5.24E+00	5.50E-02	2.85E+01	0.18	0.00
Benzo(b)fluoranthene	6.56E-01	2.75E-02	2.85E+01	0.02	0.00
Benzo(k)fluoranthene	3.10E-01	1.47E-02	2.85E+01	0.01	0.00
Chrysene	3.10E-01	1.71E-02	2.85E+01	0.01	0.00
Dibenz(a,h)anthracene	2.46E-01	9.51E-03	2.85E+01	0.01	0.00
Fluoranthene	1.56E+00	3.73E-02	2.85E+01	0.05	0.00
Fluorene	2.62E-02	9.88E-04	2.85E+01	0.00	0.00
Indeno(1,2,3-cd)pyrene	5.53E-01	1.98E-02	2.85E+01	0.02	0.00
2-Methylnaphthalene	3.34E-03	1.26E-04	2.85E+01	0.00	0.00
Naphthalene	7.27E-03	2.53E-04	2.85E+01	0.00	0.00
Phenanthrene	2.17E-01	1.24E-02	2.85E+01	0.01	0.00
Pyrene	3.77E-01	2.51E-02	2.85E+01	0.01	0.00
Semi-volatiles					
Bis(2-ethylhexyl)phthalate	7.75E+00	4.06E-02	1.10E-01	**70**	0.37
Butylbenzylphthalate	5.29E-02	1.09E-03	No data	--	--
Carbazole	1.76E+01	6.86E-02	No data	--	--
Dibenzofuran	1.68E-02	3.50E-04	2.18E-01	0.08	0.00
Diethyl phthalate	3.82E+00	1.47E-02	1.10E-02	**347**	**1.3**
Di-n-butylphthalate	1.82E-02	1.01E-03	1.10E-02	**1.7**	0.09
Di-n-octylphthalate	3.28E+01	1.17E-01	1.10E-02	**2984**	**10.7**
Phenol	1.79E-01	4.39E-03	No data	--	--
Pesticides					
4,4'-DDD	4.37E-04	2.97E-05	5.60E-02	0.01	0.00
4,4'-DDE	7.99E-04	6.96E-05	5.60E-02	0.01	0.00
4,4'-DDT	9.22E-04	6.31E-05	5.60E-02	0.02	0.00
Endosulfan I	1.92E-03	7.63E-05	1.00E+00	0.00	0.00
Endosulfan sulfate	1.27E-03	5.11E-05	1.00E+00	0.00	0.00
Endrin ketone	1.34E-03	7.32E-05	3.00E-01	0.00	0.00
Metals					
Cadmium	9.22E-02	6.82E-03	1.45E+00	0.06	0.00
Sodium	2.78E+02	5.83E+00	No data	--	--

1 Receptor exposure from Table H.30.
2 NOAEL toxicity reference value from Table H.13.
3 Hazard quotient calculated as HQ = exposure rate / toxicity reference value
BOLD : represents receptor HQ > 1.

Mammals

Compound	Deer Mouse Hazard Quotient	Shrew Hazard Quotient
Benzo(a)pyrene	**1.6**	**7.0**
Carbazole	**1.1**	**5.6**
Fluoranthene	0.3	**1.6**
Di-n-octylphthalate	0.6	**2.9**

The hazard quotients calculated for the mammalian species are all ascribed to limited zones of shallow soil/sediment contamination as they generally result due to finding elevated concentrations of the chemicals in one or more related samples. Specifically, the hazard quotients calculated for Benzo(a)pyrene, Carbazole, and Fluoranthene initially result from measuring elevated concentrations of each of these species (i.e., 2,700 ug/Kg, 430 ug/Kg, and 4,300 ug/Kg, respectively) at a single location SW/SD63-19. Of further note is the fact that the second highest concentration measured in any shallow soil/sediment sample for each of these compounds is also collocated in a sample collected from SW/SD63-18. Using the next highest measured concentration for each species and repeating the hazard quotient calculation results in the indication that concentrations measured for one of the problematic chemicals (i.e., Fluoranthene) is potentially acceptable, while a reduced hazard quotient is still represented by the other two chemicals for the shrew.

If the third highest measured concentration is then used for the remaining two species (i.e., 540 ug/Kg for benzo(a)pyrene at SW/SD63-4 and 93 ug/kg for carbazole SW/SD63-13), the computed hazard quotients for the shrew are further reduced to 1.4 and 1.2, respectively for the shrew. Of additional note, is the fact that the continuing high carbazole level is found in the location SW/SD63-4 that is downgradient of both SW/SD 63-18 and 19. The computed hazard quotient for all three chemicals and the deer mouse are all less than 1.

If the maximum concentrations measured for the benzo(a)pyrene and the carbazole are set to the fourth highest concentration measured (i.e., 200 ug/Kg and 34 ug/Kg, respectively), the calculated risk posed to the shrew is also eliminated.

With respect to the hazard quotient recorded for Di-n-octylphthalate, this results due the sole sample in which it was detected at a concentration of 19J ug/Kg. This sample was collected at location SWSD63-3, which is north of SEAD-63.

Birds

The HQs computed for four phthalate species based on the maximum observed concentration in shallow soil/sediment samples indicate that site contaminants represent a potential threat to the American Robin and/or the Mourning Dove. A summary of this data is presented below:

Compound	**American Robin Hazard Quotient**	**Mourning Dove Hazard Quotient**
Bis(2-ethylhexyl)phthalate	**70**	0.37
Diethyl phthalate	**347**	**1.3**
Di-n-butylphthalate	**1.7**	0.09
Di-n-octylphthalate	**2984**	**10.7**

Bis(2-ethylhexyl)phthalate was found in 17 of 27 shallow soil/sediment samples collected from SEAD-63. Measured concentrations ranged from a minimum of 8.3 to a maximum of 1,800 ug/Kg. Based on the indices used for the determination for the robin, the maximum concentration that could be measured to ensure that no risk was present for the robin would be 26 ug/Kg. Seven of the 17 samples that contained Bis2-ethylhexyl)phthalate exhibit concentrations that were higher than this level. These samples are all generally located in the vicinity of the former burial area.

Diethyl phthalate was detected in 9 of 22 shallow soil/sediment samples collected from the area of SEAD-63. Measured concentrations ranged from a low of 4.7 to a high of 92 ug/Kg. All of the measured concentrations would represent a potential threat to the American Robin, while any concentration in excess of 70 ug/Kg would suggest a potential threat to the Mourning Dove. The identified Diethyl phthalate is all located in drainage ditches that surrounds the former burial area.

Di-n-butylphthalate was detected in 7 of the 27 shallow soil/sediment samples collected from the area of SEAD-63. Measured concentrations ranged from a low of 6.5 to a high of 120 ug/Kg. The second highest concentration measured in any shallow soil/sediment sample was 19 ug/Kg, and at this concentration the hazard quotient calculated for the robin would drop to 0.28. This suggests that the presumed risk associated with this compound is restricted to a hotspot that is near SWSD63-14..

Di-n-octylphthalate was detected in 1 of the 22 shallow soil/sediment samples collected from the area of SEAD-63. The only measured concentration found for this compound was 19J. This suggests that the apparent risk posed to both the robin and dove is associated with a hot spot that is located at SWSD63-3, as is noted above for the mouse and shrew.

F.6.4.1 Uncertainty

Uncertainty is inherent in each step of the ecological risk assessment process. Major factors contributing to uncertainty in this risk assessment are discussed qualitatively in the following sections.

Chemicals of Potential Concern

The sampling data may not represent the actual overall distribution of contamination at the site, which could result in underestimation or overestimation of potential risk from identified chemicals. However, the use of maximum concentrations provided conservative exposure estimates and it is, therefore, unlikely that the potential for deleterious levels of contaminants has been underestimated.

Exposure Assessment

While the potential receptor species selected for the site are inevitably a limited subset of the total list of species that may utilize the site, the potential exposure of the species evaluated in this assessment is considered likely to be representative of the nature and magnitude of the exposures experienced by those species not discussed.

Risk associated with intake of contaminants through the terrestrial food chain was addressed by modeling food chain transfer of chemical residues through plants and earthworms. The degree of uncertainty in the results of the analysis increases with the increasing distance of the receptor from the base of the food chain. Intakes from dermal contact with and inhalation of contaminants were not quantifiable for ecological receptors. However, this does not significantly increase the uncertainty of the estimated intakes because for most receptors, intakes via these routes are likely to be minimal relative to intakes via ingestion.

Toxicity Assessment

There is uncertainty associated with the TRVs calculated for this risk characterization because the toxicity data were not site-specific. However, the TRVs used were conservative and were modified by uncertainty factors where necessary to increase the applicability of the data to the assessment. The HQs calculated from these conservative TRVs and maximum concentrations provide confidence that the risk assessment yielded reasonably conservative estimates of the potential risk of adverse ecological effects on the assessment endpoint.

Each COPC was assumed to be highly bioavailable. However, for most chemicals in most media, this is an overestimation (Dixon et al., 1993) that may result in an overestimation of the potential for ecological risk. Empirical information on bioavailability of the COPCs was not available. No leachability tests in soil or sediment were conducted. No analysis for acid-volatile sulfide/simultaneously extracted metals was conducted as a measure of bioavailability in sediment. It is possible that some of the contaminants, particularly the metals, may be bound to soil or sediment particles and not available for uptake by receptors. This would tend to overestimate risk.

The soil-to-plant uptake equations and the BAFs include a bioavailability factor; however, these data, taken from the scientific literature, are not specific to this site and may under- or overestimate exposure. For several metals, no quantitative bioavailability data could be found, other than an indication from the literature that the constituent does not significantly bioaccumulate. For these metals, a bioaccumulation factor of 1.0 was used in the exposure equation. This is likely to overestimate the actual value.

The potential for toxic effects to be produced in receptor organisms as a result of exposure to multiple chemicals in a single medium or in multiple media was not evaluated. Therefore, the potential toxic effects in a receptor as a result of exposure to a given medium could be higher or lower than estimated, depending on toxicological interactions. Exposure of a receptor to multiple contaminated media is likely to increase the risk of toxic effects.

Risk Characterization

The methodology, conservative assumptions, and toxicity benchmarks used in the risk estimation portion of the risk characterization are expected to overestimate, rather than underestimate, the potential for COPCs to pose risk to the ecological assessment endpoint. Maximum environmental concentrations were used, concentrations were assumed to remain constant over time, and the toxicity benchmarks used were the NOAEL values (levels where no toxic effects are expected) or conservative surrogates based on LOAEL values for non-lethal or reproductive effects appropriate for extrapolation to effects on the assessment endpoint.

F.6.4.2 Ecological Risk Summary

COPCs in soil were quantitatively assessed for ecological risk for future conditions. These COPCs include contaminants estimated to have the potential to pose adverse effects to the selected assessment endpoints. Exposure to these COPCs by representative terrestrial receptors (deer mouse, American robin, mourning dove, and short-tailed shrew) was further evaluated to determine if any COPCs have a high likelihood of being a risk to the receptor population analyzed for this risk assessment or the ecological community that encompasses the study area.

A hierarchy of assessment endpoints was selected to assess both proximate and ultimate risks that might be associated with site-related chemicals. The proximate assessment endpoint was chosen to provide protection of the population levels of vertebrate species that utilize the sites to a significant extent and that are important as indicators of potential effects on the health of the community. Deer mice and short-tailed shrews represent terrestrial vertebrate populations at the sites. The American robin and mourning dove represent avian populations that usually remain close to or on the surface of the soil and come in contact with it quite frequently. Although toxic effects that reduce this assessment endpoint population or the populations they represent in the immediate vicinity of the site are significant to the populations themselves, they are not necessarily significant to the ultimate, more important, assessment endpoint: the community of species that occupies the area surrounding and including the site.

It is this ultimate assessment endpoint, maintenance of the health and diversity of the natural community in the area, that is the most important ecological component to be protected with regard to this site. Therefore, any COCs estimated to pose a potential for adverse effects to proximate assessment endpoints would subsequently be evaluated with regard to the risk they may pose to the ultimate assessment endpoint.

The ecological setting of the site is not unique or significant, as described in **Section F.6.2.2.** There are no endangered, threatened, or special concern species in the vicinity that are likely to be dependent on or affected by the habitat at the site. The species that inhabit the site are not rare in the region and are not generally considered to be of special societal value. The habitat in the site appears to be relatively low in diversity and productivity.

In soils available to terrestrial receptors (0-2-ft. depth), representative of future conditions at the site, HQs calculated for seven semivolatile organic compounds indicate that potential risks may exist for selected mammalian and avian species. Closer review of these data indicates that the posed threats may be isolated to hot spots that required closer examination during the proposed removal action.

TABLE A-1
CALCULATION OF INTAKE AND RISK FROM INHALATION OF DUST IN AMBIENT AIR
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CA \times IR \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CA = Chemical Concentration in Air, Calculated from Air EPC Data
IR = Inhalation Rate
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Inhalation RfD (mg/kg-day)	Carc. Slope Inhalation (mg/kg-day)-1	Air EPC* from Surface Soil (mg/m3)	Air EPC* from Total Soils (mg/m3)	Park Worker Intake (mg/kg-day) (Nc)	Park Worker Intake (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Intake (mg/kg-day) (Nc)	Recreational Visitor (Child) Intake (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Intake (mg/kg-day) (Nc)	Construction Worker Intake (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Volatile Organics																
Acetone	NA	NA		2.37E-008												
2-Butanone	2.86E-001	NA		6.81E-009									6.93E-010		2E-009	
Benzene	1.71E-003	2.73E-002	3.40E-011	5.92E-010	1.86E-012	6.65E-013	1E-009	2E-014	4.21E-012	3.01E-013	2E-009	8E-015	6.02E-011	8.61E-013	4E-008	2E-014
Toluene	1.14E-001	NA	1.02E-010	3.40E-009	5.59E-012		5E-011		1.26E-011		1E-010		3.46E-010		3E-009	
Total Xylenes	NA	NA	2.38E-010	2.07E-009												
Semivolatile Organics																
Benzo(a)anthracene	NA	NA		4.44E-009												
Benzo(a)pyrene	NA	NA	4.08E-010	6.66E-009												
Benzo(b)fluoranthene	NA	NA	3.57E-010	5.62E-009												
Benzo(ghi)perylene	NA	NA		4.59E-009												
Benzo(k)fluoranthene	NA	NA	3.57E-010	6.36E-009												
bis(2-Ethylhexyl)phthalate	NA	NA	3.06E-008	2.66E-007												
Chrysene	NA	NA	3.91E-010	4.59E-009												
Dibenz(a,h)anthracene	NA	NA		4.14E-009												
Di-n-butylphthalate	NA	NA		1.29E-008												
Fluoranthene	NA	NA	6.46E-010	9.32E-009												
Indeno(1,2,3-cd)pyrene	NA	NA		5.48E-009												
Phenanthrene	NA	NA		4.59E-009												
Pesticides/PCBs																
4,4'-DDD	NA	NA		2.96E-010												
4,4'-DDE	NA	NA		6.51E-010												
4,4'-DDT	NA	3.40E-001		4.88E-010										7.10E-013		2E-013
Metals																
Cadmium	NA	6.30E+000	9.52E-009	3.55E-006		1.86E-010		1E-009		8.43E-011		5E-010		5.16E-009		3E-008
Mercury	8.57E-005	NA	1.02E-009	7.25E-008	5.59E-011		7E-007		1.26E-010		1E-006		7.38E-009		9E-005	
Total Hazard Quotient and Cancer Risk:							**7E-007**	**1E-009**			**1E-006**	**5E-010**			**9E-005**	**3E-008**

	Assumptions for Park Worker		Assumptions for Recreational Visitor (Child)		Assumptions for Construction Worker	
CA =	EPC Surface Only		EPC Surface Only		EPC Surface and Sub-Surface	
BW =	70	kg	15	kg	70	kg
IR =	8	m3/day	8.7	m3/day	10.4	m3/day
EF =	175	days/year	78	days/year	250	days/year
ED =	25	years	5	years	1	year
AT (Nc) =	9,125	days	1,825	days	365	days
AT (Car) =	25,550	days	25,550	days	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
* See Table A-3 for calculation of Air EPC.
NA= Information not available.

TABLE-2

CALCULATION OF INTAKE AND RISK FROM INHALATION OF DUST IN AMBIENT AIR

REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63

EE/CA Mini Risk Assessment

Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CA \times IR \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):

CA = Chemical Concentration in Air, Calculated from Air EPC Data
IR = Inhalation Rate
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Lifetime Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Inhalation RfD (mg/kg-day)	Carc. Slope Inhalation (mg/kg-day)-1	Air EPC* from Surface Soil (mg/m3)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Volatile Organics												
Acetone	NA	NA										
2-Butanone	2.86E-001	NA										
Benzene	1.71E-003	2.73E-002	3.40E-011	9.32E-012	3.19E-012	5E-009	9E-014	1.89E-011	1.62E-012	1E-008	4E-014	1E-013
Toluene	1.14E-001	NA	1.02E-010	2.79E-011		2E-010		5.67E-011		5E-010		
Total Xylenes	NA	NA	2.38E-010									
Semivolatile Organics												
Benzo(a)anthracene	NA	NA										
Benzo(a)pyrene	NA	NA	4.08E-010									
Benzo(b)fluoranthene	NA	NA	3.57E-010									
Benzo(ghi)perylene	NA	NA										
Benzo(k)fluoranthene	NA	NA	3.57E-010									
bis(2-Ethylhexyl)phthalate	NA	NA	3.06E-008									
Chrysene	NA	NA	3.91E-010									
Dibenz(a,h)anthracene	NA	NA										
Di-n-butylphthalate	NA	NA										
Fluoranthene	NA	NA	6.46E-010									
Indeno(1,2,3-cd)pyrene	NA	NA										
Phenanthrene	NA	NA										
Pesticides/PCBs												
4,4'-DDD	NA	NA										
4,4'-DDE	NA	NA										
4,4'-DDT	NA	3.40E-001										
Metals												
Cadmium	NA	6.30E+000	9.52E-009		8.94E-010		6E-009		4.54E-010		3E-009	8E-009
Mercury	8.57E-005	NA	1.02E-009	2.79E-010		3E-006		5.67E-010		7E-006		
Total Hazard Quotient and Cancer Risk:						**3E-006**				**7E-006**		**8E-009**

Assumptions for Resident (Adult)

CA =	EPC Surface Only	
BW =	70	kg
IR =	20	m3/day
EF =	350	days/year
ED =	24	years
AT (Nc) =	8,760	days
AT (Car) =	25,550	days

Assumptions for Resident (Child)

CA =	EPC Surface Only	
BW =	15	kg
IR =	8.7	m3/day
EF =	350	days/year
ED =	6	years
AT (Nc) =	2,190	days
AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
* See Table A-3 for calculation of Air EPC.
NA= Information not available.

TABLE A-3
AMBIENT AIR EXPOSURE POINT CONCENTRATIONS - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Air EPC from Surface Soil (mg/m^3) = CS dsurf x PM d10 x CF	Equation for Air EPC from Total Soils (mg/m^3) = CS dtot x PM d10 x CF
Variables:	Variables:
CS dsurf = Chemical Concentration in Surface Soil, from EPC data (mg/kg)	CS dtot = Chemical Concentration in Total Soils, from EPC data (mg/kg)
PM d10 = Average Measured PM d10 Concentration = 17 ug/m^3	PM d10 = PM d10 Concentration Calculated for Construction Worker= 148 ug/m^3
CF = Conversion Factor = 1E-9 kg/ug	CF = Conversion Factor = 1E-9 kg/ug

Analyte	EPC Data for Surface Soil (mg/kg)	EPC Data for Total Soils (mg/kg)	Calculated Air EPC Surface Soil (mg/m^3)	Calculated Air EPC Total Soils (mg/m^3)
Volatile Organics				
Acetone		1.60E-001		2.37E-008
2-Butanone		4.60E-002		6.81E-009
Benzene	2.00E-003	4.00E-003	3.40E-011	5.92E-010
Toluene	6.00E-003	2.30E-002	1.02E-010	3.40E-009
Total Xylenes	1.40E-002	1.40E-002	2.38E-010	2.07E-009
Semivolatile Organics				
Benzo(a)anthracene		3.00E-002		4.44E-009
Benzo(a)pyrene	2.40E-002	4.50E-002	4.08E-010	6.66E-009
Benzo(b)fluoranthene	2.10E-002	3.80E-002	3.57E-010	5.62E-009
Benzo(ghi)perylene		3.10E-002		4.59E-009
Benzo(k)fluoranthene	2.10E-002	4.30E-002	3.57E-010	6.36E-009
bis(2-Ethylhexyl)phthalate	1.80E+000	1.80E+000	3.06E-008	2.66E-007
Chrysene	2.30E-002	3.10E-002	3.91E-010	4.59E-009
Dibenz(a,h)anthracene		2.80E-002		4.14E-009
Di-n-butylphthalate		8.70E-002		1.29E-008
Fluoranthene	3 80E-002	6.30E-002	6.46E-010	9.32E-009
Indeno(1,2,3-cd)pyrene		3.70E-002		5.48E-009
Phenanthrene		3.10E-002		4.59E-009
Pesticides/PCBs				
4,4'-DDD		2.00E-003		2.96E-010
4,4'-DDE		4.40E-003		6.51E-010
4,4'-DDT		3.30E-003		4.88E-010
Metals				
Cadmium	5.60E-001	2.40E+001	9.52E-009	3.55E-006
Mercury	6.00E-002	4.90E-001	1.02E-009	7.25E-008

ND = Compound was not detected.

TABLE A-4
CALCULATION OF INTAKE AND RISK FROM THE INGESTION OF SOIL
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Soil, Calculated from Soil EPC Data
IR = Ingestion Rate
CF = Conversion Factor
FI = Fraction Ingested
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Oral RfD	Carc. Slope Oral	EPC Surface Soil	EPC from Total Soils	Park Worker				Recreational Visitor (Child)				Construction Worker			
					Intake (mg/kg-day)		Hazard Quotient	Cancer Risk	Intake (mg/kg-day)		Hazard Quotient	Cancer Risk	Intake (mg/kg-day)		Hazard Quotient	Cancer Risk
	(mg/kg-day)	(mg/kg-day)-1	(mg/kg)	(mg/kg)	(Nc)	(Car)			(Nc)	(Car)			(Nc)	(Car)		
Volatile Organics																
Acetone	1.00E-001	NA		1.60E-001									7.51E-007		8E-006	
2-Butanone	6.00E-001	NA		4.60E-002									2.16E-007		4E-007	
Benzene	3.00E-003	2.90E-002	2.00E-003	4.00E-003	1.37E-009	4.89E-010	5E-007	1E-011	5.70E-009	4.07E-010	2E-006	1E-011	1.88E-008	2.68E-010	6E-006	8E-012
Toluene	2.00E-001	NA	6.00E-003	2.30E-002	4.11E-009		2E-008		1.71E-008		9E-008		1.08E-007		5E-007	
Total Xylenes	2.00E+000	NA	1.40E-002	1.40E-002	9 59E-009		5E-009		3.99E-008		2E-008		6.58E-008		3E-008	
Semivolatile Organics																
Benzo(a)anthracene	NA	7.30E-001		3.00E-002										2.01E-009		1E-009
Benzo(a)pyrene	NA	7.30E+000	2.40E-002	4.50E-002		5.87E-009		4E-008		4.88E-009		4E-008		3.02E-009		2E-008
Benzo(b)fluoranthene	NA	7.30E-001	2.10E-002	3.80E-002		5.14E-009		4E-009		4.27E-009		3E-009		2.55E-009		2E-009
Benzo(ghi)perylene	NA	NA		3.10E-002												
Benzo(k)fluoranthene	NA	7.30E-002	2.10E-002	4.30E-002		5.14E-009		4E-010		4.27E-009		3E-010		2.89E-009		2E-010
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	1.80E+000	1.80E+000	1.23E-006	4.40E-007	6E-005	6E-009	5.13E-006	3.66E-007	3E-004	5E-009	8.45E-006	1.21E-007	4E-004	2E-009
Chrysene	NA	7.30E-003	2.30E-002	3.10E-002		5.63E-009		4E-011		4.68E-009		3E-011		2.08E-009		2E-011
Dibenz(a,h)anthracene	NA	7.30E+000		2.80E-002										1.88E-009		1E-008
Di-n-butylphthalate	1.00E-001	NA		8.70E-002									4.09E-007		4E-006	
Fluoranthene	4.00E-002	NA	3.80E-002	6.30E-002	2.60E-008		7E-007		1.08E-007		3E-006		2.96E-007		7E-006	
Indeno(1,2,3-cd)pyrene	NA	7.30E-001		3.70E-002										2.48E-009		2E-009
Phenanthrene	NA	NA		3.10E-002												
Pesticides/PCBs																
4,4'-DDD	NA	2.40E-001		2.00E-003										1.34E-010		3E-011
4,4'-DDE	NA	3.40E-001		4.40E-003										2.95E-010		1E-010
4,4'-DDT	5.00E-004	3.40E-001		3.30E-003									1.55E-008	2.21E-010	3E-005	8E-011
Metals																
Cadmium	5.00E-004	NA	5.60E-001	2.40E+001	3.84E-007		8E-004		1.60E-006		3E-003		1.13E-004		2E-001	
Mercury	3.00E-004	NA	6.00E-002	4.90E-001	4.11E-008		1E-004		1.71E-007		6E-004		2.30E-006		8E-003	
Total Hazard Quotient and Cancer Risk:							**1E-003**	**5E-008**			**4E-003**	**4E-008**			**2E-001**	**4E-008**

Assumptions for Park Worker			Assumptions for Recreational Visitor (Child)			Assumptions for Construction Worker		
CF =	1E-006	kg/mg	CF =	1E-006	kg/mg	CF =	1E-006	kg/mg
CS =	EPC Surface Only		CS =	EPC Surface Only		CS =	EPC Surface and Subsurface	
BW =	70	kg	BW =	15	kg	BW =	70	kg
IR =	100	mg soil/day	IR =	200	mg soil/day	IR =	480	mg soil/day
FI =	1	unitless	FI =	1	unitless	FI =	1	unitless
EF =	175	days/year	EF =	78	days/year	EF =	250	days/year
ED =	25	years	ED =	5	years	ED =	1	years
AT (Nc) =	9,125	days	AT (Nc) =	1,825	days	AT (Nc) =	365	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE 5
CALCULATION OF INTAKE AND RISK FROM THE INGESTION OF SOIL
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = CS x IR x CF x FI x EF x ED / BW x AT

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Soil, Calculated from Soil EPC Data
IR = Ingestion Rate
CF = Conversion Factor
FI = Fraction Ingested
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Oral RfD	Carc. Slope Oral	EPC Surface Soil	Resident (Adult)				Resident (Child)				Resident
				Intake (mg/kg-day)		Hazard Quotient	Contribution to Lifetime Cancer Risk	Intake (mg/kg-day)		Hazard Quotient	Contribution to Lifetime Cancer Risk	Total Lifetime Cancer Risk
	(mg/kg-day)	(mg/kg-day)-1	(mg/kg)	(Nc)	(Car)			(Nc)	(Car)			
Volatile Organics												
Acetone	1.00E-001	NA										
2-Butanone	6.00E-001	NA										
Benzene	3.00E-003	2.90E-002	2.00E-003	2.74E-009	9.39E-010	9E-007	3E-011	2.56E-008	2 19E-009	9E-006	6E-011	9E-011
Toluene	2.00E-001	NA	6 00E-003	8 22E-009		4E-008		7.67E-008		4E-007		
Total Xylenes	2.00E+000	NA	1.40E-002	1.92E-008		1E-008		1.79E-007		9E-008		
Semivolatile Organics												
Benzo(a)anthracene	NA	7.30E-001										
Benzo(a)pyrene	NA	7.30E+000	2.40E-002		1.13E-008		8E-008		2.63E-008		2E-007	3E-007
Benzo(b)fluoranthene	NA	7.30E-001	2.10E-002		9.86E-009		7E-009		2 30E-008		2E-008	2E-008
Benzo(ghi)perylene	NA	NA										
Benzo(k)fluoranthene	NA	7.30E-002	2.10E-002		9 86E-009		7E-010		2 30E-008		2E-009	2E-009
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	1.80E+000	2.47E-006	8.45E-007	1E-004	1E-008	2.30E-005	1 97E-006	1E-003	3E-008	4E-008
Chrysene	NA	7.30E-003	2.30E-002		1 08E-008		8E-011		2.52E-008		2E-010	3E-010
Dibenz(a,h)anthracene	NA	7.30E+000										
Di-n-butylphthalate	1.00E-001	NA										
Fluoranthene	4.00E-002	NA	3.80E-002	5.21E-008		1E-006		4.86E-007		1E-005		
Indeno(1,2,3-cd)pyrene	NA	7.30E-001										
Phenanthrene	NA	NA										
Pesticides/PCBs												
4,4'-DDD	NA	2.40E-001										
4,4'-DDE	NA	3.40E-001										
4,4'-DDT	5.00E-004	3.40E-001										
Metals												
Cadmium	5.00E-004	NA	5.60E-001	7.67E-007		2E-003		7.16E-006		1E-002		
Mercury	3.00E-004	NA	6.00E-002	8.22E-008		3E-004		7.67E-007		3E-003		
Total Hazard Quotient and Cancer Risk:						**2E-003**				**2E-002**		**3E-007**

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
CF =	1E-006	kg/mg	CF =	1E-006	kg/mg
CS =	EPC Surface Only		CS =	EPC Surface Only	
BW =	70	kg	BW =	15	kg
IR =	100	mg soil/day	IR =	200	mg soil/day
FI =	1	unitless	FI =	1	unitless
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-6
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SOIL
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
- CS = Chemical Concentration in Soil, from Soil EPC Data
- CF = Conversion Factor
- SA = Surface Area Contact
- AF = Adherence Factor
- ABS = Absorption Factor
- EF = Exposure Frequency
- ED = Exposure Duration
- BW = Bodyweight
- AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Surface Soil (mg/kg)	EPC from Total Soils (mg/kg)	Park Worker Absorbed Dose (mg/kg-day) (Nc)	Park Worker Absorbed Dose (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Nc)	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Absorbed Dose (mg/kg-day) (Nc)	Construction Worker Absorbed Dose (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Volatile Organics																	
Acetone	1.00E-001	NA	NA		1.60E-001												
2-Butanone	6.00E-001	NA	NA		4.60E-002												
Benzene	3.00E-003	2.90E-002	NA	2.00E-003	4.00E-003												
Toluene	2.00E-001	NA	NA	6.00E-003	2.30E-002												
Total Xylenes	2.00E+000	NA	NA	1.40E-002	1.40E-002												
Semivolatile Organics																	
Benzo(a)anthracene	NA	7.3E-001	0.13		3.00E-002										5.40E-010		3.9E-010
Benzo(a)pyrene	NA	7.3E+000	0.13	2.40E-002	4.50E-002		8.70E-009		6.4E-008		1.78E-009		1.3E-008		8.10E-010		5.9E-009
Benzo(b)fluoranthene	NA	7.3E-001	0.13	2.10E-002	3.80E-002		7.61E-009		5.6E-009		1.56E-009		1.1E-009		6.84E-010		5.0E-010
Benzo(ghi)perylene	NA	NA	0.13		3.10E-002												
Benzo(k)fluoranthene	NA	7.3E-002	0.13	2.10E-002	4.30E-002		7.61E-009		5.6E-010		1.56E-009		1.1E-010		7.74E-010		5.6E-011
bis(2-Ethylhexyl)phthalate	2.00E-002	1.4E-002	0.1	1.80E+000	1.80E+000	1.41E-006	5.02E-007	7.0E-005	7.0E-009	1.44E-006	1.03E-007	7.2E-005	1.4E-009	1.74E-006	2.49E-008	8.7E-005	3.5E-010
Chrysene	NA	7.3E-003	0.13	2.30E-002	3.10E-002		8.34E-009		6.1E-011		1.70E-009		1.2E-011		5.58E-010		4.1E-012
Dibenz(a,h)anthracene	NA	7.3E+000	0.13		2.80E-002										5.04E-010		3.7E-009
Di-n-butylphthalate	1.00E-001	NA	0.1		8.70E-002									8.43E-008		8.4E-007	
Fluoranthene	4.00E-002	NA	0.13	3.80E-002	6.30E-002	3.86E-008		9.6E-007		3.94E-008		9.9E-007		7.93E-008		2.0E-006	
Indeno(1,2,3-cd)pyrene	NA	7.3E-001	0.13		3.70E-002										6.66E-010		4.9E-010
Phenanthrene	NA	NA	0.13		3.10E-002												
Pesticides/PCBs																	
4,4'-DDD	NA	2.40E-001	0.03		2.00E-003										8.30E-012		2.0E-012
4,4'-DDE	NA	3.40E-001	0.03		4.40E-003										1.83E-011		6.2E-012
4,4'-DDT	5.00E-004	3.40E-001	0.03		3.30E-003									9.59E-010	1.37E-011	1.9E-006	4.7E-012
Metals																	
Cadmium	1.25E-005	NA	0.001	5.60E-001	2.40E+001	4.37E-009		3.5E-004		4.47E-009		3.6E-004		2.32E-007		1.9E-002	
Mercury	2.10E-005	NA	NA	6.00E-002	4.90E-001												
Total Hazard Quotient and Cancer Risk:								**4E-004**	**8E-008**			**4E-004**	**2E-008**			**2E-002**	**1E-008**

	Assumptions for Park Worker	Assumptions for Recreational Visitor (Child)	Assumptions for Construction Worker
CS =	EPC Surface Only	EPC Surface Only	EPC Surface and Subsurface
CF =	1.00E-006 kg/mg	1.00E-006 kg/mg	1.00E-006 kg/mg
SA =	5,700 cm2	2,800 cm2	3,300 cm2
AF =	0.2 mg/cm2	0.2 mg/cm2	0.3 mg/cm2
EF =	175 days/year	78 days/year	250 days/year
ED =	25 years	5 years	1 years
BW =	70 kg	15 kg	70 kg
AT (Nc) =	9,125 days	1,825 days	365 days
AT (Car) =	25,550 days	25,550 days	25,550 days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.
* Recommended dermal absorption factor by EPA Dermal Risk Assessment Guidance (1999).

TABLE A-7
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SOIL
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Soil, from Soil EPC Data
CF = Conversion Factor
SA = Surface Area Contact
AF = Adherence Factor
ABS = Absorption Factor
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Lifetime Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Surface Soil (mg/kg)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Volatile Organics													
Acetone	1.00E-001	NA	NA										
2-Butanone	6.00E-001	NA	NA										
Benzene	3.00E-003	2.90E-002	NA	2.00E-003									
Toluene	2.00E-001	NA	NA	6.00E-003									
Total Xylenes	2.00E+000	NA	NA	1.40E-002									
Semivolatile Organics													
Benzo(a)anthracene	NA	7.30E-001	0.13										
Benzo(a)pyrene	NA	7.30E+000	0.13	2.40E-002		5.85E-009		4.27E-008		9.57E-009		6.99E-008	1E-007
Benzo(b)fluoranthene	NA	7.30E-001	0.13	2.10E-002		5.12E-009		3.73E-009		8.38E-009		6.12E-009	1E-008
Benzo(ghi)perylene	NA	NA	0.13										
Benzo(k)fluoranthene	NA	7.30E-002	0.13	2.10E-002		5.12E-009		3.73E-010		8.38E-009		6.12E-010	1E-009
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	0.10	1.80E+000	9.84E-007	3.37E-007	4.92E-005	4.72E-009	6.44E-006	5.52E-007	3.22E-004	7.73E-009	1E-008
Chrysene	NA	7.30E-003	0.13	2.30E-002		5.60E-009		4.09E-011		9.17E-009		6.70E-011	1E-010
Dibenz(a,h)anthracene	NA	7.30E+000	0.13										
Di-n-butylphthalate	1.00E-001	NA	0.10										
Fluoranthene	4.00E-002	NA	0.13	3.80E-002	2.70E-008		6.75E-007		1.77E-007		4.42E-006		
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	0.13										
Phenanthrene	NA	NA	0.13										
Pesticides/PCBs													
4,4'-DDD	NA	2.40E-001	0.03										
4,4'-DDE	NA	3.40E-001	0.03										
4,4'-DDT	5.00E-004	3.40E-001	0.03										
Metals													
Cadmium	1.25E-005	NA	0.00	5.60E-001	3.06E-009		2.45E-004		2.00E-008		1.60E-003		
Mercury	2.10E-005	NA	NA	6.00E-002									
Total Hazard Quotient and Cancer Risk:							**3E-004**	**5E-009**			**2E-003**	**8E-009**	**1E-008**

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
CS =	EPC Surface Only		CS =	EPC Surface Only	
CF =	1E-006	kg/mg	CF =	1E-006	kg/mg
SA =	5,700	cm2	SA =	2,800	cm2
AF =	0.07	mg/cm2	AF =	0.2	mg/cm2
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
BW =	70	kg	BW =	15	kg
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.
* Recommended dermal absorption factor by EPA Dermal Risk Assessment Guidance (1999).

TABLE A-8
CALCULATION OF INTAKE AND RISK FROM INHALATION OF GROUNDWATER (WHILE SHOWERING)
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63

Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

Based on a lack of toxicity data (i.e. inhalation RfDs and carcinogenic slope factors for the analytes detected) risks from this pathway were not quantified.

TABLE A-9
CALCULATION OF INTAKE AND RISK FROM THE INGESTION OF GROUNDWATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CW \times IR \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CW = Chemical Concentration in Groundwater, from Groundwater EPC Data
IR = Ingestion Rate
EF = Exposure Frequency
ED=Exposure Duration
BW=Bodyweight
AT=Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Oral RfD (mg/kg-day)	Carc. Slope Oral (mg/kg-day)-1	EPC Groundwater (mg/liter)	Park Worker Intake (mg/kg-day) (Nc)	Park Worker Intake (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Intake (mg/kg-day) (Nc)	Recreational Visitor (Child) Intake (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk
Semivolatile Organics											
Phenol	6.00E-001	NA	2.00E-003	1.37E-005		2E-005		2.85E-005		5E-005	
Metals											
Manganese	5.00E-002	NA	1.07E+000	7.33E-003		1E-001		1.52E-002		3E-001	
Sodium	NA	NA	1.46E+002								
Total Hazard Quotient and Cancer Risk:						**1E-001**				**3E-001**	

Construction Worker Intake (mg/kg-day) (Nc)	Construction Worker Intake (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Ingestion of Groundwater Not Applicable for Construction Worker			

Assumptions for Park Worker

BW =	70	kg
IR =	1	liter/day
EF =	175	days/year
ED =	25	years
AT (Nc) =	9,125	days
AT (Car) =	25,550	days

Assumptions for Recreational Visitor (Child)

BW =	15	kg
IR =	1	liter/day
EF =	78	days/year
ED =	5	years
AT (Nc) =	1,825	days
AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-10
CALCULATION OF INTAKE AND RISK FROM THE INGESTION OF GROUNDWATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CW \times IR \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):

CW = Chemical Concentration in Groundwater, from Groundwater EPC Data
IR = Ingestion Rate
EF = Exposure Frequency
ED=Exposure Duration
BW=Bodyweight
AT=Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Oral RfD (mg/kg-day)	Carc. Slope Oral (mg/kg-day)-1	EPC Groundwater (mg/liter)	Resident (Adult)				Resident (Child)				Resident
				Intake (mg/kg-day) (Nc)	Intake (mg/kg-day) (Car)	Hazard Quotient	Contribution to Lifetime Cancer Risk	Intake (mg/kg-day) (Nc)	Intake (mg/kg-day) (Car)	Hazard Quotient	Contribution to Lifetime Cancer Risk	Total Lifetime Cancer Risk
Semivolatile Organics												
Phenol	6.00E-001	NA	2.00E-003	5.48E-005		9E-005		1.28E-004		2E-004		
Metals												
Manganese	5.00E-002	NA	1.07E+000	2.93E-002		6E-001		6.84E-002		1E+000		
Sodium	NA	NA	1.46E+002									
Total Hazard Quotient and Cancer Risk:						**6E-001**				**1E+000**		

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
BW =	70	kg	BW =	15	kg
IR =	2	liters/day	IR =	1	liters/day
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-11
CALCULATION OF INTAKE AND RISK FROM DERMAL CONTACT TO GROUNDWATER (WHILE SHOWERING)
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
DA = Absorbed Dose per Event
SA = Surface Area Contact
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics: $DA = 2Kp \times CW \sqrt{\frac{6 \times \tau \times ET}{\pi}} \times CF$

For inorganics: DA = Kp x CW x ET x CF

Kp = Permeability Coefficient
CW = EPC Cderm
ET = Exposure Time
τ = Lag Time
CF = Conversion Factor

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient *Kp* (cm/hr)	Tau (hours)	EPC Groundwater (mg/liter)	Absorbed Dose/Event (mg-cm²/event)	Park Worker Intake (mg/kg-day) (Nc)	Park Worker Intake (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Intake (mg/kg-day) (Nc)	Recreational Visitor (Child) Intake (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Intake (mg/kg-day) (Nc)	Construction Worker Intake (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Semivolatile Organics							Dermal Contact to Groundwater Not Applicable for Park Worker								Dermal Contact to Groundwater Not Applicable for Construction Worker			
Phenol	6.00E-001	NA	4.3E-003	3.80E-001	2.00E-003	6.26E-007					5.89E-005		1E-004					
Metals																		
Manganese	2.00E-003	NA	1.00E-003	NA	1.07E+000	1.07E-006					1.01E-004		5E-002					
Sodium	NA	NA	1.00E-003	NA	1.46E+002	1.71E+002												
Total Hazard Quotient and Cancer Risk:													**5E-002**					

Assumptions for Recreational Visitor (Child)

CF =	0.001	l/cm3
BW =	15	kg
SA =	6,600	cm2
ET =	1.00	hours/day
EF =	78	days/year
ED =	5	years
AT (Nc) =	1,825	days
AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-12
CALCULATION OF INTAKE AND RISK FROM DERMAL CONTACT TO GROUNDWATER (WHILE SHOWERING)
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
DA = Absorbed Dose per Event | ED = Exposure Duration
SA = Surface Area Contact | BW = Bodyweight
EF = Exposure Frequency | AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics: $DA = 2Kp \times CW \sqrt{\frac{6 \times \tau \times ET}{\pi}} \times CF$

For inorganics: $DA = Kp \times CW \times ET \times CF$

Kp = Permeability Coefficient
CW = EPC Cderm
ET = Exposure Time
τ = Lag Time
CF = Conversion Factor

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient Kp (cm/hr)	Tau (hours)	EPC Groundwater (mg/liter)	Absorbed Dose/Event (mg-cm²/event)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Semivolatile Organics															
Phenol	6.00E-001	NA	4 30E-003	3.80E-001	2.00E-003	6.26E-007	1.54E-004		3E-004		2.64E-004		4E-004		
Metals															
Manganese	2.00E-003	NA	1.00E-003	NA	1.07E+000	1.07E-006	2.64E-004		1E-001		4.51E-004		2E-001		
Sodium	NA	NA	1.00E-003	NA	1.46E+002	1.71E+002									
Total Hazard Quotient and Cancer Risk:									**1E-001**				**2E-001**		

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
CF =	0.001	l/cm3	CF =	0.001	l/cm3
BW =	70	kg	BW =	15	kg
SA =	18,000	cm2	SA =	6,600	cm2
ET =	0.58	hours/day	ET =	1.00	hours/day
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-13

CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SURFACE WATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
DA = Absorbed Dose per Event; ED = Exposure Duration
SA = Surface Area Contact; BW = Bodyweight
EF = Exposure Frequency; AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics with ET < t*: $DA = 2Kp \cdot CW \sqrt{\frac{6 \cdot \tau \cdot ET}{\pi}} \cdot CF$

For organics with ET > t*: DA = Kp x CW x [ET/(1+B) + 2Tau(1+3B)/(1+B)] x CF
For inorganics: DA = Kp x CW x ET x CF
Kp = Permeability Coefficient; Tau = Lag Time
CW = EPC Surface Water; CF = Conversion Factor
ET = Exposure Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient Kp (cm/hr)	Tau (hours)	B (unitless)	EPC Surface Water (mg/L)	Absorbed Dose/Event (mg-cm²/event)	Park Worker Intake (mg/kg-day) (Nc)	Park Worker Intake (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Intake (mg/kg-day) (Nc)	Recreational Visitor (Child) Intake (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Intake (mg/kg-day) (Nc)	Construction Worker Intake (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Volatile Organics																			
Chloroform	1.00E-002	6 10E-003	6.9E-003	0.53	0 0	8.00E-004	1.11E-008	1.55E-008	5.53E-009	2E-006	3E-011	1.34E-007	9.56E-009	1E-005	6E-011	**Dermal Contact to Surface Water Not Applicable For Construction Worker**			
Toluene	2.00E-001	NA	3.2E-002	0.37	0.1	1 00E-003	5.51E-008	7.69E-008		4E-007		6.64E-007		3E-006					
Semivolatile Organics																			
4-Methylphenol	NA	NA	7.7E-003	0.45	0.0	2 20E-004	3.14E-009												
Benzo(a)pyrene	NA	7.30E+000	8.3E-001	2.83	5.0	1.00E-003	3.86E-006		1.92E-006		1E-005		3.32E-006		2E-005				
Benzo(b)fluoranthene	NA	7.30E-001	8.3E-001	2.92	5 1	9.00E-004	3.53E-006		1.76E-006		1E-006		3.04E-006		2E-006				
Benzo(ghi)perylene	NA	NA	1.2E+000	4.24		8 00E-004	5.66E-006												
Benzo(k)fluoranthene	NA	7.30E-002	7.6E-001	3.03		1 00E-003	3.65E-006		1.82E-006		1E-007		3.15E-006		2E-007				
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	2.9E-002	17.44	0.2	6.80E-002	2.28E-005	3.18E-005	1.13E-005	2E-003	2E-007	2.74E-004	1.96E-005	1E-002	3E-007				
Butylbenzylphthalate	2.00E-001	NA	4.2E-002	7.04		2.30E-004	7.03E-008	9.80E-008		5E-007		8.47E-007		4E-006					
Di-n-butylphthalate	1.00E-001	NA	2.6E-002	4.06	0.2	1 50E-004	2.17E-008	3.03E-008		3E-007		2.62E-007		3E-006					
Dibenz(a,h)anthracene	NA	7.30E+000	1.8E+000	4.08	11.7	8.00E-004	8.04E-006		4.01E-006		3E-005		6.92E-006		5E-005				
Diethyl phthalate	8.00E-001	NA	4.00E-003	1.97	0.0	2.90E-004	4.50E-009	6.28E-009		8E-009		5.42E-008		7E-008					
Fluoranthene	4.00E-002	NA	2.5E-001	1.53	1.4	7.00E-004	5.98E-007	8.35E-007		2E-005		7 21E-006		2E-004					
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	1.3E+000	3.97	8.0	9.00E-004	6.44E-006		3.21E-006		2E-006		5.55E-006		4E-006				
Pentachlorophenol	3.00E-002	1.20E-001	4.6E-001	3.50	2.9	1.00E-003	2.38E-006	3.32E-006	1.18E-006	1E-004	1E-007	2.87E-005	2.05E-006	1E-003	2E-007				
Phenanthrene	NA	NA	1.6E-001	1.12	0.8	5.70E-005	2.67E-008												
Phenol	6.00E-001	NA	4.3E-003	0.38	0.0	8.00E-004	6.05E-009	8.44E-009		1E-008		7.30E-008		1E-007					
Pyrene	3.00E-002	NA	2.2E-001	1.50		5.00E-004	3.68E-007	5.13E-007		2E-005		4.43E-006		1E-004					
Pesticides/PCBs																			
4,4'-DDD	NA	2.40E-001	2.1E-001	6.98	1.4	2.60E-005	3.99E-008		1 99E-008		5E-009		3.43E-008		8E-009				
4,4'-DDE	NA	3.40E-001	1.8E-001	6.80	1.2	5.10E-006	6.62E-009		3.30E-009		1E-009		5.70E-009		2E-009				
4,4'-DDT	5.00E-004	3.40E-001	3.2E-001	10.96	2.3	4 60E-005	1.35E-007	1.88E-007	6.71E-008	4E-004	2E-008	1.62E-006	1.16E-007	3E-003	4E-008				
Endosulfan sulfate	6.00E-003	NA	1.9E-003	26.55		1.40E-005	3.83E-010	5.35E-010		9E-008		4.62E-009		8E-007					
Endrin	3.00E-004	NA	1.4E-002	15.33	0.1	5.20E-005	7.88E-009	1.10E-008		4E-005		9.50E-008		3E-004					
Endrin aldehyde	NA	NA	1.4E-002	15.33	0.1	6.20E-005	9.39E-009												
Endrin ketone	NA	NA	1.4E-002	15.33	0.1	4.60E-005	6.97E-009												
gamma-Chlordane	5.00E-004	3.50E-001	1.2E-002	4.80	0.1	4.00E-006	2.91E-010	4.05E-010	1.45E-010	8E-007	5E-011	3.50E-009	2.50E-010	7E-006	9E-011				
Heptachlor	5.00E-004	4.50E+000	9.6E-003	13.91	0.1	3.60E-006	3.56E-010	4.97E-010	1.77E-010	1E-006	8E-010	4.29E-009	3.07E-010	9E-006	1E-009				
Heptachlor epoxide	1.30E-005	9.10E+000	2.3E-002	20.73		3.00E-006	8.58E-010	1.20E-009	4.27E-010	9E-005	4E-009	1.03E-008	7.39E-010	8E-004	7E-009				
Metals																			
Aluminum	1.00E+000	NA	1.00E-003	NA	NA	3.63E+000	3.63E-006	5.06E-006		5E-006		4.38E-005		4E-005					
Arsenic	3.00E-004	1.50E+000	1.00E-003	NA	NA	3.80E-003	3.80E-009	5.30E-009	1.89E-009	2E-005	3E-009	4.58E-008	3.27E-009	2E-004	5E-009				
Barium	4.90E-003	NA	1.00E-003	NA	NA	9.14E-002	9.14E-008	1.27E-007		3E-005		1.10E-006		2E-004					
Beryllium	1.40E-005	NA	1.00E-003	NA	NA	1.90E-004	1.90E-010	2.65E-010		2E-005		2 29E-009		2E-004					
Cadmium	1.25E-005	NA	1.00E-003	NA	NA	7.80E-004	7.80E-010	1.09E-009		9E-005		9.40E-009		8E-004					
Calcium	NA	NA	1.00E-003	NA	NA	2.20E+002	2.20E-004												
Chromium	7.50E-005	NA	2.00E-003	NA	NA	5.60E-003	1.12E-008	1.56E-008		2E-004		1.35E-007		2E-003					
Cobalt	2.00E-002	5.00E-006	4.00E-004	NA	NA	7.20E-003	2.88E-009	4.02E-009	1.43E-009	2E-007	7E-015	3.47E-008	2.48E-009	2E-006	1E-014				
Copper	4.00E-002	NA	1.00E-003	NA	NA	7.90E-003	7.90E-009	1.10E-008		3E-007		9.52E-008		2E-006					
Iron	3.00E-001	NA	1.00E-003	NA	NA	9.05E+000	9.05E-006	1.26E-005		4E-005		1.09E-004		4E-004					
Lead	NA	NA	1.00E-004	NA	NA	2.00E-002	2.00E-009												
Magnesium	NA	NA	1.00E-003	NA	NA	3.37E+001	3.37E-005												
Manganese	2.00E-003	NA	1.00E-003	NA	NA	2.30E+000	2.30E-006	3.21E-006		2E-003		2.77E-005		1E-002					
Mercury	2.10E-005	NA	1.00E-003	NA	NA	1.00E-004	1.00E-010	1.39E-010		7E-006		1.21E-009		6E-005					
Nickel	8.00E-004	NA	2.00E-004	NA	NA	1.88E-002	3.76E-009	5.24E-009		7E-006		4.53E-008		6E-005					
Potassium	NA	NA	2.00E-003	NA	NA	1.16E+001	2.32E-005												
Silver	2.00E-004	NA	6.00E-004	NA	NA	8.90E-004	5.34E-010	7.45E-010		4E-006		6.44E-009		3E-005					
Sodium	NA	NA	1.00E-003	NA	NA	5.93E+001	5.93E-005												
Thallium	8.00E-005	NA	1.00E-003	NA	NA	1.90E-003	1.90E-009	2.65E-009		3E-005		2.29E-008		3E-004					
Vanadium	1.82E-004	NA	1.00E-003	NA	NA	8.90E-003	8.90E-009	1.24E-008		7E-005		1.07E-007		6E-004					
Zinc	3.00E-001	NA	6.00E-004	NA	NA	9.90E-002	5.94E-008	8.29E-008		3E-007		7.16E-007		2E-006					
Total Hazard Quotient and Cancer Risk:										**4E-003**	**5E-005**			**4E-002**	**8E-005**				

TABLE A-13

CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SURFACE WATER

REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63

EE/CA - Mini Risk Assessment

Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):

DA = Absorbed Dose per Event   ED = Exposure Duration
SA = Surface Area Contact   BW = Bodyweight
EF = Exposure Frequency   AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics with ET < t*: $DA = 2Kp \; CW \sqrt{\frac{6 \cdot \tau \cdot ET}{\pi}} \; CF$

For organics with ET > t*: DA = Kp x CW x [ET/(1+B) + 2Tau(1+3B)/(1+B)] x CF

For inorganics: DA = Kp x CW x ET x CF

Kp = Permeability Coefficient   Tau = Lag Time
CW = EPC Surface Water   CF = Conversion Factor
ET = Exposure Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient *Kp* (cm/hr)	Tau (hours)	B (unitless)	EPC Surface Water (mg/L)	Absorbed Dose/Event (mg-cm²/event)	Park Worker Intake (mg/kg-day) (Nc)	Park Worker Intake (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Intake (mg/kg-day) (Nc)	Recreational Visitor (Child) Intake (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Intake (mg/kg-day) (Nc)	Construction Worker Intake (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
								Assumptions for Park Worker				Assumptions for Recreational Visitor (Child)							
								CF =	1E-003	liter/cm3		CF =	1E-003	liter/cm3					
								BW =	70	kg		BW =	15	kg					
								SA =	1,980	cm2		SA =	3,300	cm2					
								ET =	1	hour/day		ET =	1	hour/day					
								EF =	18	days/year		EF =	20	days/year					
								ED =	25	years		ED =	5	years					
								AT (Nc) =	9,125	days		AT (Nc) =	1,825	days					
								AT (Car) =	25,550	days		AT (Car) =	25,550	days					

Notes:

1. Cells in this table were intentionally left blank due to a lack of toxicity data.

2. Kp, B, and Tou were taken from EPA Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment Interim Guidance, 1999. Where Kp and B were not availabe, they were calculated according to the guidance. Kow values from SRC PhysProp Database were used to estimate Kp (http://esc.syrres.com/interkow/physdemo.htm).

TABLE

CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SURFACE WATER

REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63

EE/CA - Mini Risk Assessment

Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):

DA = Absorbed Dose per Event | ED = Exposure Duration
SA = Surface Area Contact | BW = Bodyweight
EF = Exposure Frequency | AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics with ET < t*: $DA = 2Kp \; CW \sqrt{\frac{6 \; \tau \cdot ET}{\pi}} \; CF$

For organics with ET > t DA = Kp x CW x [ET/(1+B) + 2Tau(1+3B)/(1+B)] x CF

For inorganics: DA = Kp x CW x ET x CF

Kp = Permeability Coefficient | Tau = Lag Time
CW = EPC Surface Water | CF = Conversion Factor
ET = Exposure Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient Kp (cm/hr)	Tau (hours)	B (unitless)	EPC Surface Water (mg/L)	Absorbed Dose/Event (mg-cm²/event)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Volatile Organics																
Chloroform	1.00E-002	6.10E-003	6.9E-003	0.53	0.0	8.00E-004	1.11E-008	1.61E-008	5.53E-009	2E-006	3E-011	1.34E-007	9.56E-009	1E-005	6E-011	9E-011
Toluene	2.00E-001	NA	3.2E-002	0.37	0.1	1.00E-003	5.51E-008	8.01E-008		4E-007		6.64E-007		3E-006		
Semivolatile Organics																
4-Methylphenol	NA	NA	7.7E-003	0.45	0.0	2.20E-004	3.14E-009									
Benzo(a)pyrene	NA	7.30E+000	8.3E-001	2.83	5.0	1.00E-003	3.86E-006		1.92E-006		1E-005		3.32E-006		2E-005	4E-005
Benzo(b)fluoranthene	NA	7.30E-001	8.3E-001	2.92	5.1	9.00E-004	3.53E-006		1.76E-006		1E-006		3.04E-006		2E-006	4E-006
Benzo(ghi)perylene	NA	NA	1.2E+000	4.24		8.00E-004	5.66E-006									
Benzo(k)fluoranthene	NA	7.30E-002	7.6E-001	3.03		1.00E-003	3.65E-006		1.82E-006		1E-007		3.15E-006		2E-007	4E-007
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	2.9E-002	17.44	0.2	6.80E-002	2.28E-005	3.31E-005	1.13E-005	2E-003	2E-007	2.74E-004	1.96E-005	1E-002	3E-007	4E-007
Butylbenzylphthalate	2.00E-001	NA	4.2E-002	7.04		2.30E-004	7.03E-008	1.02E-007		5E-007		8.47E-007		4E-006		
Di-n-butylphthalate	1.00E-001	NA	2.6E-002	4.06	0.2	1.50E-004	2.17E-008	3.16E-008		3E-007		2.62E-007		3E-006		
Dibenz(a,h)anthracene	NA	7.30E+000	1.8E+000	4.08	11.7	8.00E-004	8.04E-006		4.01E-006		3E-005		6.92E-006		5E-005	8E-005
Diethyl phthalate	8.00E-001	NA	4.00E-003	1.97	0.0	2.90E-004	4.50E-009	6.54E-009		8E-009		5.42E-008		7E-008		
Fluoranthene	4.00E-002	NA	2.5E-001	1.53	1.4	7.00E-004	5.98E-007	8.69E-007		2E-005		7.21E-006		2E-004		
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	1.3E+000	3.97	8.0	9.00E-004	6.44E-006		3.21E-006		2E-006		5.55E-006		4E-006	6E-006
Pentachlorophenol	3.00E-002	1.20E-001	4.6E-001	3.50	2.9	1.00E-003	2.38E-006	3.46E-006	1.18E-006	1E-004	1E-007	2.87E-005	2.05E-006	1E-003	2E-007	4E-007
Phenanthrene	NA	NA	1.6E-001	1.12	0.8	5.70E-005	2.67E-008									
Phenol	6.00E-001	NA	4.3E-003	0.38	0.0	8.00E-004	6.05E-009	8.79E-009		1E-008		7.30E-008		1E-007		
Pyrene	3.00E-002	NA	2.2E-001	1.50		5.00E-004	3.68E-007	5.34E-007		2E-005		4.43E-006		1E-004		
Pesticides/PCBs																
4,4'-DDD	NA	2.40E-001	2.1E-001	6.98	1.4	2.60E-005	3.99E-008		1.99E-008		5E-009		3.43E-008		8E-009	1E-008
4,4'-DDE	NA	3.40E-001	1.8E-001	6.80	1.2	5.10E-006	6.62E-009		3.30E-009		1E-009		5.70E-009		2E-009	3E-009
4,4'-DDT	5.00E-004	3.40E-001	3.2E-001	10.96	2.3	4.60E-005	1.35E-007	1.96E-007	6.71E-008	4E-004	2E-008	1.62E-006	1.16E-007	3E-003	4E-008	6E-008
Endosulfan sulfate	6.00E-003	NA	1.9E-003	26.55		1.40E-005	3.83E-010	5.57E-010		9E-008		4.62E-009		8E-007		0E+000
Endrin	3.00E-004	NA	1.4E-002	15.33	0.1	5.20E-005	7.88E-009	1.14E-008		4E-005		9.50E-008		3E-004		0E+000
Endrin aldehyde	NA	NA	1.4E-002	15.33	0.1	6.20E-005	9.39E-009									
Endrin ketone	NA	NA	1.4E-002	15.33	0.1	4.60E-005	6.97E-009									
gamma-Chlordane	5.00E-004	3.50E-001	1.2E-002	4.80	0.1	4.00E-006	2.91E-010	4.22E-010	1.45E-010	8E-007	5E-011	3.50E-009	2.50E-010	7E-006	9E-011	1E-010
Heptachlor	5.00E-004	4.50E+000	9.6E-003	13.91	0.1	3.60E-006	3.56E-010	5.18E-010	1.77E-010	1E-006	8E-010	4.29E-009	3.07E-010	9E-006	1E-009	2E-009
Heptachlor epoxide	1.30E-005	9.10E+000	2.3E-002	20.73		3.00E-006	8.58E-010	1.25E-009	4.27E-010	1E-004	4E-009	1.03E-008	7.39E-010	8E-004	7E-009	1E-008
Metals																
Aluminum	1.00E+000	NA	1.00E-003	NA	NA	3.63E+000	3.63E-006	5.27E-006		5E-006		4.38E-005		4E-005		
Arsenic	3.00E-004	1.50E+000	1.00E-003	NA	NA	3.80E-003	3.80E-009	5.52E-009	1.89E-009	2E-005	3E-009	4.58E-008	3.27E-009	2E-004	5E-009	8E-009
Barium	4.90E-003	NA	1.00E-003	NA	NA	9.14E-002	9.14E-008	1.33E-007		3E-005		1.10E-006		2E-004		
Beryllium	1.40E-005	NA	1.00E-003	NA	NA	1.90E-004	1.90E-010	2.76E-010		2E-005		2.29E-009		2E-004		
Cadmium	1.25E-005	NA	1.00E-003	NA	NA	7.80E-004	7.80E-010	1.13E-009		9E-005		9.40E-009		8E-004		
Calcium	NA	NA	1.00E-003	NA	NA	2.20E+002	2.20E-004									
Chromium	7.50E-005	NA	2.00E-003	NA	NA	5.60E-003	1.12E-008	1.63E-008		2E-004		1.35E-007		2E-003		
Cobalt	2.00E-002	5.00E-006	4.00E-004	NA	NA	7.20E-003	2.88E-009	4.18E-009	1.43E-009	2E-007	7E-015	3.47E-008	2.48E-009	2E-006	1E-014	2E-014
Copper	4.00E-002	NA	1.00E-003	NA	NA	7.90E-003	7.90E-009	1.15E-008		3E-007		9.52E-008		2E-006		
Iron	3.00E-001	NA	1.00E-003	NA	NA	9.05E+000	9.05E-006	1.31E-005		4E-005		1.09E-004		4E-004		
Lead	NA	NA	1.00E-004	NA	NA	2.00E-002	2.00E-009									
Magnesium	NA	NA	1.00E-003	NA	NA	3.37E+001	3.37E-005									
Manganese	2.00E-003	NA	1.00E-003	NA	NA	2.30E+000	2.30E-006	3.34E-006		2E-003		2.77E-005		1E-002		
Mercury	2.10E-005	NA	1.00E-003	NA	NA	1.00E-004	1.00E-010	1.45E-010		7E-006		1.21E-009		6E-005		
Nickel	8.00E-004	NA	2.00E-004	NA	NA	1.88E-002	3.76E-009	5.46E-009		7E-006		4.53E-008		6E-005		
Potassium	NA	NA	2.00E-003	NA	NA	1.16E+001	2.32E-005									
Silver	2.00E-004	NA	6.00E-004	NA	NA	8.90E-004	5.34E-010	7.76E-010		4E-006		6.44E-009		3E-005		
Sodium	NA	NA	1.00E-003	NA	NA	5.93E+001	5.93E-005									
Thallium	8.00E-005	NA	1.00E-003	NA	NA	1.90E-003	1.90E-009	2.76E-009		3E-005		2.29E-008		3E-004		
Vanadium	1.82E-004	NA	1.00E-003	NA	NA	8.90E-003	8.90E-009	1.29E-008		7E-005		1.07E-007		6E-004		
Zinc	3.00E-001	NA	6.00E-004	NA	NA	9.90E-002	5.94E-008	8.63E-008		3E-007		7.16E-007		2E-006		
Total Hazard Quotient and Cancer Risk:										5E-003	5E-005			4E-002	8E-005	1E-004

TABLE A-14
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SURFACE WATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = (DA x SA x EF x ED) / (BW x AT)

Variables (Assumptions for Each Receptor are Listed at the Bottom):

DA = Absorbed Dose per Event | ED = Exposure Duration
SA = Surface Area Contact | BW = Bodyweight
EF = Exposure Frequency | AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics with ET < t*: $DA = 2Kp \times CW \times \sqrt{\frac{6 \cdot \tau \cdot ET}{\pi}} \times CF$

For organics with ET > t DA = Kp x CW x [ET/(1+B) + 2Tau(1+3B)/(1+B)] x CF

For inorganics: DA = Kp x CW x ET x CF

Kp = Permeability Coefficient | Tau = Lag Time
CW = EPC Surface Water | CF = Conversion Factor
ET = Exposure Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient *Kp* (cm/hr)	Tau (hours)	B (unitless)	EPC Surface Water (mg/L)	Absorbed Dose/Event (mg-cm²/event)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
								Assumptions for Resident (Adult)				Assumptions for Resident (Child)				
								CF =	1E-003	liter/cm3		CF =	1E-003	liter/cm3		
								BW =	70	kg		BW =	15	kg		
								SA =	4,500	cm2		SA =	3,300	cm2		
								ET =	0.5	hour/day		ET =	1	hour/day		
								EF =	35	days/year		EF =	35	days/year		
								ED =	24	years		ED =	6	years		
								AT (Nc) =	8,760	days		AT (Nc) =	2,190	days		
								AT (Car) =	25,550	days		AT (Car) =	25,550	days		

Notes:

1. Cells in this table were intentionally left blank due to a lack of toxicity data.
2. Kp, B, and Tou were taken from EPA Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment Interim Guidance, 1999
Where Kp and B were not availabe, they were calculated according to the guidance. Kow values from SRC PhysProp Database were used to estimate Kp (http://esc.syrres.com/interkow/physdemo.htm).

TABLE A-15
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SEDIMENT
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Sediment, from Sediment EPC Data
CF = Conversion Factor
SA = Surface Area Contact
AF = Adherence Factor
ABS = Absorption Factor
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Sediment (mg/kg)	Park Worker Absorbed Dose (mg/kg-day) (Nc)	Park Worker Absorbed Dose (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Nc)	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Absorbed Dose (mg/kg-day) (Nc)	Construction Worker Absorbed Dose (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Volatile Organics																
Acetone	1.00E-001	NA	NA	1.50E-001												
Methyl ethyl ketone	6.00E-001	NA	NA	3.50E-002												
Toluene	2.00E-001	NA	NA	1.40E-002												
Semivolatile Organics																
2-Methylnaphthalene	4.00E-002	NA	0.10	1.40E-002	1.12E-009		3E-008		1.12E-008		3E-007					
Benzo(a)anthracene	NA	7.30E-001	0.13	2.00E+000		7.46E-008		5E-008		1.48E-007		1E-007				
Benzo(a)pyrene	NA	7.30E+000	0.13	2.70E+000		1.01E-007		7E-007		2.00E-007		1E-006				
Benzo(b)fluoranthene	NA	7.30E-001	0.13	3.50E+000		1.31E-007		1E-007		2.59E-007		2E-007				
Benzo(k)fluoranthene	NA	7.30E-002	0.13	1.90E+000		7.08E-008		5E-009		1.41E-007		1E-008				
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	0.10	1.10E-001	8.83E-009	3.16E-009	4E-007	4E-011	8.78E-008	6.27E-009	4E-006	9E-011				
Butylbenzylphthalate	2.00E-001	NA	0.10	2.20E-002	1.77E-009		9E-009		1.76E-008		9E-008					
Carbazole	NA	2.00E-002	0.10	4.30E-001		1.23E-008		2E-010		2.45E-008		5E-010				
Chrysene	NA	7.30E-003	0.10	2.20E+000		6.31E-008		5E-010		1.25E-007		9E-010				
Di-n-butylphthalate	1.00E-001	NA	0.10	1.90E-002	1.53E-009		2E-008		1.52E-008		2E-007					
Di-n-octylphthalate	NA	NA	0.10	1.90E-002												
Dibenz(a,h)anthracene	NA	7.30E+000	0.13	1.20E+000		4.47E-008		3E-007		8.89E-008		6E-007				
Dibenzofuran	NA	NA	0.10	3.60E-002												
Diethyl phthalate	8.00E-001	NA	0.10	9.20E-002	7.39E-009		9E-009		7.34E-008		9E-008					
Fluoranthene	4.00E-002	NA	0.13	4.30E+000	4.49E-007		1E-005		4.46E-006		1E-004					
Fluorene	4.00E-002	NA	0.13	1.10E-001	1.15E-008		3E-007		1.14E-007		3E-006					
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	0.13	2.50E+000		9.32E-008		7E-008		1.85E-007		1E-007				
Naphthalene	2.00E-002	NA	0.13	2.30E-002	2.40E-009		1E-007		2.39E-008		1E-006					
Phenanthrene	NA	NA	0.13	1.50E+000												
Phenol	6.00E-001	NA	0.10	1.10E-002	8.83E-010		1E-009		8.78E-009		1E-008					
Pyrene	3.00E-002	NA	0.13	3.20E+000	3.34E-007		1E-005		3.32E-006		1E-004					
Pesticides/PCBs																
4,4'-DDD	NA	2.40E-001	0.03	3.90E-003		3.36E-011		8E-012		6.67E-011		2E-011				
4,4'-DDE	NA	3.40E-001	0.03	9.20E-003		7.92E-011		3E-011		1.57E-010		5E-011				
4,4'-DDT	5.00E-004	3.40E-001	0.03	8.30E-003	2.00E-010	7.14E-011	4E-007	2E-011	1.99E-009	1.42E-010	4E-006	5E-011				
alpha-Chlordane	5.00E-004	3.50E-001	0.04	3.20E-003	1.03E-010	3.67E-011	2E-007	1E-011	1.02E-009	7.29E-011	2E-006	3E-011				
Aroclor-1260	2.00E-005	2.00E+000	0.14	1.10E-001	1.24E-008	4.42E-009	6E-004	9E-009	1.23E-007	8.78E-009	6E-003	2E-008				
Endosulfan I	6.00E-003	NA	0.10	7.50E-003	6.02E-010		1E-007		5.98E-009		1E-006					
Endosulfan sulfate	6.00E-003	NA	0.10	1.20E-002	9.64E-010		2E-007		9.57E-009		2E-006					
Endrin aldehyde	NA	NA	0.10	8.60E-003												
Endrin ketone	NA	NA	0.10	9.40E-003												
Metals																
Aluminum	1.00E+000	NA	NA	1.67E+004												
Arsenic	3.00E-004	1.50E+000	3.00E-002	6.80E+000	1.64E-007	5.85E-008	5E-004	9E-008	1.63E-006	1.16E-007	5E-003	2E-007				
Barium	4.90E-003	NA	NA	1.07E+002												
Beryllium	1.40E-005	NA	NA	8.00E-001												
Cadmium	1.25E-005	NA	1.00E-003	8.30E-001	6.67E-010		5E-005		6.62E-009		5E-004					
Calcium	NA	NA	NA	2.11E+005												
Chromium	7.50E-005	NA	NA	2.44E+001												
Cobalt	2.00E-002	5.00E-006	NA	1.44E+001												
Copper	4.00E-002	NA	NA	4.26E+001												
Cyanide	2.00E-002	NA	NA	2.10E+000												
Iron	3.00E-001	NA	NA	2.97E+004												
Lead	NA	NA	NA	4.62E+001												
Magnesium	NA	NA	NA	1.61E+004												
Manganese	2.00E-003	NA	NA	9.95E+002												
Mercury	2.10E-005	NA	NA	1.30E-001												
Nickel	8.00E-004	NA	NA	4.42E+001												

Dermal Contact to Sediment Not Applicable for for Construction Worker

TABLE A-15
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SEDIMENT
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Sediment, from Sediment EPC Data
CF = Conversion Factor
SA = Surface Area Contact
AF = Adherence Factor
ABS = Absorption Factor
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Sediment (mg/kg)	Park Worker Absorbed Dose (mg/kg-day) (Nc)	Park Worker Absorbed Dose (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Nc)	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Absorbed Dose (mg/kg-day) (Nc)	Construction Worker Absorbed Dose (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Potassium	NA	NA	NA	2.57E+003												
Selenium	5.00E-003	NA	NA	2.10E+000												
Sodium	NA	NA	NA	5.78E+002												
Thallium	8.00E-005	NA	NA	2.30E+000												
Vanadium	1.82E-004	NA	NA	2.80E+001												
Zinc	3.00E-001	NA	NA	5.34E+002												
Total Hazard Quotient and Cancer Risk:							1E-003	1E-006			1E-002	3E-006				

Assumptions for Park Worker		
CF =	1E-006	kg/mg
BW =	70	kg
SA =	5,700	cm2
AF =	0.2	mg/cm2
EF =	18	days/year
ED =	25	years
AT (Nc) =	9,125	days
AT (Car) =	25,550	days

Assumptions for Recreational Visitor (Child)		
CF =	1E-006	kg/mg
BW =	15	kg
SA =	2,800	cm2
AF =	0 2	mg/cm2
EF =	78	days/year
ED =	5	years
AT (Nc) =	1,825	days
AT (Car) =	25,550	days

Note Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.
Absorption factors are from EPA Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment, 1999.

TABLE A-16
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SEDIMENT
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
- CS = Chemical Concentration in Sediment, from Sediment EPC Data
- CF = Conversion Factor
- SA = Surface Area Contact
- AF = Adherence Factor
- ABS = Absorption Factor
- EF = Exposure Frequency
- ED = Exposure Duration
- BW = Bodyweight
- AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose
Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD	Carc. Slope Dermal	Absorption Factor*	EPC Sediment	Resident (Adult)				Resident (Child)				Resident
					Absorbed Dose (mg/kg-day)		Hazard Quotient	Contribution to Lifetime Cancer Risk	Absorbed Dose (mg/kg-day)		Hazard Quotient	Contribution to Lifetime Cancer Risk	Total Lifetime Cancer Risk
	(mg/kg-day)	(mg/kg-day)-1	(unitless)	(mg/kg)	(Nc)	(Car)			(Nc)	(Car)			
Volatile Organics													
Acetone	1.00E-001	NA	NA	1.50E-001									
Methyl ethyl ketone	6.00E-001	NA	NA	3.50E-002									
Toluene	2.00E-001	NA	NA	1.40E-002									
Semivolatile Organics													
2-Methylnaphthalene	4.00E-002	NA	0.10	1.40E-002	1.12E-009		3E-008		1.12E-008		3E-007		
Benzo(a)anthracene	NA	7.30E-001	0.13	2.00E+000		7.46E-008		5E-008		1.48E-007		1E-007	1.63E-007
Benzo(a)pyrene	NA	7.30E+000	0.13	2.70E+000		1.01E-007		7E-007		2.00E-007		1E-006	2.20E-006
Benzo(b)fluoranthene	NA	7.30E-001	0.13	3.50E+000		1.31E-007		1E-007		2.59E-007		2E-007	2.85E-007
Benzo(k)fluoranthene	NA	7.30E-002	0.13	1.90E+000		7.08E-008		5E-009		1.41E-007		1E-008	1.54E-008
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	0.10	1.10E-001	8.83E-009	3.16E-009	4E-007	4E-011	8.78E-008	6.27E-009	4E-006	9E-011	1.32E-010
Butylbenzylphthalate	2.00E-001	NA	0.10	2.20E-002	1.77E-009		9E-009		1.76E-008		9E-008		
Carbazole	NA	2.00E-002	0.10	4.30E-001		1.23E-008		2E-010		2.45E-008		5E-010	7.37E-010
Chrysene	NA	7.30E-003	0.10	2.20E+000		6.31E-008		5E-010		1.25E-007		9E-010	1.38E-009
Di-n-butylphthalate	1.00E-001	NA	0.10	1.90E-002	1.53E-009		2E-008		1.52E-008		2E-007		
Di-n-octylphthalate	NA	NA	0.10	1.90E-002									
Dibenz(a,h)anthracene	NA	7.30E+000	0.13	1.20E+000		4.47E-008		3E-007		8.89E-008		6E-007	9.76E-007
Dibenzofuran	NA	NA	0.10	3.60E-002									
Diethyl phthalate	8.00E-001	NA	0.10	9.20E-002	7.39E-009		9E-009		7.34E-008		9E-008		
Fluoranthene	4.00E-002	NA	0.13	4.30E+000	4.49E-007		1E-005		4.46E-006		1E-004		
Fluorene	4.00E-002	NA	0.13	1.10E-001	1.15E-008		3E-007		1.14E-007		3E-006		
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	0.13	2.50E+000		9.32E-008		7E-008		1.85E-007		1E-007	2.03E-007
Naphthalene	2.00E-002	NA	0.13	2.30E-002	2.40E-009		1E-007		2.39E-008		1E-006		
Phenanthrene	NA	NA	0.13	1.50E+000									
Phenol	6.00E-001	NA	0.10	1.10E-002	8.83E-010		1E-009		8.78E-009		1E-008		
Pyrene	3.00E-002	NA	0.13	3.20E+000	3.34E-007		1E-005		3.32E-006		1E-004		
Pesticides/PCBs													
4,4'-DDD	NA	2.40E-001	0.03	3.90E-003		3.36E-011		8E-012		6.67E-011		2E-011	2.41E-011
4,4'-DDE	NA	3.40E-001	0.03	9.20E-003		7.92E-011		3E-011		1.57E-010		5E-011	8.04E-011
4,4'-DDT	5.00E-004	3.40E-001	0.03	8.30E-003	2.00E-010	7.14E-011	4E-007	2E-011	1.99E-009	1.42E-010	4E-006	5E-011	7.25E-011
alpha-Chlordane	5.00E-004	3.50E-001	0.04	3.20E-003	1.03E-010	3.67E-011	2E-007	1E-011	1.02E-009	7.29E-011	2E-006	3E-011	3.84E-011
Aroclor-1260	2.00E-005	2.00E+000	0.14	1.10E-001	1.24E-008	4.42E-009	6E-004	9E-009	1.23E-007	8.78E-009	6E-003	2E-008	2.64E-008
Endosulfan I	6.00E-003	NA	0.10	7.50E-003	6.02E-010		1E-007		5.98E-009		1E-006		
Endosulfan sulfate	6.00E-003	NA	0.10	1.20E-002	9.64E-010		2E-007		9.57E-009		2E-006		
Endrin aldehyde	NA	NA	0.10	8.60E-003									
Endrin ketone	NA	NA	0.10	9.40E-003									
Metals													
Aluminum	1.00E+000	NA	NA	1.67E+004									
Arsenic	3.00E-004	1.50E+000	3.00E-002	6.80E+000	1.64E-007	5.85E-008	5E-004	9E-008	1.63E-006	1.16E-007	5E-003	2E-007	2.62E-007
Barium	4.90E-003	NA	NA	1.07E+002									
Beryllium	1.40E-005	NA	NA	8.00E-001									
Cadmium	1.25E-005	NA	1.00E-003	8.30E-001	6.67E-010		5E-005		6.62E-009		5E-004		
Calcium	NA	NA	NA	2.11E+005									
Chromium	7.50E-005	NA	NA	2.44E+001									
Cobalt	2.00E-002	5.00E-006	NA	1.44E+001									
Copper	4.00E-002	NA	NA	4.26E+001									
Cyanide	2.00E-002	NA	NA	2.10E+000									
Iron	3.00E-001	NA	NA	2.97E+004									
Lead	NA	NA	NA	4.62E+001									
Magnesium	NA	NA	NA	1.61E+004									
Manganese	2.00E-003	NA	NA	9.95E+002									
Mercury	2.10E-005	NA	NA	1.30E-001									
Nickel	8.00E-004	NA	NA	4.42E+001									

TABLE A-16
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SEDIMENT
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Sediment, from Sediment EPC Data
CF = Conversion Factor
SA = Surface Area Contact
AF = Adherence Factor
ABS = Absorption Factor
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose
Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Sediment (mg/kg)	Resident (Adult) Absorbed Dose (mg/kg-day) (Nc)	Resident (Adult) Absorbed Dose (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Absorbed Dose (mg/kg-day) (Nc)	Resident (Child) Absorbed Dose (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Potassium	NA	NA	NA	2.57E+003									
Selenium	5.00E-003	NA	NA	2.10E+000									
Sodium	NA	NA	NA	5.78E+002									
Thallium	8.00E-005	NA	NA	2.30E+000									
Vanadium	1.82E-004	NA	NA	2.80E+001									
Zinc	3.00E-001	NA	NA	5.34E+002									
Total Hazard Quotient and Cancer Risk:							1E-003	1E-006			1E-002	3E-006	4.13E-006

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
CF =	1E-006	kg/mg	CF =	1E-006	kg/mg
BW =	70	kg	BW =	15	kg
SA =	5,700	cm2	SA =	2,800	cm2
AF =	0.07	mg/cm2	AF =	0.2	mg/cm2
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.
Absorption factors are from EPA Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment, 1999.

Response to the Comments From the U.S. Environmental Protection Agency, Region II

Subject: Action Memorandum for the Miscellaneous Components Burial Site (SEAD-63) Seneca Army Depot, Romulus, New York, dated July, 2001

Comments Dated: August 23, 2001

Date of Comment Response: October 31, 2001

USEPA REGION II:

1. Comment: Section 2.1, 2nd ¶, 2nd to last Sentence: This statement seems outdated.

   Response: We believe the comment refers to the sentence "The depot formerly employed approximately 1,000 civilian and military personnel." This sentence is valid. No change has been made to the text

2. Comment: Section 5.1.9, 1st Sentence: Replace the word remedial with removal.

   Response: The word remedial has been replaced with removal.

3. Comment: An exposure frequency of 14 days for SEAD-63 is not protective of public health. EPA proposed an exposure frequency based on 3 days/week during 13 summer weeks, and 1 day/week for the remaining 39 weeks of the year for a total exposure frequency of 78 days/year.

   Response: EPA's recommended exposure frequency as stated above has been considered for a recreational visitor (child). The recommended exposure frequency was directly used for exposure to soil, groundwater, and sediment. For exposure to surface water, we assumed wading events take place every time during 13 spring visits (when water is most likely to accumulate in the ditches) and 10% of other visits. Therefore, an exposure frequency of 20 days/yr was used for exposure to ditch water and sediment. This is a very conservative assumption because the ditch is usually dry except during storm periods. In addition, we used other conservative assumptions such as half of the total body surface being exposed during the wading event. The comparison of the human health risks presented in this report with the previously calculated risks are summarized in the attached table.

   All the risks calculated for the recreational child, park worker, and construction worker are within EPA's target risk ranges (i.e., 10^{-4} to 10^{-6} for lifetime cancer risk and 1 for non-cancer hazard risk) and therefore, are acceptable. The recreational child resulted in a hazard index of 0.4 and a cancer risk of 8E-5. The park worker resulted in a hazard index of 0.2 and a cancer risk of 5E-5. The primary constituents driving the cancer risk are dibenz(a,h)anthracene and benzo(a)pyrene in surface water. These two constituents were detected in only one sample out of 22 samples. Therefore, risk driven by these two constituents is most likely lower than indicated by the mini-risk assessment. In addition, the sediment of the ditch where dibenz(a,h)anthracene and benzo(a)pyrene were detected in the surface water is proposed to be excavated. Therefore, risks associated with the surface water due to the compounds will be addressed by the removal action.

In addition to addressing EPA's comments, we have updated our risk assessment of the dermal exposure route according to the USEPA's Dermal Risk Assessment Interim Guidance (1999), which represents the current knowledge of dermal risk assessment. The following major changes were included:

(1) We have updated soil dermal absorption factor according to the USEPA 1999 guidance. Risks associated with semivolatile organic compounds have been added to the risk evaluation by using a default value of 0.1 as the dermal absorption factor.

(2) The dermal RfD or cancer slope factor has been updated according to the USEPA's recommendations (1999).

(3) The permeability coefficient for compounds in water (Kp) and lag time per event (τ) have been updated.

(4) The RME values for soil and water dermal contact (e.g., skin surface area, soil adherence factor) have been updated according to the 1999 guidance.

We have also added residential risk evaluation backup calculations in Appendix F and updated table references in Table 2-15. The residential risk scenario was performed for comparison purposes only and was presented in the text of the earlier versions of this document.

Table 1, attached, compares the risk values in the July 2001 report and the updated risk values provided in this final version.

TABLE 1
Summary of Total Noncarcinogenic and Carcinogenic Risks
SEAD-63
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	Total Noncarcinogenic and Carcinogenic Risks			
		July, 2001 Report		October, 2001 Report	
		HAZARD INDEX	CANCER RISK	HAZARD INDEX	CANCER RISK
PARK WORKER	Inhalation of Dust in Ambient Air	7E-07	1E-09	7E-07	1E-09
	Ingestion of Soil	1E-03	5E-08	1E-03	5E-08
	Dermal Contact to Soil	4E-03	NQ	4E-04	8E-08
	Ingestion of Groundwater	1E-01	NQ	1E-01	NQ
	Dermal Contact to Surface Water	7E-03	9E-05	4E-03	5E-05
	Dermal Contact to Sediment	8E-04	1E-08	1E-03	1E-06
	TOTAL RECEPTOR RISK (Nc & Car)	**2E-01**	**9E-05**	**2E-01**	**5E-05**
RECREATIONAL VISITOR (CHILD)	Inhalation of Dust Ambient Air	3E-07	1E-10	1E-06	5E-10
	Ingestion of Soil	7E-04	8E-09	4E-03	4E-08
	Dermal Contact to Soil	7E-04	NQ	4E-04	2E-08
	Ingestion of Groundwater	5E-02	NQ	3E-01	NQ
	Dermal Contact to Groundwater	4E-03	NQ	5E-02	NQ
	Dermal Contact to Surface Water	3E-02	8E-05	4E-02	8E-05
	Dermal Contact to Sediment	3E-03	1E-08	1E-02	3E-06
	TOTAL RECEPTOR RISK (Nc & Car)	**9E-02**	**8E-05**	**4E-01**	**8E-05**
CONSTRUCTION WORKER	Inhalation of Dust in Ambient Air	9E-05	3E-08	9E-05	3E-08
	Ingestion of Soil	2E-01	4E-08	2E-01	4E-08
	Dermal Contact to Soil	3E-01	NQ	2E-02	1E-08
	TOTAL RECEPTOR RISK (Nc & Car)	**5E-01**	**8E-08**	**3E-01**	**9E-08**

NQ = Not Quantified due to lack of toxicity data

PARSONS ENGINEERING SCIENCE, INC.

30 Dan Road • Canton, Massachusetts 02021-2809 • (781) 401-3200 • Fax: (781) 401-2575

October 31, 2001

Commander
U.S. Army Corps of Engineers
Engineering and Support Center, Huntsville
Attn: Major David Sheets/ CEHNC-PM-EO
4820 University Square
Huntsville, AL 35816-1822

SUBJECT: **Seneca Army Depot Activity - Final Action Memorandum and Engineering Evaluation/Cost Analysis (EE/CA) for the Miscellaneous Components Burial Site (SEAD-63).**

Dear Major Sheets:

Parsons Engineering Science (Parsons) is pleased to submit responses to USEPA's comments on the Action Memorandum and Engineering Evaluation/Cost Analysis (EE/CA) for SEAD-63 at the Seneca Army Depot Activity located in Romulus, New York dated July, 2001. Replacement pages to the document have been provided.

This work was performed in accordance with the Scope of Work (SOW) for Delivery Order 11 to the Parsons Contract DACA87-95-0031.

Parsons appreciates the opportunity to provide you with this memorandum. Should you have any questions, please do not hesitate to call me at (781) 401-2535 to discuss them.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Jacqueline Travers

Jacqueline Travers, P.E.
Task Order Manager

cc: Maj. D. Sheets, USACE – Huntsville
K. Hoddinott, USACHPPM
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PARSONS

PARSONS ENGINEERING SCIENCE, INC.

30 Dan Road • Canton, Massachusetts 02021-2809 • (781) 401-3200 • Fax: (781) 401-2575

October 31, 2001

Mr. Julio Vazquez
USEPA Region II
Superfund Federal Facilities Section
290 Broadway, 18th Floor
New York, NY 10007-1866

Ms. Alicia Thorne
New York State Department of Environmental Conservation (NYSDEC)
Bureau of Eastern Remedial Action
Division of Hazardous Waste Remediation
625 Broadway 11th Floor
Albany, NY 12233-7015

SUBJECT: **Seneca Army Depot Activity – Final Action Memorandum and Engineering Evaluation/Cost Analysis (EE/CA) for the Miscellaneous Components Burial Site (SEAD-63).**

Dear Mr. Vazquez/Ms. Thorne:

Parsons Engineering Science (Parsons) is pleased to submit responses to USEPA's comments on the Action Memorandum and Engineering Evaluation/Cost Analysis (EE/CA) for SEAD-63 at the Seneca Army Depot Activity located in Romulus, New York dated July 2001. Please find enclosed replacement pages to update the Action Memorandum and Appendices. Instructions are provided.

Should you have any questions, please do not hesitate to call me at (781) 401-2535 to discuss them.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Jacqueline Travers

Jacqueline Travers, P.E.
Task Order Manager

cc:
S. Absolom, SEDA
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T. Sydelko, Argonne Nat'l Lab
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K. Healy, USACE – Huntsville

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SENECA ARMY DEPOT ACTIVITY
FINAL ACTION MEMORANDUM – OCTOBER 2001
Instructions to Complete Edit/Update to revised final document

Please find enclosed the following items to update the July 2001 revised final document to the October 2001 final document.

A. Update cover and spine for the Final Action Memorandum.
B. Final Action Memorandum:
   Reissued pages 3-1 and 5-3. Replace previous pages.
C. Appendix A – Engineering Evaluation/Cost Analysis (EE/CA):
   Reissued Table 2-15 and pages 2-64 and 7-3. Replace previous table and pages.
D. Reissued Appendix F and Attachment A to Appendix F. Replace previous Appendix F and Attachment A. Attachment A should be separated from Appendix F with the green divider sheet enclosed. Please note that Attachment B to Appendix F has not been reissued and should remain in the document.
E. Appendix I – Please add the responses to comments to the end of Appendix I.

If you have any questions please contact Jacqueline Travers at (781) 401-2535.

3.0 THREATS TO PUBLIC HEALTH, WELFARE OR THE ENVIRONMENT; STATUTORY AND REGULATORY AUTHORITIES

The removal action program discussed in this action memorandum is proposed to address the potential threats discussed below.

3.1 THREATS TO PUBLIC HEALTH OR WELFARE

A streamlined risk assessment (or mini-risk assessment) was conducted to determine the extent of human risk posed by the contaminants present at SEAD-63 (see **Section 2** of **Appendix A**). Likely receptors included a park worker, construction worker, and recreational visitor (child). A residential receptor was also considered for comparative purposes only. Future residential use of the land is highly unlikely. Except for groundwater and surface water exposure under the residential scenario, risks for the recreational child, park worker, and construction worker are acceptable (HI less than 1 and carcinogenic risk less than $1x10^{-4}$). The recreational child resulted in a hazard index of 0.4 and the lifetime cancer risk for an adult is 8×10^{-5}. The park worker resulted in a hazard index of 0.2 and a cancer risk of 5×10^{-5}. The primary constituents driving the cancer risks for recreational child and parker worker are dibenz(a,h)anthracene and benzo(a)pyrene in surface water. These two constituents were only detected in one out of 22 samples. Therefore, risk driven by these two constituents is most likely significantly lower than indicated by the mini-risk assessment: the likelihood of a residential receptor spending all of his/her exposure time at the one location where the detection was made is highly unlikely. Under the construction worker scenario, the hazard index is 0.3 and the cancer risk is 9×10^{-8}. The primary driver for noncarcinogenic risk is exposure to cadmium in soils. Mercury, which was also detected above background levels, did not contribute significantly to risk.

The residential scenario, which was considered for comparative purposes only, exhibited the greatest noncarcinogenic risk for a residential child (HI=2). This was primarily due to the presence of manganese in groundwater. As there is no source of manganese at SEAD-63 (soil concentrations of manganese did not exceed background levels), its presence in the groundwater is suspect and may be due to turbidity in the three groundwater samples collected from the site. The collection of additional groundwater data is recommended for this site. Carcinogenic risk is 1×10^{-4}, which is mainly caused by exposure to dibenz(a,h)anthracene and benzo(a)pyrene in surface water.

5.1.4 Engineering Evaluation/Cost Analysis

In order to determine the appropriate remedial technology for the SEAD-63, an EE/CA was conducted. The EE/CA is included as **Appendix A** of this report. The EE/CA contains a brief summary of the site history and the results of previous investigations.

5.1.5 Description of Alternative Technologies

The main focus of the EE/CA is an evaluation of the different remedial technologies. Because the impetus for the removal action at this site is the presence of debris, and due to the uncertain nature of these buried drums and military components, only one alternative, excavation and disposal, rather than any sort of in situ treatment of these items is logical. For this reason, no alternative technologies were evaluated as part of this evaluation.

5.1.6 Institutional Controls

There are no institutional controls required for this action. The requirement for institutional controls will be addressed as part of the overall remedial action.

5.1.7 Off-Site Disposal Policy

It is anticipated that no materials classified as hazardous waste will be generated during this removal action. All non-hazardous, non-radiological waste (construction debris, etc.) will be disposed in an approved non-hazardous waste landfill (if necessary). Envirocare in Clive, UT is proposed as the destination for any radiological containing debris or soils exhibiting radionuclides greater than clean up goals. Envirocare accepts low level radiological wastes and soils.

5.1.8 Post-Removal Site Control Activities

The depot is fenced and patrolled by armed guards to limit access.

5.1.9 QA/QC Plan

The removal contractor will be required to develop a QA/QC plan which will be submitted to the appropriate agencies for approval. This plan will address both detailed and broad QA/QC issues.

TABLE 2-15
CALCULATION OF TOTAL NONCARCINOGENIC AND CARCINOGENIC RISKS
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	EXPOSURE/RISK CALCULATIONS Table Number	HAZARD INDEX	CANCER RISK
PARK WORKER	Inhalation of Dust in Ambient Air	Table A-1	7E-07	1E-09
	Ingestion of Soil	Table A-4	1E-03	5E-08
	Dermal Contact to Soil	Table A-6	4E-04	8E-08
	Ingestion of Groundwater	Table A-9	1E-01	NQ
	Dermal Contact to Surface Water	Table A-13	4E-03	5E-05
	Dermal Contact to Sediment	Table A-14	1E-03	1E-06
	TOTAL RECEPTOR RISK (Nc & Car)		**2E-01**	**5E-05**
RECREATIONAL VISITOR (CHILD)	Inhalation of Dust Ambient Air	Table A-1	1E-06	5E-10
	Ingestion of Soil	Table A-4	4E-03	4E-08
	Dermal Contact to Soil	Table A-6	4E-04	2E-08
	Ingestion of Groundwater	Table A-8	3E-01	NQ
	Dermal Contact to Groundwater	Table A-11	5E-02	NQ
	Dermal Contact to Surface Water	Table A-13	4E-02	8E-05
	Dermal Contact to Sediment	Table A-15	1E-02	3E-06
	TOTAL RECEPTOR RISK (Nc & Car)		**4E-01**	**8E-05**
CONSTRUCTION WORKER	Inhalation of Dust in Ambient Air	Table A-1	9E-05	3E-08
	Ingestion of Soil	Table A-4	2E-01	4E-08
	Dermal Contact to Soil	Table A-6	2E-02	1E-08
	TOTAL RECEPTOR RISK (Nc & Car)		**3E-01**	**9E-08**
ADULT RESIDENT (Hazard Index)	Inhalation of Dust Ambient Air	Table A-2	3E-06	See risk below
	Ingestion of Soil	Table A-5	2E-03	
	Dermal Contact to Soil	Table A-7	3E-04	
	Ingestion of Groundwater	Table A-9	6E-01	
	Dermal Contact to Groundwater	Table A-12	1E-01	
	Dermal Contact to Surface Water	Table A-14	5E-03	
	Dermal Contact to Sediment	Table A-16	1E-03	
	TOTAL RECEPTOR RISK (Nc & Car)		**7E-01**	
CHILD RESIDENT (Hazard Index)	Inhalation of Dust Ambient Air	Table A-2	7E-06	See risk below
	Ingestion of Soil	Table A-5	2E-02	
	Dermal Contact to Soil	Table A-7	2E-03	
	Ingestion of Groundwater	Table A-9	1E+00	
	Dermal Contact to Groundwater	Table A-12	2E-01	
	Dermal Contact to Surface Water	Table A-14	4E-02	
	Dermal Contact to Sediment	Table A-16	1E-02	
	TOTAL RECEPTOR RISK (Nc & Car)		**2E+00**	
RESIDENT (Total Lifetime Cancer Risk)	Inhalation of Dust Ambient Air	Table A-2	See risk above	8E-09
	Ingestion of Soil	Table A-5		3E-07
	Dermal Contact to Soil	Table A-7		1E-08
	Ingestion of Groundwater	Table A-9		NQ
	Dermal Contact to Groundwater	Table A-12		NQ
	Dermal Contact to Surface Water	Table A-14		1E-04
	Dermal Contact to Sediment	Table A-16		4E-06
	TOTAL RECEPTOR RISK (Nc & Car)			**1E-04**

NQ = Not Quantified due to lack of toxicity data
Non-cancer risk is reported for adults and child residents separately. Cancer risk is considered over a lifetime, therefore the adult and child values are summed

p:\pit\projects\seneca\s63eeca\eeca\tables\fintbl2\TOTRISK_mem.XLS uses of the SEDA facility. The LRA has established that the Q Area, which includes SEAD-63, will be used as a Wildlife Conservation Area. At the time when the SEDA facility is relinquished by the Army, the Army will ensure that SEAD-63 can be used for the intended purpose.

The complete potential exposure pathways from sources to receptors, based upon current and future use scenarios, are shown in **Figure 2-12**. The potential for human exposures, with the exception of fugitive dust and radon gas, is directly affected by the accessibility to the site. Human and vehicular access to the site is restricted by a chain-link fence with a locking gate, which is part of SEDA's general security provisions.

Three scenarios shown in **Figure 2-12** were considered in conducting the mini-risk assessment for SEAD-63, the recreational child, park worker, and the construction worker. Only chemical constituents of concern were considered in the mini-risk assessment, since radionuclides were not present in soils above background levels and those present above background levels in sediments did not exhibit a dose equivalent of 10 mrem/yr above background. Risk assessment was conducted for residential receptors for comparative purposes only. Future residential use of the site is highly unlikely. In addition to the human health risk assessment, a mini-risk assessment was conducted for ecological risk. Four receptors were considered: the deer mouse, American robin, mourning dove, and short-tailed shrew. **Appendix F** provides the detailed assumptions and methodology used in conducting the mini-risk assessment.

Table 2-15 shows the human health risk associated with the exposure to soil, sediment, surface water (where applicable), and groundwater (where applicable). Risk calculated for the recreational child, park worker, and construction worker is acceptable (HI less than 1 and carcinogenic risk less than $1x10^{-4}$). The recreational child resulted in a hazard index of 0.4 and a cancer risk of 8×10^{-5}. The park worker resulted in a hazard index of 0.2 and a cancer risk of 5×10^{-5}. The primary constituents driving the cancer risk are dibenz(a,h)anthracene and benzo(a)pyrene in surface water. These two constituents were only detected in one out of 22 samples. In addition, the ditch is usually dry except during storm period. The vegetation observed in the ditches, i.e., cattail, verifies this conclusion since cattails prefer saturated soil conditions to flooded conditions. Therefore, the risks driven by these two constituents are most likely lower than indicated by the mini-risk assessment. Under the construction worker scenario, the hazard index is 0.3 and the cancer risk is 9×10^{-8}. The primary driver for non-carcinogenic risk is exposure to cadmium in soils. Mercury, which was also detected above background levels, did not contribute to risk.

EPA. 1989b. Bioremediation of Contaminated Surface Soils. EPA/600/9-89/073. Washington. D.C.: U.S. Environmental Protection Agency.

EPA. 1989c. Terra Vac In Situ Vacuum Extraction System, Applications Analysis Report. EPA/540/A5-89/003. Washington. D.C.: U.S. Environmental Protection Agency.

EPA, 1990. Handbook on In Situ Treatment of Hazardous Waste-Contaminated Soils. EPA/540/2-90/002. Washington, D.C.: U.S. Environmental Protection Agency.

EPA. 1999. Risk Assessment Guidance For Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Dermal Risk Assessment, Interim Guidance. Office of Emergency and Remedial Response. U.S. Environmental Protection Agency, Washington. D.C. 20460.

United States Army Toxic and Hazardous Materials Agency (USATHAMA), 1989. Seneca Army Depot Landfill/Burning Pit Site Investigation.

APPENDIX F
STREAMLINED RISK EVALUATION

The threat from a site can be quantified through the use of risk assessment techniques. Risk assessments have been performed at several of the higher priority sites and have been a useful tool in evaluating site conditions. Since future land use scenarios have been described as part of the Base Realignment Plan these scenarios have been incorporated into the risk assessment. Risk assessments are appropriate for developing and supporting planning decisions regarding the disposition of the remaining sites that exist at the Seneca Army Depot Activity.

This section of the EE/CA presents the streamlined risk evaluation, or mini-risk assessment, that has been performed for SEAD-63. The risk assessment provides an understanding of the potential threats that this site may pose. The outcome of this evaluation is used to support decisions regarding site disposition. If the site is above the EPA target risk level, it will be considered further. If the site is below these criteria, it may be eliminated from further consideration. Procedures for conducting a mini-risk assessment were presented to EPA and NYSDEC in the Decision Criteria Document dated March 1998.

The methods used to conduct mini-risk assessments for sites at SEDA are the same as those used in prior baseline risk assessments at several of the other sites with the exception that the maximum concentration of a component will be used instead of the Upper 95th Confidence Limit (UCL) of the mean. The reason for using the maximum concentration is that at many of the sites, the existing database is small. Using the maximum detected value will provide an added degree of conservatism. Biased sampling has been performed, and the data represent "worst case" conditions.

The objectives of the mini-risk assessment are:

- to quantify the threat that a site may pose;
- to help determine whether a remedial investigation is necessary;
- to provide a basis for determining if a removal action will eliminate the threat; and
- to help support selection of the "No Action" remedial alternative, where appropriate.

To meet these objectives, the *Risk Assessment Guidance for Superfund* (RAGS) (USEPA, 1989a) was followed when possible and applicable. Technical judgment, consultation with USEPA staff, and recent publications were used in the development of the baseline risk assessment.

SEAD-63, the Miscellaneous Components Burial Site, is shown in **Figure 2-2** of **Section 2** of the EE/CA. The future land use for this site is to be part of a conservation and recreation area.

F.1 Methodology and Organization

The methodology employed for this risk assessment follows USEPA guidance. This section contains seven major subsections, as follows:

1. Identification of Chemicals of Concern (**Section F.2**)

This section provides site-related data along with background chemical data. Detailed summaries and statistical analyses of these data are provided in this section. All chemicals with validated detections in the applicable environmental media were evaluated in the risk assessment. The relevant exposure pathway risks were calculated for each detected chemical. Also included in the Data Evaluation section is an evaluation of site background data. Relevant background data are presented and, where appropriate, statistical analyses were performed to allow for comparing on-site chemical concentrations with background concentrations. Based on these analyses, chemicals whose presence at the site is attributable to background were not further evaluated in the mini-risk assessment.

2. Exposure Assessment (**Section F.3**)

This section includes derivation and presentation of the applicable exposure point concentrations (EPCs) used in the human health risk assessment. Exposure point concentrations for the baseline risk assessment are based on analytical data and modeling results. The EPCs provided are used for future onsite land-use scenarios, and correspond to the applicable exposure pathways for the baseline risk assessment.

For the future on-site land-use scenario, construction workers, park workers, and recreational visitors (child) are the most conservative and relevant exposed populations. In all scenarios, the calculated risk values apply to a hypothetical reasonable maximum exposure (RME) individual working on or visiting the site, and the risk values are dictated by the collected environmental sampling data used in the risk assessment as exposure point concentrations for the applicable media. A residential receptor was also considered for comparative purposes only. Future residential use of the land is highly unlikely.

The three primary exposure routes considered in the baseline risk assessment are ingestion, inhalation, and dermal contact. Chemical intake values for future land use are calculated based on exposure pathways, specific exposure values, and assumptions. Equations used to calculate intakes for all applicable exposure pathways are presented in this section.

3. Toxicity Assessment (**Section F.4**)

This section presents oral, inhalation, and dermal toxicity values used in the human health risk calculations. Appropriate data sources (i.e., IRIS, HEAST and EPA Risk Assessment Issue papers) are provided to support the toxicity values.

4. Risk Characterization (**Section F.5**)

This section presents the risk calculations for all human health exposure pathways for the expected future land use. Non-carcinogenic and carcinogenic risk estimates are summarized for each receptor and exposure pathway.

F.2 Identification of Chemicals of Concern

Data collected were evaluated for suitability of use in the risk assessment as discussed in RAGS (EPA, 1989a). These decisions were based on analytical methods, quantitation limits, qualifiers, and blank contamination.

The data usability criteria for documentation, analytical methods, data validation, precision, accuracy, representativeness, comparability, and completeness are discussed below in Section F.2.1.

A portion of the data used in the mini-risk assessment were collected during ESI field investigation conducted in June through July 1994 and documented in the report cited in the last paragraph. Additional data for surface water and sediment were collected in the fall, 1997 and are presented in **Section 2** of this report.

Twelve subsurface soil, 22 sediment and 22 surface water samples were collected at SEAD-63. Groundwater samples were collected from the three monitoring wells, which were installed at SEAD-63 during the RI.

The following sections describe the processes by which the data were analyzed, examined, and reduced to arrive at a list of analytes, for each exposure pathway, that were quantified for use in the human health mini-risk assessment.

F2.1 Data Usability

The data usability criteria for documentation, analytical methods, data validation, precision, accuracy, representativeness, comparability, and completeness are discussed in this section.

The RI data were collected during two investigations, the SEAD-63 ESI and the SEAD-63 RI. The ESI began in the late spring/early summer (i.e., June/July) of 1994 and the RI was conducted in December of 1997.

The data used for the risk assessment were grouped into six databases, one for each of the exposure route/exposure scenarios that were developed from the exposure point pathway models. Individual databases contained data specific to one of the following sample combinations: surface soils (defined as soil samples collected from 0 to 2 inches below grade) only, surface and subsurface soils (i.e. all soils data), groundwater, surface water, and sediments for the human health risk assessment and a combined surface soils/sediment sample to a depth of two feet for the ecological risk assessment

The following sections describe the processes by which the data were analyzed, examined, and reduced to arrive at a list of analytes and their representative concentrations, for each exposure pathway addressed in the baseline human health and ecological risk assessments.

F2.1.1 Documentation

Documentation of sample collection and laboratory analysis is essential in order to authenticate conclusions derived from data. Standard operating procedures (SOPs) for field collection of samples are provided in the generic workplan, and were followed during sample collection. Formal chain-of-custody records that included sample identifications (IDs), date sampled, sample collector, analyses and methods required, matrix, preservation per analysis, and comments were maintained.

Laboratory SOPs were used for all analyses required. Deviations from these SOPs were documented in case narratives that were part of each sample delivery group (SDG). Deviations from these SOPs were minor and did not adversely affect data quality.

F2.1.2 Evaluation of Analytical Methods

All data used in the risk assessment were generated using level IV CLP protocols. The CLP was developed to ensure that consistent QA/QC methods are used when evaluating samples from

Superfund site. However, this does not mean that all CLP data are automatically of sufficient quality and reliability for use in the quantitative risk assessment.

The data used in this baseline risk assessment were validated in compliance with EPA Region II validation guidelines. The following criteria were considered and used to validate the data: spike/matrix spike duplicates, field duplicates, internal standard performance, compound identification, compound quantitation, spike sample recovery for metals, laboratory duplicates for metals, interference for metals, and qualifiers. Several steps were taken to ensure that the data were appropriate and reliable for use in the risk assessment. These steps, such as evaluation of quantitation limits, are discussed in the following sections.

F.2.1.3 Evaluation of Qualified and Coded Data

Qualifiers are attached to analytical data by personnel of the laboratory performing the analysis or by data validation personnel. These qualifiers often pertain to QA/QC problems and may indicate questions concerning chemical identity, chemical concentration, or both. The qualifiers used are as follows:

U	The analyte was not detected.
UJ	The analyte was not detected; however, the associated reporting limit is approximate.
J	The analyte was positively identified; however, QC results indicate that the reported concentration may not be accurate and is therefore an estimate.
R, JR, UR	The analyte was rejected due to laboratory QC deficiencies, sample preservation problems, or holding time exceedance. The presence or absence of the analyte cannot be determined.

Before data were used in the quantitative risk assessment all qualifiers were addressed. This was done according to the prescribed data validation procedures. The end result of the data validation was four possible situations:

1) the result was rejected by either laboratory or data validation personnel and considered unusable (R, JR, UR),
2) the compound was analyzed for but was not detected (U),
3) the result was an estimated value (J), or

4) the result was unqualified.

Data that was not detected by the laboratory (U) and was assigned a J by the data validation personnel is considered a non-detect for the risk assessment (UJ).

F2.1.4 Chemicals in Blanks

Blanks are QC samples analyzed in the same manner as environmental samples, and provide a means of identifying possible contamination of environmental samples. Sources of contamination include the laboratory, the sampling environment, and the sampling equipment. To address contamination, three types of blanks were analyzed: method blanks, trip blanks, and equipment rinsates. Method blanks consisted of laboratory reagent water or pre-purified and extracted sand taken through the same analytical process as environmental samples. Trip blanks consisted of distilled water poured into a 40-milliliter glass vial and sealed with a Teflon septum for soil and water samples. The trip blanks accompanied sample bottles to the field during sample collection. Trip blanks were not opened during sample collection. Equipment rinsates consisted of deionized water poured into or pumped through sampling devices and then transferred to sample bottles.

According to the data validation guidelines, if the blank contained detectable levels of a common laboratory contaminant, then the sample results were considered positive (unqualified hit) only if the concentration in the sample exceeded ten times the maximum amount detected in any blank. If the concentration in the sample was less than ten times the maximum amount detected in the blank, it was concluded that the chemical was not detected. Common laboratory contaminants are acetone, 2-butanone, methylene chloride, toluene, and phthalate esters. If the blank contained detectable levels of a chemical that is not a common laboratory contaminant, then the sample results were considered positive (unqualified hit) only if the concentration in the sample exceeded five times the maximum amount detected in any blank. If the concentration in the sample was less than five times the maximum amount detected in the blank, it was concluded that the chemical was not detected. This procedure was performed as part of the data validation.

F2.1.5 Precision

The term precision is used to describe the reproducibility of results. It can be defined as the agreement between the numerical values of two or more measurements resulting from the same process. In the case of chemical analyses, precision is determined through the analyses of duplicate environmental samples. Duplicate sample analyses include matrix spikes, blank spikes, blind field duplicates, and replicate instrumental analyses of individual environmental samples.

Matrix spikes involve the introduction of compounds or elements to samples of known concentrations. The assumption is that these introduced compounds will be recovered from environmental samples to the same degree as in matrix spikes. Blank spikes involve the introduction of compounds or elements to laboratory reagent water or pre-purified and extracted sand. Blank spikes eliminate the possibility of matrix interference's or contributions, thereby monitoring analytical performance from sample preparation to analysis. Blind field duplicates are samples labeled with a fictitious sample ID taken from an existing sampling location. They are collected simultaneously with a properly labeled sample and provide the most legitimate means of assessing precision.

Precision estimates were obtained using the relative percent difference (RPD) between duplicate analyses. Overall precision, as well as precision control limits, was estimated using a weighted combination of RPDs from spikes and duplicate analyses. Precision and RPD were acceptable.

F2.1.6 Accuracy

Accuracy is the degree to which a measurement represents the true value of that parameter. Estimates of accuracy are more difficult to obtain than precision since accuracy requires knowledge of the true quantity being measured. In the case of chemical analyses, accuracy is determined through the introduction of compounds or elements to samples of known concentrations, or analytical spikes. The assumption is that compounds will be recovered from environmental samples to the same degree as in analytical spikes.

Two types of compounds were added to environmental samples to assess accuracy: surrogate compounds and matrix spike compounds. Surrogates are compounds that closely approximate target analytes in structure, but are not target analytes. Surrogate compounds generally are added to samples in the preparation stages and monitor the effectiveness of the preparation process. Matrix spike compounds are target analytes that are added based upon expectations of matrix interference's, that impede analyte detection. Laboratory method blank samples were spiked with surrogate compounds, per analysis day, as an additional means of estimating accuracy. The accuracy of chemical analyses was estimated using the percent recovery (PR) of compounds or elements that were added to analytical spikes. Accuracy and PR were acceptable.

F2.1.7 Representativeness

Representativeness expresses the extent to which sample data characterize the population or environmental media. Factors influencing representativeness include sample collection, selection of sampling locations representative of site conditions, and use of appropriate chemical methods for sample analyses. Appropriate chemical analysis methods were followed as described in **Section F2.1.2**. Sampling from locations representative of site conditions was achieved through implementation of the approved field sampling plan. Blind field duplicates were collected and analyzed in order to assess the influence of sample collection on representativeness. Approximately 5 percent of field samples were collected in duplicate. Representativeness was estimated using the RPD between blind field duplicates and was acceptable.

F2.1.8 Comparability

Comparability refers to the consistency of one laboratory's results with others. Comparability factors include the use of standard analytical methodologies, data reported in standard or consistent units, appropriate frequency of applicable QC analyses, and laboratory participation in appropriate performance evaluation studies. All data were reported in appropriate and acceptable units. The laboratory performing the CLP inorganic and organic analyses participated in the quarterly USEPA blind performance evaluation program and the MRD performance evaluation program. Their performance in this program was acceptable.

F2.1.9 Completeness

Completeness measures the amount of usable data relative to the amount of samples collected and analyzed. The completeness goal in the project workplan was 90 percent. Completeness was acceptable.

F.2.2 Site-Specific Data Evaluation Considerations

The maximum concentration of a component in the database was used as the exposure point concentration in the mini-risk assessment.

NYSDEC CLP Statement of Work methods were used for the analysis of organic and inorganic constituents in soil and groundwater. These methods provide data suitable for the mini-risk assessment.

For inorganics, the site data set was compared against the SEDA background dataset to determine if the site data set is statistically different from the background dataset. This background comparison was performed for two media: soil and groundwater.

For each inorganic constituent, the average concentration for the site was compared to 2 times the average background concentration. If the site average concentration for a constituent was less than 2 times the background average concentration, the constituent was considered to be present due to background conditions, and it was eliminated from further consideration in the risk assessment. USEPA Region 2 recommended this comparison method.

Removing analytes from further consideration is consistent with RAGS (EPA 1989a). Inorganic constituents that were not detected were not considered; these were eliminated from further consideration as is consistent with RAGS (EPA, 1989a).

Only inorganic constituents were compared to background. Anthropogenic organic constituents have not been considered. Organic compounds were eliminated from further consideration only if they were not detected at a particular site. This has produced a more conservative risk assessment since all organic constituents have been assumed to be present due to previous site activities. Background data sets are provided in **Appendix D**.

Two inorganic analytes were found to occur in the SEAD-63 soil dataset at average concentrations that were greater than twice the average for those observed in the background soil measurements. They are cadmium and mercury. These inorganic constituents in soil were retained for further analysis in the mini-risk assessment performed for SEAD-63.

For the groundwater samples, two inorganic analytes, sodium and manganese, were found to occur in the groundwater dataset at an average concentration that was twice the background average. These inorganic constituents in groundwater were retained for further analysis in the mini-risk assessment performed for SEAD-63.

Although samples of sediment have been collected from the drainage ditches that surround and transect portions of SEAD-63, these samples have been treated as shallow soil samples within the ecological mini risk assessments. Generally, the drainage ditches in the area of SEAD-63 are dry except when they carry storm-water runoff; thus, these areas are unlikely to support any form of aquatic or amphibian life. To assess the potential effect of chemicals identified in "sediment" at SEAD-63 therefore, this dataset has been used to augment the shallow soil dataset that is used for the evaluation of potential impacts on the mammalian and avian receptors. The combined shallow soil/sediment dataset is presented in **Table F-1**.

Tables F-2 and **F-3** summarize the results of average comparisons for the soil dataset and the groundwater dataset, respectively. **Table F-4** summarizes the result of the average comparison for the combined shallow soil/sediment data set that has been used for the ecological risk assessment only.

F.2.3 Data Quantification for Use in the Risk Assessment

After eliminating inorganic analytes present at background levels from the risk assessment, exposure point concentrations (EPCs) were selected as the maximum detected value for each constituent of concern. When the maximum value occurred in a sample that had a duplicate sample, the maximum value was used in the risk assessment, i.e., the samples were not averaged.

Table F-5 lists the chemicals of potential concern for the mini-risk assessment for SEAD-63 in all soils and groundwater, less the inorganic analytes found at background levels. The number of analyses performed, the number of times detected, the frequency of detection, and the maximum detected concentration for each chemical of potential concern are provided in the data tables presented in **Section 2** of **Appendix A** and in **Table F-1** for the combined shallow soil/sediment dataset used for the ecological risk assessment.

F.3 Exposure Assessment

F.3.1 Overview and Characterization of Exposure Setting

The objective of the exposure assessment was to estimate the type and magnitude of exposures to the Chemicals of Potential Concern (COPC) that are present at, or migrating from, the site. This component of the risk assessment can be performed either qualitatively or quantitatively. Quantitative assessment is preferred when toxicity factors necessary to characterize a compound of concern are available.

The exposure assessment consists of three steps (EPA, 1989a):

1) **Characterize Exposure Setting:** In this step, information on the physical characteristics of the site that may influence exposure is considered. The physical setting involves

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
						Matrix		SOIL		SOIL		SOIL		SOIL		SOIL		SEDIMENT	
						Area		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
						Sample Depth (ft)		2		2		1.5		1.5		1.5		0.05	
						Sample Date		06/26/94		06/26/94		06/27/94		06/27/94		06/28/94		13-Jun-94	
						Location		TP63-2		TP63-5		TP63-7		TP63-8		TP63-10		SD63-1	
						Sample Number		225561		225564		225566		225596		225803			
						SDG		45062		45062		45062		45062		45062			
Volatile Organic Compounds																			
Acetone	ug/Kg	150	29.6%	200	0	8	27	12	U	12	U	12	U	12	U	12	U	15	U
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	12	U	12	U	12	U	12	U	12	U	15	U
Benzene	ug/Kg	2	20.0%	60	0	1	5	12	U	12	U	12	U	2	J	12	U		
Toluene	ug/Kg	14	7.4%	1500	0	2	27	12	U	12	U	12	U	6	J	12	U	15	U
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5	12	U	12	U	12	U	14		12	U		
SemiVolatile Organic Compounds																			
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22											480	U
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	390	U	410	U	380	U	390	U	410	U	69	J
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	390	U	410	U	380	U	24	J	410	U	73	J
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	390	U	410	U	380	U	21	J	410	U	130	J
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	390	U	410	U	380	U	21	J	410	U	89	J
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	290	J	1800	J	80	J	71	J	67	J	25	J
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22											480	U
Carbazole	ug/Kg	430	45.5%		0	10	22											480	U
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	390	U	410	U	380	U	23	J	410	U	110	J
Di-n-butylphthalate	ug/Kg.	120	25.9%	8100	0	7	27	390	U	410	U	380	U	390	U	410	U	480	U
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22											480	U
Dibenz(a,h)anthracene	ug/Kg	1200	40.7%	14	9	11	27	390	U	410	U	380	U	390	U	410	U	480	U
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22											480	U
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22											480	U
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	390	U	410	U	380	U	38	J	410	U	110	J
Fluorene	ug/Kg	110	13.6%	50000	0	3	22											480	U
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	390	U	410	U	380	U	390	U	410	U	46	J
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22											480	U
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	390	U	410	U	380	U	390	U	410	U	49	J
Phenol	ug/Kg	93	4.5%	30	1	1	22											480	U
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22											100	J
Organochlorine Pesticides																			
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	3.9	UJ	4.1	UJ	3.8	UJ	3.9	UJ	4.1	U	4.9	UJ
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	3.9	UJ	4.1	UJ	3.8	UJ	3.9	UJ	4.1	U	4.9	UJ
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	3.9	UJ	4.1	UJ	3.8	UJ	3.9	UJ	4.1	U	4.9	UJ
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22											2.5	UJ
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22											4.9	UJ
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22											4.9	UJ

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

							Matrix	SOIL		SOIL		SOIL		SOIL		SOIL		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	2		2		1.5		1.5		1.5		0.05	
							Sample Date	06/26/94		06/26/94		06/27/94		06/27/94		06/28/94		13-Jun-94	
							Location	TP63-2		TP63-5		TP63-7		TP63-8		TP63-10		SD63-1	
							Sample Number	225561		225564		225566		225596		225803			
							SDG	45062		45062		45062		45062		45062			
Parameter	**Unit**	**Maximum Concentration Measured**	**Frequency of Detection**	**TAGM Level**	**Number of Samples above TAGM**	**Number of Samples where Detected**	**Number of Samples Collected**	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Metals/Cyanide																			
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	14800	J	15300	J	11700	J	16500	J	18000	J	7590	
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5	0.26	UJ	0.27	UJ	0.23	J	0.3	UJ	0.31	UJ		
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	5.4		4.9		4.2		5.2		5.3		4.1	
Barium	mg/Kg	107	100.0%	300	0	27	27	65.3	J	75.4	J	45.8	J	59.5	J	72.4	J	36.3	J
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.74	J	0.69	J	0.54	J	0.64	J	0.71	J	0.44	J
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.26	J	0.52	J	0.56	J	0.24	J	0.39	J	0.6	J
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	3830	J	40500	J	39800	J	5440	J	14200	J	101000	
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	22.9	J	23.2	J	19.1	J	21.5	J	24.6	J	13.8	J
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	11.6		12.4		10.7		9.7	J	12.7		10.6	J
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	27.1	J	35.1	J	35.3	J	20.2	J	27.3	J	25.2	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22											0.6	U
Iron	mg/Kg	30100	100.0%	38110	0	27	27	30100	J	28100	J	25000	J	25000	J	28500	J	17100	
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	18.5		22.3		15.6		15.5		17.1		33.5	R
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	4530	J	8310	J	8160	J	4400	J	5520	J	15000	
Manganese	mg/Kg.	995	100.0%	1095	0	27	27	278	J	403	J	359	J	350	J	452	J	449	
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.05	J	0.06	J	0.04	J	0.06	J	0.05	J	0.04	J
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	31.5	J	42	J	39.1	J	23.9	J	33.5	J	29.8	
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	1180	J	2150	J	1310	J	1530	J	2000	J	1370	J
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	1.5		1.5		0.74		1.3		1.1	J	0.62	U
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	50.6	J	138	J	124	J	50.6	J	46.7	U	121	J
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	0.38	U	0.3	J	0.29	J	0.44	U	0.45	U	0.44	U
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	25.2	J	22.4	J	16.8	J	27.6	J	28.4	J	19.9	
Zinc	mg/Kg	534	100.0%	115	7	27	27	74.8	J	88.9	J	95.7	J	68.6	J	63.4	J	105	
Others																			
Total Solids	%W/W	85.8	100.0%		0	5	5	83.7		81.2		85.8		85.2		79.6			

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Matrix								SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
Area								SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
Sample Depth (ft)								0.05		0.05		0.05		0.8		0.8		0.6	
Sample Date								12-Jun-94		13-Jun-94		13-Jun-94		4-Dec-97		4-Dec-97		5-Dec-97	
Location								SD63-2		SD63-3		SD63-4		63101		12215		63102	
Sample Number																			
SDG																			
Parameter	**Unit**	**Maximum Concentration Measured**	**Frequency of Detection**	**TAGM Level**	**Number of Samples above TAGM**	**Number of Samples where Detected**	**Number of Samples Collected**	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Acetone	ug/Kg	150	29.6%	200	0	8	27	23	UJ	12	UJ	150	J	16		18	U	14	U
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	8	J	12	UJ	35	J	16	U	18	U	14	U
Benzene	ug/Kg	2	20.0%	60	0	1	5												
Toluene	ug/Kg	14	7.4%	1500	0	2	27	18	UJ	12	UJ	14	J	16	U	18	U	14	U
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5												
SemiVolatile Organic Compounds																			
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	140	J	70	J	350	J	13	U	14	J	51	J
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	170	J	79	J	540	J	21	U	23	J	58	J
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	380	J	110	J	860	J	37	U	39	JY	120	Y
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	180	J	66	J	470	J	120	U	120	U	88	U
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	700	UJ	390	U	720	UJ	25	U	21	JB	110	B
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22	700	UJ	390	U	720	UJ	22	J	19	J	88	U
Carbazole	ug/Kg	430	45.5%		0	10	22	700	UJ	390	U	34	J	120	U	120	U	9.4	J
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	200	J	110	J	540	J	13	U	14	J	73	J
Di-n-butylphthalate	ug/Kg.	120	25.9%	8100	0	7	27	700	UJ	390	U	720	UJ	14	J	19	JB	18	JB
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22	700	UJ	19	J	720	UJ	120	U	120	U	88	U
Dibenz(a,h)anthracene	ug/Kg	1200	40.7%	14	9	11	27	700	UJ	390	U	140	J	120	U	8.7	U	19	J
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22	700	UJ	390	U	720	UJ	120	U	7.4	JB	4.7	JB
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	240	J	100	J	720	J	32	U	32	J	100	
Fluorene	ug/Kg	110	13.6%	50000	0	3	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	83	J	42	J	320	J	12	U	14	J	37	J
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	120	J	50	J	270	J	14	J	16	J	51	J
Phenol	ug/Kg	93	4.5%	30	1	1	22	700	UJ	390	U	720	UJ	120	U	120	U	88	U
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22	220	J	110	J	600	J	23	U	23	J	80	J
Organochlorine Pesticides																			
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	7	UJ	3.9	UJ	3.9	J	6.2	U	6.1	U	4.4	U
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	6	J	3.9	UJ	9.2	J	6.2	U	6.1	U	4.4	U
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	7	UJ	3.9	UJ	4.3	J	6.2	U	6.1	U	4.4	U
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22	7.5	J	4.6	J	3.7	UJ	3.2	U	3.1	U	2.3	U
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22	7	UJ	3.9	UJ	5.2	J	6.2	U	6.1	U	4.4	U
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22	7	UJ	3.9	UJ	9.4	J	6.2	U	6.1	U	4.4	U

.E F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

							Matrix	SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.05		0.05		0.05		0.8		0.8		0.6	
							Sample Date	12-Jun-94		13-Jun-94		13-Jun-94		4-Dec-97		4-Dec-97		5-Dec-97	
							Location	SD63-2		SD63-3		SD63-4		63101		12215		63102	
							Sample Number												
							SDG												
Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Metals/Cyanide																			
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	11700	J	11100		11000	J	9770	*	16700	*	2030	*
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5												
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	3.7	J	4.3		2.4	J	2.9		5.2		2.3	B
Barium	mg/Kg	107	100.0%	300	0	27	27	63.5	J	37.2		90.6	J	68.1		107		19.9	B
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.59	J	0.52	J	0.54	J	0.51	B	0.8	B	0.11	B
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.83	J	0.38	J	0.68	J	0.08	U	0.08	U	0.08	U
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	89800	J	31500		34100	J	2090		3080	*	139000	*
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	19.1	J	20.3	J	18.2	J	15	*	23.4	*	4.1	*
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	11.9	J	11.2		10.5	J	7.9		10.7	B	3.2	B
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	35.6	J	32.7		30.7	J	15.9		24		8.7	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22	0.97	UJ	0.53	U	0.99	UJ	1.1	UJ	1.1	UN	2.1	N
Iron	mg/Kg	30100	100.0%	38110	0	27	27	19200	J	26500		18700	J	16300		24400	*	4790	*
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	37.4	R	27.5	R	37.2	R	17.6	*	[redacted]	N*	8.6	N*
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	13900	J	6210		8590	J	2610	*	4090	*	9380	*
Manganese	mg/Kg.	995	100.0%	1095	0	27	27	653	J	260		801	J	431	J	536	*	225	*
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.06	J	0.03	J	0.12	J	0.08	U	0.07	BN	0.05	UN
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	35	J	44.2		32.8	J	18.4		29.5	*	8.8	B*
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	2570	J	1340	J	1670	J	1120		1830	B	597	B
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	0.68	UJ	1.1		0.97	J	1.2	U	1.3	U	1.2	U
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	194	J	197	J	119	J	234	U	[redacted]	B	323	B
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	0.48	UJ	0.34	U	0.62	UJ	[redacted]	B	1.8	UN	1.6	UN
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	27.5	J	19.1		21.2	J	17.1		27.7		10.9	B
Zinc	mg/Kg	534	100.0%	115	7	27	27	133	J	68		325	J	52.3	*	81	E	37.2	E
Others																			
Total Solids	%W/W	85.8	100.0%		0	5	5												

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

							Matrix	SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.3		0.6		0.7		0.5		0.45		0.3	
							Sample Date	11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97	
							Location	63103		63104		63105		63106		63107		63108	
							Sample Number												
							SDG												
Parameter	**Unit**	**Maximum Concentration Measured**	**Frequency of Detection**	**TAGM Level**	**Number of Samples above TAGM**	**Number of Samples where Detected**	**Number of Samples Collected**	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Acetone	ug/Kg	150	29.6%	200	0	8	27	10	J	20	U	7	U	8	U	27	U	35	
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	18	U	20	U	18	U	21	U	27	U	17	U
Benzene	ug/Kg	2	20.0%	60	0	1	5												
Toluene	ug/Kg	14	7.4%	1500	0	2	27	18	U	20	U	18	U	21	U	27	U	17	U
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5												
SemiVolatile Organic Compounds																			
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22	150	U	150	U	130	U	100	U	220	U	12	J
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	15	J	12	J	9.5	J	8.1	J	130	J	660	
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	22	J	15	J	12	J	10	J	170	J	790	
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	23	J	33	JY	14	J	15	J	240		1400	E
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	17	J	150	U	14	J	9.9	J	150	J	570	
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	13	J	9.6	J	19	J	8.3	J	22	J	16	J
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22	150	U	150	U	130	U	100	U	16	J	120	U
Carbazole	ug/Kg	430	45.5%		0	10	22	150	U	150	U	130	U	100	U	32	J	260	
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	22	J	15	J	14	J	12	J	180	J	840	
Di-n-butylphthalate	ug/Kg.	120	25.9%	8100	0	7	27	9.5	J	150	U	130	U	6.5	J	11	J	120	U
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22	150	U	150	U	130	U	100	U	220	U	120	U
Dibenz(a,h)anthracene	ug/Kg	1200	40.7%	14	9	11	27	150	U	150	U	130	U	100	U	46	J	250	
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22	150	U	150	U	130	U	100	U	220	U	36	J
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22	150	U	150	U	7.5	J	100	U	220	U	120	U
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	31	J	28	J	23	J	18	J	360		1900	E
Fluorene	ug/Kg	110	13.6%	50000	0	3	22	150	U	150	U	130	U	100	U	220	U	79	J
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	14	J	11	J	9.2	J	8.2	J	140	J	800	
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22	150	U	150	U	130	U	100	U	220	U	21	J
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	12	J	12	J	11	J	6	J	120	J	940	
Phenol	ug/Kg	93	4.5%	30	1	1	22	150	U	150	U	130	U	100	U	220	U	120	U
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22	24	J	19	J	18	J	14	J	240		1200	E
Organochlorine Pesticides																			
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22	3.8	U	3.8	U	3.3	U	2.6	U	5.7	U	3	U
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22	7.3	U	7.3	U	6.3	U	5	U	11	U	5.9	U

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

							Matrix	SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.3		0.6		0.7		0.5		0.45		0.3	
							Sample Date	11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97		11-Dec-97	
							Location	63103		63104		63105		63106		63107		63108	
							Sample Number												
							SDG												
Parameter	**Unit**	**Maximum Concentration Measured**	**Frequency of Detection**	**TAGM Level**	**Number of Samples above TAGM**	**Number of Samples where Detected**	**Number of Samples Collected**	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Metals/Cyanide																			
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	11600	*	11900	*	13000	*	12800	*	12300	*	10900	*
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5												
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	4.7		4.1	B	4.6		5.2		6.8		4.1	
Barium	mg/Kg	107	100.0%	300	0	27	27	85.1	B	76.2	B	90.5		64		105	B	59.8	B
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.64	B	0.63	B	0.65	B	0.59	B	0.47	B	0.48	B
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.13	U	0.13	U	0.08	U	0.08	U	0.19	U	0.1	U
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	7050	*	2650	*	3370	*	14400	*	55600	*	34800	*
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	18.4	*	18.5	*	18.8	*	21.8	*	22.4	*	17.5	*
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	10.7	B	7.6	B	8.5	B	12.7	B	14.4	B	9.3	B
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	24.7		20.4		21.9		32		[redacted]		28.8	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22	1.1	UN	1.2	UN	0.96	UN	0.76	UN	1.7	UN	0.92	UN
Iron	mg/Kg	30100	100.0%	38110	0	27	27	21800	*	18700	*	20100	*	26000	*	24700	*	17800	*
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	[redacted]	N*	23.2	N*	24.6	N*	20.8	N*	[redacted]	N*	31.2	N*
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	5010	*	3260	*	3330	*	5400	*	14800	*	6280	*
Manganese	mg/Kg	995	100.0%	1095	0	27	27	284	*	222	*	344	*	346	*	760	*	344	*
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.11	UN	0.11	UN	0.13	BN	0.06	UN	0.16	UN	0.07	UN
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	29.4	*	22.7	*	25	*	42	*	39.6	*	30.1	*
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	1530	B	1580	B	1580		1460		2350	B	2290	
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	2	U	2	U	1.3	U	1.3	U	3	U	1.5	U
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	285	B	298	B	235	B	[redacted]	B	578	B	383	B
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	2.7	UN	2.7	UN	1.7	UN	1.7	UN	4	UN	2	UN
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	20.4	B	20.7	B	21.3		19.6		26.9	B	21.2	
Zinc	mg/Kg	534	100.0%	115	7	27	27	79.2	E	65.8	E	69.4	E	73.4	E	295	E	90.6	E
Others																			
Total Solids	%W/W	85.8	100.0%		0	5	5												

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Matrix	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
Area	SEAD-63	SEAD-63	SEAD-63	SEAD-63	SEAD-63	SEAD-63
Sample Depth (ft)	0.5	0.4	0.4	0.4	0.4	0.3
Sample Date	11-Dec-97	11-Dec-97	12-Dec-97	12-Dec-97	12-Dec-97	12-Dec-97
Location	63109	63110	63111	12217	63112	63113
Sample Number						
SDG						

Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Acetone	ug/Kg	150	29.6%	200	0	8	27	9	J	17		21	U	24	UJ	68	J	16	U
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	18	U	16	U	18	U	17	U	14	U	16	U
Benzene	ug/Kg	2	20.0%	60	0	1	5												
Toluene	ug/Kg	14	7.4%	1500	0	2	27	18	U	16	U	18	U	17	UJ	14	U	16	U
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5												
SemiVolatile Organic Compounds																			
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22	14	J	100	U	120	U	120	U	160	U	120	U
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	2000	E	180		110	J	120	J	25	J	75	J
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	2700	E	200		130	J	140		56	J	74	J
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	3500	E	240		160	YJ	170		72	J	130	
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	1900	E	200		120	U	120		160	U	63	J
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	20	J	12	J	120	JB	120	U	160	U	120	U
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22	150	U	100	U	120	J	15	U	160	U	120	U
Carbazole	ug/Kg	430	45.5%		0	10	22	430		28	J	19	U	24	J	160	U	17	J
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	2200	E	220		150	J	150		49	J	100	J
Di-n-butylphthalate	ug/Kg	120	25.9%	8100	0	7	27	150	U	100	U	120	JB	120	U	160	U	120	U
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22	150	U	100	U	120	U	120	U	160	U	120	U
Dibenz(a,h)anthracene	ug/Kg	1200	40.7%	14	9	11	27	1200		84	J	28	J	34	J	160	U	12	J
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22	35	J	100	U	120	U	120	U	160	U	120	U
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22	150	U	100	U	8.2	JB	6.2	J	92	J	6.4	J
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	4300	E	400		250	J	250		43	J	180	
Fluorene	ug/Kg	110	13.6%	50000	0	3	22	110	J	10	J	120	U	120	U	160	U	120	U
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	2500	E	170		97	J	93	J	27	J	65	J
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22	23	J	100	U	120	U	120	U	160	U	120	U
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	1500	E	120		80	J	88	J	37	J	56	J
Phenol	ug/Kg	93	4.5%	30	1	1	22	150	U	100	U	120	U	11	U	160	U	120	U
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22	3200	E	290		180	J	200		45	J	120	J
Organochlorine Pesticides																			
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	7.7	U	5.2	U	6	U	5.9	U	2.1	U	6.2	U
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	7.7	U	5.2	U	6	U	5.9	U	3.1	J	6.2	U
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	12	U	5.2	U	6	U	5.9	U	8.3		6.2	U
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22	4	U	2.6	U	3.1	U	3	U	2.1	U	3.2	U
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22	12	U	6.1	U	6	U	5.9	U	4.1	U	6.2	U
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22	12	U	3.9	U	6	U	5.9	U	4.1	U	6.2	U

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

							Matrix	SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.5		0.4		0.4		0.4		0.4		0.3	
							Sample Date	11-Dec-97		11-Dec-97		12-Dec-97		12-Dec-97		12-Dec-97		12-Dec-97	
							Location	63109		63110		63111		12217		63112		63113	
							Sample Number												
							SDG												
Parameter	**Unit**	**Maximum Concentration Measured**	**Frequency of Detection**	**TAGM Level**	**Number of Samples above TAGM**	**Number of Samples where Detected**	**Number of Samples Collected**	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds																			
Metals/Cyanide																			
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	11000	*	6320	*	7030	*	9230	*	2600	*	12900	*
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5												
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	5.7		3.8		3.1		3.2		2.5		5	
Barium	mg/Kg	107	100.0%	300	0	27	27	81.3	B	34.7	B	48.8		63.9	B	26.8	B	70.9	
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.28	B	0.29	B	0.25	B	0.3	B	0.08	B	0.49	B
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.13	U	0.09	U	0.08	U	0.1	U	0.06	U	0.09	U
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	43300	*	90000	*	47400	*	69000		211000		27300	
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	18.8	*	12	*	12.4	*	17.3	*	7.9	*	23.1	*
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	12	B	7.5	B	8.2	B	11.2	B	2.7	B	12.8	B
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	31.2		20.2		22.1		30.5		7.4		33.4	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22	1.2	UN	0.78	UN	0.99	UN	0.89	UJ	0.63	UJ	1	UJ
Iron	mg/Kg	30100	100.0%	38110	0	27	27	20900	*	12600	*	12700	*	19800		6360		24600	
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	46.2	N*	19.6	N*	24.9	N*	[illegible]	*	3.4	*	34.7	*
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	9980	*	9640	*	7590	*	12300	*	16100	*	9460	*
Manganese	mg/Kg	995	100.0%	1095	0	27	27	995	*	315	*	475	*	746	J	315	J	559	J
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.1	UN	0.06	UN	0.09	UN	0.07	U	0.05	U	0.09	U
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	33.7	*	21.1	*	20.8	*	29		4.5	B	32.1	
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	2000	B	1360	B	1160		1180	B	509	B	1980	
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	2.1	U	1.4	U	1.3	U	1.7	B	0.94	U	2.1	
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	543	B	312	B	343	B	202	B	122	U	266	B
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	2.8	UN	1.8	UN	1.7	UN	2.1	U	1.3	U	2.3	B
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	28		15.5		15.8		20.9		11.7		24.3	
Zinc	mg/Kg	534	100.0%	115	7	27	27	534	E	120	E	87.4	E	118	*	24.7	*	432	*
Others																			
Total Solids	%W/W	85.8	100.0%		0	5	5												

TABLE F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

Parameter	Unit	Maximum Concentration Measured	Frequency of Detection	TAGM Level	Number of Samples above TAGM	Number of Samples where Detected	Number of Samples Collected	Value	(Q)	Value	(Q)	Value	(Q)
Matrix								SEDIMENT		SEDIMENT		SEDIMENT	
Area								SEAD-63		SEAD-63		SEAD-63	
Sample Depth (ft)								0.3		0.3		0.3	
Sample Date								12-Dec-97		12-Dec-97		13-Dec-97	
Location								63114		63115		63116	
Sample Number													
SDG													
Volatile Organic Compounds													
Acetone	ug/Kg	150	29.6%	200	0	8	27	15	U	15	U	25	J
2-Butanone	ug/Kg	35	7.4%	300	0	2	27	15	U	15	U	14	U
Benzene	ug/Kg	2	20.0%	60	0	1	5						
Toluene	ug/Kg	14	7.4%	1500	0	2	27	15	U	15	U	14	UJ
Xylene (total)	ug/Kg	14	20.0%	1200	0	1	5						
SemiVolatile Organic Compounds													
2-Methylnaphthalene	ug/Kg	14	9.1%	36400	0	2	22	94	U	120	U	93	U
Benzo(a)anthracene	ug/Kg	2000	77.8%	224	3	21	27	9.2	J	33	J	93	
Benzo(a)pyrene	ug/Kg	2700	81.5%	61	12	22	27	12	J	30	J	93	
Benzo(b)fluoranthene	ug/Kg	3500	81.5%	1100	2	22	27	18	J	51	J	93	
Benzo(k)fluoranthene	ug/Kg	1900	63.0%	1100	1	17	27	8.7	J	33	J	93	
bis(2-Ethylhexyl)phthalate	ug/Kg	1800	63.0%	50000	0	17	27	94	U	120	U	93	U
Butylbenzylphthalate	ug/Kg	120	27.3%	50000	0	6	22	94	U	6.7	J	5.7	J
Carbazole	ug/Kg	430	45.5%		0	10	22	94	U	15	J	93	J
Chrysene	ug/Kg	2200	81.5%	400	3	22	27	13	J	43	J	93	
Di-n-butylphthalate	ug/Kg.	120	25.9%	8100	0	7	27	94	U	120	U	93	U
Di-n-octylphthalate	ug/Kg	19	4.5%	50000	0	1	22	94	U	120	U	93	U
Dibenz(a,h)anthracene	ug/Kg	1200	40.7%	14	9	11	27	94	U	8.8	J	93	J
Dibenzofuran	ug/Kg	36	9.1%	6200	0	2	22	94	U	120	U	93	U
Diethyl phthalate	ug/Kg	92	40.9%	7100	0	9	22	94	U	9.5	J	7.6	J
Fluoranthene	ug/Kg	4300	81.5%	50000	0	22	27	25	J	82	J	93	
Fluorene	ug/Kg	110	13.6%	50000	0	3	22	94	U	120	U	93	U
Indeno(1,2,3-cd)pyrene	ug/Kg	2500	77.8%	3200	0	21	27	9.5	J	28	J	93	J
Naphthalene	ug/Kg	23	9.1%	13000	0	2	22	94	U	120	U	93	U
Phenanthrene	ug/Kg	1500	81.5%	50000	0	22	27	11	J	35	J	6.4	J
Phenol	ug/Kg	93	4.5%	30	1	1	22	94	U	120	U	93	J
Pyrene	ug/Kg	3200	95.5%	50000	0	21	22	17	J	58	J	93	
Organochlorine Pesticides													
4,4'-DDE	ug/Kg	3.9	3.7%	2100	0	1	27	4.7	U	5.9	U	4.6	U
4,4'-DDD	ug/Kg	9.2	11.1%	2900	0	3	27	4.7	U	5.9	U	4.6	U
4,4'-DDT	ug/Kg	8.3	7.4%	2100	0	2	27	4.7	U	5.9	U	4.6	U
Endosulfan I	ug/Kg	7.5	9.1%	900	0	2	22	2.4	U	3	U	2.4	U
Endosulfan sulfate	ug/Kg	5.2	4.5%	1000	0	1	22	4.7	U	5.9	U	4.6	U
Endrin ketone	ug/Kg	9.4	4.5%		0	1	22	4.7	U	5.9	U	4.6	U

.E F-1

RI SHALLOW SOIL/SEDIMENT ANALYSIS RESULTS
SEAD-63 ENGINEERING EVALUATION/COST ANALYSIS
SENECA ARMY DEPOT ACTIVITY, ROMULUS, NY

							Matrix	SEDIMENT		SEDIMENT		SEDIMENT	
							Area	SEAD-63		SEAD-63		SEAD-63	
							Sample Depth (ft)	0.3		0.3		0.3	
							Sample Date	12-Dec-97		12-Dec-97		13-Dec-97	
							Location	63114		63115		63116	
							Sample Number						
							SDG						
Parameter	**Unit**	**Maximum Concentration Measured**	**Frequency of Detection**	**TAGM Level**	**Number of Samples above TAGM**	**Number of Samples where Detected**	**Number of Samples Collected**	Value	(Q)	Value	(Q)	Value	(Q)
Volatile Organic Compounds													
Metals/Cyanide													
Aluminum	mg/Kg	18000	100.0%	20650	0	27	27	9090	*	12700	*	15200	*
Antimony	mg/Kg	0.23	20.0%	6.27	0	1	5						
Arsenic	mg/Kg	6.8	100.0%	9.6	0	27	27	3.3		3		5.6	B
Barium	mg/Kg	107	100.0%	300	0	27	27	62.7		57.7		94.4	B
Beryllium	mg/Kg	0.8	100.0%	1.13	0	27	27	0.43	B	0.48	B	0.6	B
Cadmium	mg/Kg	0.83	33.3%	2.46	0	9	27	0.08	U	0.09	U	0.06	U
Calcium	mg/Kg	211000	100.0%	125300	2	27	27	103000		3750		19600	
Chromium	mg/Kg	24.6	100.0%	30.95	0	27	27	15.2	*	19.2	*	24.4	*
Cobalt	mg/Kg	14.4	100.0%	30	0	27	27	6.9	B	7	B	13.3	B
Copper	mg/Kg	42.6	100.0%	32.94	5	27	27	18.7		18.2		30.8	
Cyanide	mg/Kg	2.1	4.5%	0.35	1	1	22	0.72	UJ	1	UJ	0.8	UJ
Iron	mg/Kg	30100	100.0%	38110	0	27	27	17200		20000		29700	
Lead	mg/Kg	46.2	85.2%	23.49	9	23	27	17.2	*	18	*	15.7	*
Magnesium	mg/Kg	16100	100.0%	21890	0	27	27	5850	*	3820	*	7140	*
Manganese	mg/Kg	995	100.0%	1095	0	27	27	255	J	217	J	520	J
Mercury	mg/Kg	0.13	44.0%	0.1	2	11	25	0.07	U	0.07	U	0.06	U
Nickel	mg/Kg	44.2	103.8%	52.58	0	27	26	20.3		18.9		38.6	
Potassium	mg/Kg	2570	100.0%	2623	0	27	27	1280	B	1380	B	1840	B
Selenium	mg/Kg	2.1	40.7%	2	1	11	27	1.2	U	1.4	B	1	B
Sodium	mg/Kg	578	81.5%	187.8	15	22	27	170	B	172	U	130	U
Thallium	mg/Kg	2.3	14.8%	0.28	4	4	27	1.6	U	1.8	U	1.7	U
Vanadium	mg/Kg	28.4	100.0%	150	0	27	27	17.3		20.9		24	
Zinc	mg/Kg	534	100.0%	115	7	27	27	66.6	*	60.4	*	72.1	*
Others													
Total Solids	%W/W	85.8	100.0%		0	5	5						

TABLE F-2
INORGANICS ANALYSIS OF SOIL - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

	Average of Background Soils (mg/kg)	2 x Average of Background Soils (mg/kg)	Average of SEAD-63 Soils (mg/kg)	Is Average of Site data > than 2 x Average of Background data?
Aluminum	13340.53	26681.05	14641.67	No
Antimony	3.56	7.12	0.26	No
Arsenic	5.08	10.15	4.68	No
Barium	78.43	156.86	73.09	No
Beryllium	0.67	1.33	0.66	No
Cadmium	0.97	1.94	2.96	Yes
Calcium	45449.65	90899.30	19976.67	No
Chromium	20.32	40.64	25.31	No
Cobalt	11.39	22.79	12.43	No
Copper	20.99	41.97	33.15	No
Iron	24704.74	49409.47	28291.67	No
Lead	16.47	32.95	22.24	No
Magnesium	10290.18	20580.35	6735.83	No
Manganese	576.14	1152.28	441.00	No
Mercury	0.04	0.09	0.09	Yes
Nickel	30.39	60.79	38.08	No
Potassium	1487.25	2974.49	1640.83	No
Selenium	0.63	1.26	1.17	No
Sodium	99.42	198.85	94.67	No
Thallium	0.43	0.86	0.38	No
Vanadium	21.41	42.82	22.71	No
Zinc	67.80	135.60	83.28	No

Notes:
A "Yes" value indicates that site metal levels are higher than background levels and metal will be retained for risk assessment.
A "No" value indicates that levels are considered to be similar to background levels and metal will not be retained for risk assessment.

TABLE F-3
INORGANICS ANALYSIS OF GROUNDWATER - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

	Average of Background Groundwater (ug/L)	2 x Average of Background Groundwater (ug/L)	Average of SEAD-63 Groundwater (ug/L)	Is Average of Site data > than 2 x Average of Background data?
Aluminum	2923.01	5846.01	622.00	No
Barium	81.20	162.40	75.60	No
Calcium	115619.35	231238.71	172133.33	No
Chromium	8.67	17.35	1.04	No
Cobalt	6.84	13.68	4.93	No
Copper	5.39	10.79	2.03	No
Iron	4476.26	8952.53	961.00	No
Lead	6.59	13.18	1.10	No
Magnesium	28567.74	57135.48	30333.33	No
Manganese	231.41	462.82	675.33	Yes
Nickel	10.57	21.14	8.20	No
Potassium	4065.59	8131.17	3856.67	No
Sodium	15020.67	30041.33	52523.33	Yes
Vanadium	8.23	16.47	1.27	No
Zinc	25.37	50.74	8.30	No

Notes:
A "Yes" value indicates that site metal levels are higher than background levels and metal will be retained for risk assessment.
A "No" value indicates that levels are considered to be similar to background levels and metal will not be retained for risk assessment.

TABLE F-4
INORGANICS ANALYSIS OF SOIL/SEDIMENT - SEAD-63

Ecological Mini-risk Assessment Dataset
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

	Average of Background Soils (mg/kg)	2 x Average of Background Soils (mg/kg)	Average of SEAD-63 Soils (mg/kg)	Is Average of Site data > than 2 x Average of Background data?
Aluminum	13340.53	26681.05	11887.06	No
Antimony	3.56	7.12	0.26	No
Arsenic	5.08	10.15	4.29	No
Barium	78.43	156.86	68.28	No
Beryllium	0.67	1.33	0.53	No
Cadmium	0.97	1.94	2.37	Yes
Calcium	45449.65	90899.30	40367.94	No
Chromium	20.32	40.64	20.16	No
Cobalt	11.39	22.79	10.59	No
Copper	20.99	41.97	28.04	No
Iron	24704.74	49409.47	22336.76	No
Lead	16.47	32.95	23.44	No
Magnesium	10290.18	20580.35	7663.82	No
Manganese	576.14	1152.28	451.29	No
Mercury	0.04	0.09	0.08	No
Nickel	30.39	60.79	31.27	No
Potassium	1487.25	2974.49	1578.41	No
Selenium	0.63	1.26	1.24	No
Sodium	99.42	198.85	215.67	Yes
Thallium	0.43	0.86	0.83	No
Vanadium	21.41	42.82	21.31	No
Zinc	67.80	135.60	117.34	No

Notes:
A "Yes" value indicates that site metal levels are higher than background levels and metal will be retained for risk assessment.
A "No" value indicates that levels are considered to be similar to background levels and metal will not be retained for risk assessment.

TABLE F-5
EXPOSURE POINT CONCENTRATIONS FOR CHEMICALS OF POTENTIAL CONCERN - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

COMPOUNDS	Total Soil ([1]) mg/Kg	Surface Soil ([1]) mg/Kg	Groundwater ([1]) mg/L	Surface Water ([1]) mg/L	Sediment ([1]) mg/Kg	Surface Soil and Sediment ([2]) mg/Kg
Volatile Organics						
Acetone	0.16				0.15 J	0.15 J
2-Butanone	0.046					
Benzene	0.004 J	0.002 J				0.002 J
Chloroform				0.0008 J		
Methyl ethyl ketone					0.035 J	0.035 J
Toluene	0.023	0.006 J		0.001	0.014 J	0.014 J
Xylene (total)	0.014	0.014				0.014
Semivolatile Organics						
2-Methylnaphthalene					0.014 J	0.014 J
4-Methylphenol				0.00022 J		
Benzo(a)anthracene	0.03 J				2 E	2 E
Benzo(a)pyrene	0.045 J	0.024 J		0.001 J	2.7 E	2.7 E
Benzo(b)fluoranthene	0.038 J	0.021 J		0.0009 J	3.5 E	3.5 E
Benzo(g,h,i)perylene	0.031 J			0.0008 J		
Benzo(k)fluoranthene	0.043 J	0.021 J		0.001 J	1.9 E	1.9 E
bis(2-Ethylhexyl)phthalate	1.8 J	1.8 J		0.068	0.11 B	1.8 J
Butylbenzylphthalate				0.00023 JB	0.12 J	0.12 J
Carbazole					0.43	0.43
Chrysene	0.031 J	0.023 J			2.2 E	2.2 E
Dibenz(a,h)anthracene	0.028 J			0.0008 J	1.2	1.2
Di-n-butylphthalate	0.087 J			0.00015 JB	0.120 JB	0.120 JB
Di-n-octylphthalate					0.019 J	0.019 J
Dibenzofuran					0.036 J	0.036 J
Diethyl phthalate				0.00029 J	0.092 J	0.092 J
Fluoranthene	0.063 J	0.038 J		0.0007 J	4.3 E	4.3 E
Fluorene					0.11 J	0.11 J
Indeno(1,2,3-cd)pyrene	0.037 J			0.0009 J	2.5 E	2.5 E
Naphthalene					0.023 J	0.023 J
Pentachlorophenol				0.001 J		
Phenanthrene	0.031 J			0.000057 J	1.5 E	1.5 E
Phenol			0.002 J	0.0008 J	93	93
Pyrene				0.0005 J	3.2 E	3.2 E
Pesticides/PCBs						
4,4'-DDD	0.002 J				0.0039 J	0.0039 J
4,4'-DDE	0.0044 J				0.0092 J	0.0092 J
4,4'-DDT	0.0033 J				0.0083	0.0083
Endosulfan I					0.0075 J	0.0075 J
Endosulfan sulfate				0.000014 P	0.0052 J	0.0052 J
Endrin ketone				0.000046	0.0094 J	0.0094 J
Metals						
Aluminum				3.63		
Antimony						
Arsenic				0.0038 J		
Barium				0.0914 J		
Beryllium				0.00019 B		
Cadmium	24	0.56 J		0.00078 J	0.83 J	0.83 J
Calcium				220		
Chromium				0.0056 J		
Cobalt				0.0072 J		
Copper				0.0079 J		
Cyanide						
Iron				9.05		
Lead				0.02		
Magnesium				33.7		
Manganese			1.07	2.3		
Mercury	0.49	0.06 J		0.0001 J		
Nickel				0.0188 J		
Potassium				11.6		
Selenium						
Silver				0.00089 J		
Sodium			146	59.3	578 B	578 B
Thallium				0.0019 J		
Vanadium				0.0089 J		
Zinc				0.099		

climate, vegetation, soil characteristics, and surface and groundwater hydrology. All potentially exposed populations and sub-populations therein (receptors) are assessed relative to their potential for exposure. Additionally, locations relative to the site along with the current and potential future land use of the site are considered. This step is a qualitative one aimed at providing a general site perspective and offering insight on the surrounding population.

2) **Identify Exposure Pathways:** All exposure pathways, ways in which receptors can be exposed to contaminants that originate from the source, are reviewed in this step. Chemical sources and mechanisms for release along with subsequent fate and transport are investigated. Exposure points of human contact and exposure routes are discussed before quantifying the exposure pathways in step 3.

3) **Quantify Exposure:** In this final step, the exposure levels (COPC intakes or doses) are calculated for each exposure pathway and receptor. These calculations typically follow EPA guidance for assumptions of intake variables or exposure factors for each exposure pathway and EPA-recommended calculation methods.

Figure F-1 illustrates the exposure assessment process.

F.3.2 Physical Setting and Characteristics

The physical setting and characteristics of the site are described in **Sections 2.1, 2.5, and 2.6** of **Section 2 of Appendix A.**

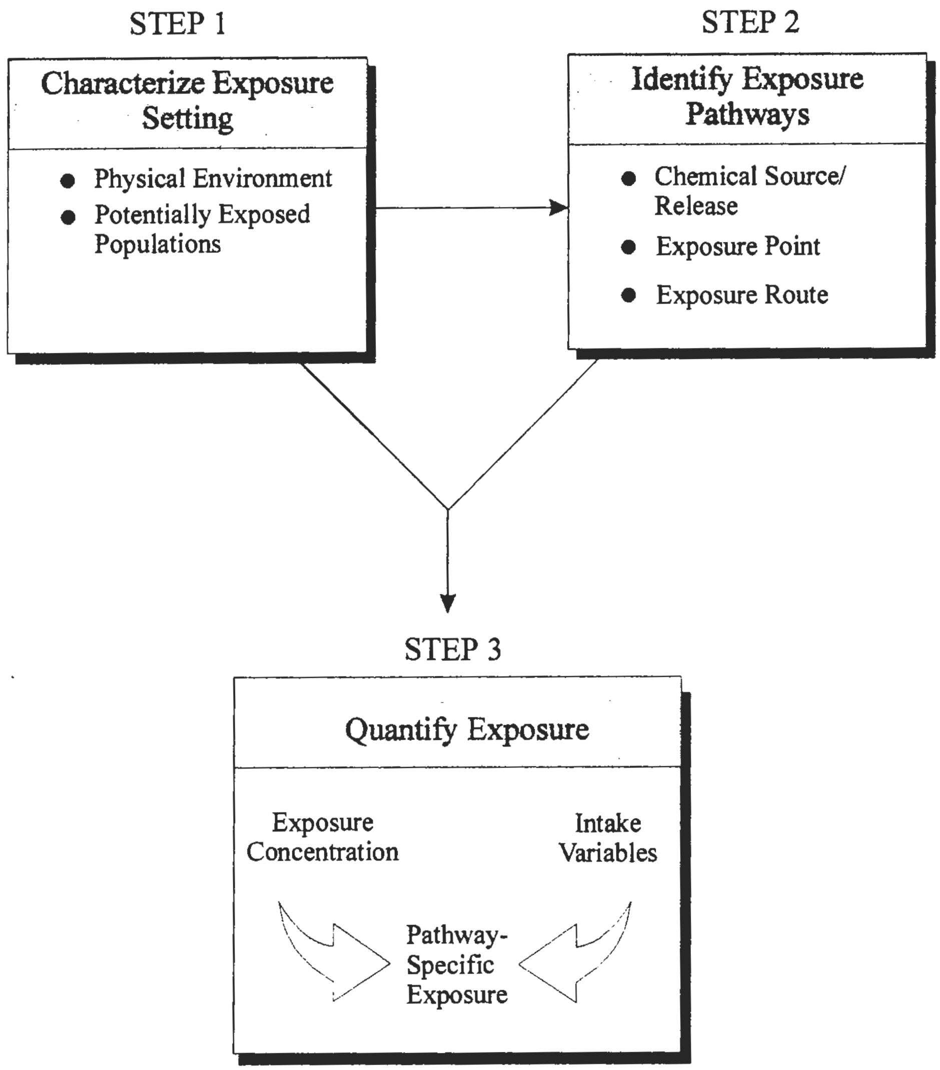
F.3.3 Land Use and Potentially Exposed Populations

F.3.3.1 Current Land Use

There is no current land use for SEAD-63. The site is abandoned and is no longer in use. This site is in the northwestern portion of SEDA. There are no drinking water supply wells at SEAD-63 and perimeter chain link fencing permits access to the site. The site has no actual site workers but is occasionally patrolled by site security personnel.

F.3.3.2 Potential Future Land Use

EPA guidance for determining future land uses recommends that, if available, master plans, which include future land uses, Bureau of Census projections and established land use trends in the general area should be utilized to establish future land use trends.



Source: USEPA, 1989a

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CLIENT/PROJECT TITLE

SENECA ARMY DEPOT ACTIVITY

DEPT ENVIRONMENTAL ENGINEERING | DWG NO

FIGURE F-1

EXPOSURE ASSESSMENT PROCESS

SCALE Not Applicable | DATE April 2001

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In July 1995, the Base Realignment and Closure Act (BRAC) Commission voted to recommend closure of SEDA. Congress approved the recommendation, which became public law on October 1, 1995. According to BRAC regulations, the Army will determine future uses of the site.

In accordance with BRAC regulations, the Army will notify all appropriate regulatory agencies and will perform any additional investigations and remedial actions to assure that any changes in the intended use of the sites is protective of human health and the environment in accordance with CERCLA. Also, Army regulations (Regulation 200-1, paragraph 12-5, Real Property Transactions), require that the Army perform an Environmental Baseline Study (EBS) prior to a transfer of Army property. The EBS is an inventory and a comprehensive evaluation of the existing environmental conditions and consists of scope definition, survey, sampling, investigative and risk assessment

SEDA has been placed on the 1995 Base Realignment and Closure List (BRAC List). The President and the Congress have approved the list and it has become public law. As BRAC applies to SEDA, the Army will determine future land use of the sites. At the time this Action Memorandum was prepared, the Local Redevelopment Authority (LRA) had been given sole discretion in determining the future uses of the SEDA facility. This Land Reuse Plan is the basis for future land use assumptions for SEAD-63 included in this risk assessment. The LRA has established that the Q Area, which includes SEAD-63, will be used as a Wildlife Conservation Area. At the time when the SEDA facility is relinquished by the Army, the Army will ensure that SEAD-63 can be used for the intended purpose.

F.3.3.3 Potentially Exposed Populations

Three potentially exposed populations that are relevant to the future land use are evaluated in this risk assessment. Since current exposure is infrequent and limited, only future receptors under the future land use scenarios are considered in this mini-risk assessment.

The three (3) exposed populations are:
1. Park worker,
2. construction worker, and
3. recreational visitor (child).

Residential receptors (including adult and child) were considered for comparative purposes only. Future residential use of the land is highly unlikely.

F.3.4 Identification of Exposure Pathways

Exposures are estimated only for plausible completed exposure pathways. A completed exposure pathway has the following four elements:

- a source and mechanism for chemical release,
- an environmental transport medium,
- an exposure point, and
- a human receptor and a feasible route of exposure at the exposure point.

A pathway cannot be completed unless each of these elements is present. **Figure 2-12** in **Section 2** of **Appendix A** illustrates the completed exposure pathways for SEAD-63. Although not shown in Figure 2-12, risks for a residential receptor via the plausible exposure pathways (i.e., same exposure pathways as for a recreational visitor) were evaluated. Future residential use of the land is highly unlikely.

F.3.4.1 Sources and Receiving Media

The suspected source at SEAD-63 is buried miscellaneous components and soil associated with the components at SEAD-63. The primary release mechanisms from the site are surface water runoff and infiltration of precipitation. Groundwater, surface water, and sediment are secondary sources.

F.3.4.2 Summary of Exposure Pathways to be Quantified

The pathways presented reflect the projected future onsite use of SEAD-63. This section presents the rationale for including these exposure pathways in this risk assessment.

Inhalation of Particulate Matter in Ambient Air

Surface soil particles may become airborne via wind erosion, which in turn may be inhaled by individuals at the site. Construction workers may also be exposed to subsurface soil particles. Therefore, inhalation exposure to soil particulates in ambient air was assessed for all future receptors.

Incidental Ingestion and Dermal Contact to On-Site Surface Soils

During the course of daily activities, a park worker or recreational visitor could come into contact with site surface soils and involuntarily ingest and/or have their skin exposed to them. Therefore, exposure via dermal contact and soil ingestion was assessed for these two receptors.

Incidental Ingestion and Dermal Contact to On-Site Surface and Subsurface Soils

The laboratory analyses of all surface and subsurface soils show the presence of VOCs, semi-volatile organics, pesticides, and metals. During the course of daily activities, an on-site construction worker will come into contact with these surface and subsurface soils during intrusive activities and may involuntarily ingest and have his/her skin exposed to them. Therefore, exposure via both dermal contact and soil ingestion was assessed for the future construction worker.

Ingestion of Groundwater

There is no current use of groundwater as a potable water source at the Depot. Potable water is supplied to the Depot from a water supply line that passes through the Town of Varick. Varick's water is obtained from the water treatment plant at the Town of Waterloo. The source of this water is Lake Seneca. It is unlikely that a groundwater well would be installed for future drinking water use. The shallow groundwater aquifer at the site is inadequate for both yield and quality. Nonetheless, since this use is not prevented via an institutional control such as a deed restriction, it was assumed that wells would be installed on-site for potable water. Therefore, this is considered a complete pathway for receptors at the site.

Inhalation and Dermal Contact with Groundwater while Showering

Recreational visitors may come into contact with groundwater while taking daily showers. These receptors may be exposed to all chemicals contained in groundwater during showering by dermal contact, and volatile chemicals which partition into the air via inhalation. Therefore, this is considered a complete pathway and data from the on-site wells are used to calculated exposure concentrations.

Dermal Contact with Surface Water and Sediment while Wading

The drainage ditches in the area of SEAD-63 are dry most of the time during the year except when they carry storm-water runoff (e.g., during spring seasons when snow melts). The drainage ditches are shallow (generally less than 3 ft below the ground surface of the road). Recreational visitors may come into contact with surface water during a wading event. Recreational visitors may also contact with ditch sediment and be exposed to all chemicals contained in sediment. Therefore, this is considered a complete pathway and surface water and sediment data from the site are used to calculated exposure concentrations.

F.3.4.3 Quantification of Exposure

In this section, each receptor's potential exposures to chemicals of potential concern (COPCs) are quantified for each of the exposure pathways described above. In each case, the exposures are calculated following methods recommended in EPA guidance documents, such as the Risk Assessment Guidance for Superfund (EPA 1989). These calculations generally involve two steps. First, representative chemical concentrations in the environment, or exposure point concentrations (EPCs), are determined for each pathway and receptor. From these EPC values, the amount of chemical that an exposed person may take into his/her body is then calculated. This value is referred to as either the Human Intake or the Absorbed Dose, depending on the exposure route.

This section describes the exposure scenarios, exposure assumptions and exposure calculation methods used in this risk assessment. All calculations are shown in the tables included in **Attachment A** to this Appendix.

Risk assessment as a whole, and the exposure assessment step in particular, are designed to be health protective. The exposure calculations require estimates and assumptions about certain human exposure parameters, such as inhalation rates, ingestion rates, etc. Generally, values are selected which tend to overestimate exposure. USEPA (1993) recommends two types of exposure estimates to be used for Superfund risk assessments: a reasonable maximum exposure (RME) and central tendency exposure (CT). The RME is defined as the highest exposure that could reasonably be expected to occur for a given exposure pathway at a site, and is intended to account for both uncertainty in the contaminant concentration and variability in the exposure parameters (such as exposure frequency or averaging time). The CT also may be evaluated for comparison purposes and is generally based on mean exposure parameters. Only RME scenarios have been evaluated in this mini-risk assessment.

Superfund risk assessments consider chronic exposures unless specific conditions warrant a short-term or an acute assessment. In this evaluation, long-term exposure to relatively low chemical concentrations is the greatest concern. Short-term (i.e., subchronic) and acute exposures were evaluated only for the construction worker.

Exposure-point concentrations (EPCs) were estimated for all pathways selected for quantitative evaluation. These concentrations are based on the highest measured values (for soil and groundwater) or on calculated estimates (for ambient air and showering). Steady-state conditions were assumed. Therefore, current and future chemical concentrations were assumed to be identical. This assumption may tend to overestimate long-term exposure concentrations because chemical concentrations are likely to decrease over time from natural processes such as dispersion, attenuation, degradation and dilution.

Estimates of pathway-specific human intakes or absorbed doses for each chemical involve assumptions about patterns of human exposure to contaminated media. These assumptions are integrated with exposure-point concentrations to calculate intakes. Intakes or doses are normally expressed as the amount of chemical at the environment-human receptor exchange boundary in milligrams per kilogram of body weight per day (mg/kg-day), which represents an exposure normalized for body weight over time. The total exposure is divided by the time period of interest to obtain an average exposure. The averaging time is a function of the toxic endpoint: for noncarcinogenic effects, it is the exposure time (specific to the scenario being assessed) and for carcinogenic effects, it is lifetime (70 years).

F3.5 Exposure Assessment

F.3.5.1 Exposure Assumptions

An important aspect of exposure assessment is the determination of assumptions regarding how receptors may be exposed to contaminants. USEPA guidance on exposure factors is extensive and was followed throughout this exposure assessment. Standard scenarios and EPA-recommended default assumptions were used where appropriate.

The exposure scenarios in this assessment involve the following future receptors: park worker, construction worker, and recreational visitor (child). The exposure assumptions for these scenarios are intended to approximate the frequency, duration and manner in which receptors are exposed to environmental media. For example, the worker scenarios are intended to approximate the exposure potential of those employed at the site.

Details of the exposure assumptions and parameters for each exposure scenario are presented in **Table F-6**.

TABLE F-6
EXPOSURE FACTOR ASSUMPTIONS FOR CONSERVATION/RECREATIONAL LAND
SEAD-63 EE/CA
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
PARK WORKER	**Inhalation of Dust in Ambient Air**	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Inhalation Rate	8	m3/day	Average inhalation rate for light activity is 1.0 m3/hr, 8 hr work day.	USEPA, 1997.
		Exposure Frequency	175	days/yr	Works on-site 5 days/wk, 8 months/yr (35 weeks).	BPJ.
	(Air EPC Calculated from Surface Soil Only)	Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Ingestion Rate	100	mg soil/day	Upper bound worker exposure to dirt and dust.	USEPA, 1993.
	(Soil EPC Calculated from Surface Soil Only)	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
		Exposure Frequency	175	days/yr	Works on-site 5 days/wk, 8 months/yr (35 weeks).	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999.
	(Soil EPC Calculated from Surface Soil Only)	Skin Contact Surface Area	5,700	cm2	RME value for residential scenario.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for industrial scenario.	USEPA, 1999.
		Exposure Frequency	175	days/yr	Works on-site 5 days/wk, 8 months/yr (35 weeks).	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Groundwater	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Ingestion Rate	1	liter/day	Standard occupational ingestion rate.	USEPA. 1991.
		Exposure Frequency	175	days/yr	Works on-site 5 days/wk, 8 months/yr (35 weeks).	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Surface Water	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Skin Contact Surface Area	1,980	cm2	Adult male hands and forearms.	USEPA, 1992.
		Exposure Time	1	hour/day	Contact time during occasional site maintenance work.	BPJ.
		Exposure Frequency	18	days/yr	Assumes activity occurs 10% of work days.	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Sediment	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999.
		Skin Contact Surface Area	5,700	cm2	RME value for residential scenario.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for industrial scenario.	USEPA, 1999.
		Exposure Frequency	18	days/yr	Assumes activity occurs 10% of work days.	BPJ.
		Exposure Duration	25	years	Upper bound time for employment at a job.	USEPA, 1991, 1993.
		Averaging Time - Nc	9,125	days	25 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.

TABLE F-6
EXPOSURE FACTOR ASSUMPTIONS FOR CONSERVATION/RECREATIONAL LAND
SEAD-63 EE/CA
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
RECREATIONAL VISITOR (CHILD)	**Inhalation of Dust in Ambient Air**	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991 1993.
		Inhalation Rate	8.7	m3/day	Average inhalation rate for a child 1-12 years old.	USEPA, 1997.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the	BPJ.
	(Air EPC Calculated from Surface Soil Only)				remaining 39 weeks of the year.	
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Ingestion Rate	200	mg soil/day	Maximum IR for a child.	USEPA, 1993.
	(Soil EPC Calculated from Surface Soil Only)	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the remaining 39 weeks of the year.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Absorption Factor	Compound	Specific		USEPA, 1999.
	(Soil EPC Calculated from Surface Soil Only)	Skin Contact Surface Area	2,800	cm2	RME value for residential child.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for residential child.	USEPA, 1999.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the remaining 39 weeks of the year.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Inhalation of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Inhalation Rate	0.08	m3/day	Inhalation rate for sedentary children ages 3-10, 0.3 m3/hr for 15 minutes.	USEPA, 1997.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the remaining 39 weeks of the year.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA. 1989.
	Ingestion of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Ingestion Rate	1	liter/day	Approximate 90th percentile value for children 1-11 years old.	USEPA. 1997.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the	BPJ.
		Exposure Duration			remaining 39 weeks of the year.	
		Averaging Time - Nc	5	years	Assumed.	BPJ.
		Averaging Time - Car	1,825	days	5 years.	
			25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Skin Contact Surface Area	6,600	cm2	RME value for showering/bathing scenario.	USEPA. 1999.
		Exposure Time	1	hour/day	RME value for showering/bathing scenario.	USEPA, 1999.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the	BPJ.
		Exposure Duration			remaining 39 weeks of the year.	
		Averaging Time - Nc	5	years	Assumed.	BPJ.
		Averaging Time - Car	1,825	days	5 years.	
			25,550	days	70 years, conventional human life span.	USEPA, 1989.

TABLE F-6
EXPOSURE FACTOR ASSUMPTIONS FOR CONSERVATION/RECREATIONAL LAND
SEAD-63 EE/CA
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
RECREATIONAL VISITOR (CHILD - CONTINUED)	**Dermal Contact of Surface Water**	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991.
		Skin Contact Surface Area	3,300	cm2	Assumes skin contact surface as half of the total body surface during a wading event.	BPJ.
		Exposure Time	1	hour/day	RME value for showering/bathing scenario.	USEPA, 1999.
		Exposure Frequency	20	days/yr	Assumes wading occurs every time during 13 spring visits and 10% of other visits.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Sediment	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999.
		Skin Contact Surface Area	2,800	cm2	RME value for soil contact by residential child.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for soil contact by residential child.	USEPA, 1999.
		Exposure Frequency	78	days/yr	Assumes 3 days/week during 13 summer weeks and 1 day/week for the remaining 39 weeks of the year.	BPJ.
		Exposure Duration	5	years	Assumed.	BPJ.
		Averaging Time - Nc	1,825	days	5 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.

TABLE F-6
EXPOSURE FACTOR ASSUMPTIONS FOR CONSERVATION/RECREATIONAL LAND
SEAD-63 EE/CA
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
CONSTRUCTION WORKER	**Inhalation of Dust in Ambient Air**	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Inhalation Rate	10.4	m3/day	Average inhalation rate for outdoor worker is 1.3 m3/hr, 8 hr work day.	USEPA, 1997.
		Exposure Frequency	250	days/yr	Site specific based on land area.	USEPA, 1991.
	(Air EPC Calculated	Exposure Duration	1	year	Upper bound time of employment for construction worker.	USEPA, 1991.
	from Surface and	Averaging Time - Nc	365	days	1 year.	
	Subsurface Soils)	Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Ingestion Rate	480	mg soil/day	Assumed IR for intensive construction work.	USEPA, 1991, 1993.
	(Soil EPC Calculated	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
	from Surface and	Exposure Frequency	250	days/yr	Site specific based on land area.	USEPA, 1991.
	Subsurface Soils)	Exposure Duration	1	year	Upper bound time of employment for construction worker.	USEPA, 1991.
		Averaging Time - Nc	365	days	1 year.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	70	kg	Standard reference weight for adults males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999.
	(Soil EPC Calculated	Skin Contact Surface Area	3,300	cm2	RME value for industrial scenario.	USEPA, 1999.
	from Surface and	Soil to Skin Adherence Factor	0.3	mg/cm2	RME value for construction workers.	USEPA, 1999.
	Subsurface Soils)	Exposure Frequency	250	days/yr	RME value for industrial scenario.	USEPA, 1999.
		Exposure Duration	1	year	Upper bound time of employment for construction worker.	USEPA, 1991.
		Averaging Time - Nc	365	days	1 year.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.

Notes:
RME = Reasonable Maximum Exposure
Car = Carcinogenic
Nc = Non-carcinogenic

Source References:
- BPJ: Best Professional Judgment.
- USEPA, 1988: Superfund Exposure Assessment Manual
- USEPA, 1989: Risk Assessment Guidance for Superfund, Volume I (RAGS)
- USEPA, 1991: Supplemental Guidance, Standard Default Exposure Factors
- USEPA, 1993: Superfund's Standard Default Exposure for the Central Tendency and Reasonable Maximum Exposure
- USEPA, 1997: Exposure Factors Handbook, Update to 1990 handbook
- USEPA, 1999: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Dermal Risk Assessment, Interim Guidance, 1999.

TABLE F- 6
EXPOSURE FACTOR ASSUMPTIONS FOR RESIDENTIAL SCENARIO
Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
RESIDENT (ADULT)	Inhalation of Dust in Ambient Air	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Inhalation Rate	20	m3/day	Assumed inhalation rate for adult receptors.	USEPA, 1991, 1993.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
	(Air EPC Calculated from Surface Soil Only)	Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Ingestion Rate	100	mg soil/day	Average residential adult exposure to indoor and outdoor dirt and dust.	USEPA, 1991, 1993.
	(Soil EPC Calculated from Surface Soil Only)	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999
	(Soil EPC Calculated from Surface Soil Only)	Skin Contact Surface Area	5,700	cm2	RME for residential adult exposed to soils.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.07	mg/cm2	RME for residential adult exposed to soils.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Inhalation of Groundwater	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Inhalation Rate	0.13	m3/day	Inhalation rate for sedentary adults, 0.5m3/hr for 15 minutes.	USEPA, 1997.
		Exposure Frequency	3.65	days/yr	Showers 15 min/day, 350 days/yr.	BPJ.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Groundwater	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Ingestion Rate	2	liter/day	90th percentile for adult residents.	USEPA, 1989.
		Exposure Frequency	350	days/yr	Assumes year round exposure to gw and vacation from home for 2 wks/yr.	BPJ.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Groundwater	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Skin Contact Surface Area	18,000	cm2	RME for residential adult for showering scenario.	USEPA, 1999.
		Exposure Time	0.58	hours/day	RME for residential adult for showering scenario.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to gw and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Surface Water	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Skin Contact Surface Area	4,500	cm2	Assumes 25% of the total body surface exposured to water during wading.	BPJ.
		Exposure Time	0.5	hours/day	Assumption.	BPJ.
		Exposure Frequency	35	days/yr	Assumes 10% of the time ditch accumulates water.	BPJ.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventioanl human life span.	USEPA, 1989.
	Dermal Contact of Sediment	Body Weight	70	kg	Standard reference weight for adult males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999
		Skin Contact Surface Area	5,700	cm2	RME for residential adult exposed to soil.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.07	mg/cm2	RME for residential adult exposed to soil.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	24	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	8,760	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventioanl human life span.	USEPA, 1989.

TABLE F- 6
EXPOSURE FACTOR ASSUMPTIONS FOR RESIDENTIAL SCENARIO
Decision Document - Mini Risk Assessment
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RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		
RESIDENT (CHILD)	Inhalation of Dust in Ambient Air	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991 1993.
		Inhalation Rate	8.7	m3/day	Average inhalation rate for a child 1-12 years old.	USEPA, 1997.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
	(Air EPC Calculated from Surface Soil Only)	Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Ingestion of Soil	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Ingestion Rate	200	mg soil/day	Maximum IR for a child.	USEPA, 1993.
	(Soil EPC Calculated from Surface Soil Only)	Fraction Ingested	1	(unitless)	100% ingestion, conservative assumption.	BPJ.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	6	years	Upper bound time in 1 residence· 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Soil	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Absorption Factor	Compound	Specific		USEPA, 1999
	(Soil EPC Calculated from Surface Soil Only)	Skin Contact Surface Area	2,800	cm2	RME value for residential child skin surface exposed to soil.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME value for residential child exposed to soil.	USEPA, 1999
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Inhalation of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Inhalation Rate	0.08	m3/day	Inhalation rate for sedentary children ages 3-10, 0.3 m3/hr for 15 minutes.	USEPA, 1997.
		Exposure Frequency	3.65	days/yr	Showers 15 min/day, 350 days/yr.	BPJ.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA. 1989.
	Ingestion of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Ingestion Rate	1	liter/day	Approximate 90th percentile value for children 1-11 years old.	USEPA. 1997.
		Exposure Frequency	350	days/yr	Assumes year round exposure to gw and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Groundwater	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991, 1993.
		Skin Contact Surface Area	6,600	cm2	RME value for residential child during showering.	USEPA. 1999.
		Exposure Time	1.0	hours/day	RME value for residential child for showering scenario.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to gw and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	6 years.	USEPA, 1989.
		Averaging Time - Car	25,550	days	70 years, conventional human life span.	USEPA, 1989.
	Dermal Contact of Surface Water	Body Weight	15	kg	Standard reference weight for children less than 6 years old.	USEPA, 1991.
		Skin Contact Surface Area	3,300	cm2	Assumes skin contact surface as half of total body surface while wading.	BPJ.
		Exposure Time	1	hours/day	RME value for showering/bathing scenario.	USEPA, 1999.
		Exposure Frequency	35	days/yr	Assumes 10% of the time ditch accumulates water.	BPJ.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993
		Averaging Time - Nc	2,190	days	6 years.	
		Averaging Time - Car	25,550	days	70 years, conventioanl human life span.	USEPA, 1989.
	Dermal Contact of Sediment	Body Weight	15	kg	Standard reference weight for adult males.	USEPA, 1991.
		Absorption Factor	Compound	Specific		USEPA, 1999
		Skin Contact Surface Area	2,800	cm2	RME for residential adult exposed to soil.	USEPA, 1999.
		Soil to Skin Adherence Factor	0.2	mg/cm2	RME for residential adult exposed to soil.	USEPA, 1999.
		Exposure Frequency	350	days/yr	Assumes year round exposure to soil and vacation from home for 2 wks/yr.	USEPA, 1991.
		Exposure Duration	6	years	Upper bound time in 1 residence: 6 years as a child, 24 years as an adult.	USEPA, 1991, 1993.
		Averaging Time - Nc	2,190	days	24 years.	
		Averaging Time - Car	25,550	days	70 years, conventioanl human life span.	USEPA, 1989.

TABLE F- 6
EXPOSURE FACTOR ASSUMPTIONS FOR RESIDENTIAL SCENARIO
Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	PARAMETER	RME		BASIS	SOURCE
			VALUE	UNITS		

Notes:
RME = Reasonable Maximum Exposure
Car = Carcinogenic
Nc = Non-carcinogenic

Source References:
- BPJ: Best Professional Judgement.
- USEPA, 1988: Superfund Exposure Assessment Manual
- USEPA, 1989: Risk Assessment Guidance for Superfund, Volume I (RAGS)
- USEPA, 1991: Supplemental Guidance, Standard Default Exposure Factors
- USEPA, 1993: Superfund's Standard Default Exposure for the Central Tendency and Reasonable Maximum Exposure
- USEPA, 1997: Exposure Factors Handbook, Update to 1990 handbook
- USEPA, 1999: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Dermal Risk Assessment, Interim Guidance, 1999.

The primary sources for the RME and CT exposure factors are as follows:

- USEPA, 1988: Superfund Exposure Assessment Manual
- USEPA, 1989a: Risk Assessment Guidance for Superfund, Volume I (RAGS)
- USEPA, 1991a: Supplemental Guidance, Standard Default Exposure Factors
- USEPA, 1992: Dermal Exposure Assessment, Principles and Applications
- USEPA, 1993a: Superfund's Standard Default Exposure for the Central Tendency and Reasonable Maximum Exposure
- USEPA, 1997: Exposure Factors Handbook
- USEPA, 1999: Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment, Interim Guidance

In the following sections, the methods used to calculate exposures by each pathway are explained. Tables, which show the human intake or absorbed dose values calculated for each exposure scenario, are contained in **Attachment A** of this appendix. These intakes and doses are used to assess overall carcinogenic and non-carcinogenic risk, as discussed later in the risk characterization section (**Section F.5**).

F3.5.2 Exposure Scenarios

The exposure scenarios for the four receptors and their respective exposure assumptions in this assessment are described below.

Construction Worker. Future construction workers are assumed to spend one year working at the site, which is a typical duration for a significant construction project. These workers spend each working day at the site. During this time, this worker inhales the ambient air at the site and may ingest or dermally contact the soil there. Since the construction worker may be digging onsite, the soil ingestion or dermal contact with both surface and subsurface soils was assumed.

Park Worker. The park worker's work schedule differs from other workers discussed above. The park worker is assumed to work onsite for only 8 months (35 weeks) per year from Spring through Autumn, when recreational visitors would use the conservation area. The workday (8 hours/day) and exposure duration (25 years) are the same as other workers. Like the industrial, warehouse and day care workers, the park worker inhales the ambient air, ingests groundwater, and ingests and dermally contacts surface soil. In addition, the park worker may occasionally dermally contact surface water and sediment in the conservation area.

Recreational Visitor (Child). While both adults and children may visit the conservation area, potential risks would be expected to be higher for children, due to their higher soil ingestion rates and lower body weights. To be conservative, a child recreational visitor receptor is assessed. The recreational visitor is assumed to visit the conservation area 3 days/week during 13 summer weeks, and 1 day/week for the remaining 39 weeks of the year for a total exposure frequency of 78 days/year for 5 years. During each visit, the child inhales the ambient air, ingests groundwater, inhales and dermally contacts groundwater during showering, ingests and dermally contacts surface soil, dermally contacts ditch sediment. In addition, the child recreational visitor may occasionally dermally contact surface water in the conservation area.

Resident. Potential risks for a residential adult and child were evaluated for comparative purposes only. Cancer risks for the residential adult and child were summed to present a lifetime cancer risk for a resident. Risks from exposure via dust inhalation, soil ingestion and dermal contact, groundwater ingestion, inhalation, and dermal contact, and surface water and sediment dermal contact were evaluated. Exposure factors are presented in **Table F-6**.

Complete exposure assumptions (exposure factors) for all receptors and exposure scenarios are summarized in Table F-6. Most exposure factors used in the exposure assessment were obtained from EPA guidance documents. Other exposure factors were based on conservative professional judgment where no data are available form EPA or other sources.

F.3.5.3 Inhalation of Particulate Matter in Ambient Air

This pathway consists of particulate matter (PM) being released from soils to the air and then being inhaled by future receptors. Ambient PM concentrations for a construction worker were estimated using an emission and dispersion model. PM concentrations for the park worker, recreational visitor, and residential receptors were based on existing site air measurements shown in **Table F-7.**

Construction Worker

During construction activities, construction workers may be exposed to chemicals in site soils via inhalation. Construction activities, such as excavation, have the potential to create dust, or suspended particulate matter (PM), originating from the soils being removed. This dust would contain the chemicals present in the soil. Construction workers in the construction area would breathe this PM in the ambient air.

TABLE F-7
SUSPENDED PARTICULATE CONCENTRATIONS MEASURED AT SEDA
SEAD-63 EE/CA
Seneca Army Depot Activity

PARTICULATE DATA	SITE #1 PM 10	SITE #2 PM 10	SITE #3 PM 10	SITE #4 PM 10
Peak Concentration (ug/m3)	37 on 23 July 95	37 on 23 July 95	37 on 5 July 95	37 on 5 July 95
Arithmetic Mean (ug/m3)	16.9	16.6	16.4	15.8
Standard Deviation	21.4	21.1	23.0	23.0
Geometric Mean (ug/m3)	15.1	14.8	14.8	14.2
No. of 24-hr. Avgs. Above 150 ug/m3	0	0	0	0
Number of Valid Samples	29	32	29	31
Percent Data Recovery	90.6	100.0	90.6	96.9

ulative Summary for April 1, 1995 through July 31, 1995

Air concentrations of site chemicals of concern were estimated for this exposure pathway using excavation models recommended in the USEPA's "Models for Estimating Air Emission Rates from Superfund Remedial Actions" (EPA 451/R-93-001). Particulate emissions from soil excavation and loading into trucks are estimated with the following equation:

$$E = \frac{k\,(0.0016)\,(M)\,[U/2.2]^{1.3}}{[X/2]^{1.4}}$$

Where:

E	=	emissions (g)
k	=	particle size multiplier (unitless)
0.0016	=	empirical constant (g/kg)
M	=	mass of soil handled (kg)
U	=	mean wind speed (m/sec)
2.2	=	empirical constant (m/sec)
X	=	percent moisture content (%)

The construction worker receptor is assumed to work at the site for a one year period. To conservatively estimate potential particulate emissions from construction activities during this period, it was assumed that the entire area of the site (an approximate 4 acre area) is excavated to a depth of two meters over the course of one year as part of the site construction. This results in the following mass of soil removed:

Mass = Area x Depth x Soil Bulk Density

= 16,188 square meters x 2 meters x 1.5 g/cm^3 x 10^6 cm^3/m^3
= 4.856 x 10^{10} grams
= 4.856 x 10^7 kg

Other parameter values for the model are as follows:

k	=	0.35 for PM_{10} (EPA 1993)
U	=	4.4 m/sec, average wind speed for Syracuse, NY (EPA 1985)
X	=	10%, recommended default (EPA 1993)

With these values for M, k, U and X, the emission rate (E) from excavation activities is calculated 7,035 grams of PM_{10} over the course of a year. This emission rate would be representative if all soil excavated at the site were contaminated, and if local climatic factors did not suppress emissions. For example, precipitation, snow cover and frozen soil in the winter will minimize emissions. To account for these climatic/seasonal factors, it was assumed that emissions occur only half of the construction time. This results in a representative emission rate (E) of 3,517 grams/year. This is equivalent to an average emission rate of 14 g/day, 1.75 g/hr or 0.49 mg/sec, assuming emission occurs only during work days: 250 days/yr, 8 hr/day.

Much greater short-term emissions are estimated for site grading with a bulldozer or tractor. This type of activity is assumed to occur for 90 work days (8-hour day) over the course of a year. The model equation for grading emissions is:

$$E = \frac{0.094\,(s)^{1.5}}{X^{1.4}}$$

Where:

E	=	emission rate (g/sec)
0.094	=	empirical constant (g/sec)
s	=	percent silt content (%)
X	=	percent moisture content (%)

Assuming the EPA-recommended default values of 8% for s, and 10% for X, the emission rate (E) from grading is calculated as 0.085 g/sec. Averaged over the course of a year with 90 8-hour days of grading emissions, this is 38.1 g/hr or 10.6 mg/sec of PM_{10} emissions, assuming all emissions occur during working hours.

Total annual average emissions from excavation and grading are estimated as 0.49 mg/sec + 10.6 mg/sec = 11.09 mg/sec.

Localized exposure concentrations for construction workers are estimated with a simple box model. The model treats a defined surface area as a uniform emission source over the time period of interest. The box, or mixing volume, is defined by this surface area and an assumed mixing height. The emitted PM_{10} is assumed to mix uniformly throughout the box, with dilution from surface winds.

The general model equation is:

$$C = \frac{E}{(U)(W)(H)}$$

Where:

E	=	emission rate, mg/sec
U	=	wind speed, m/sec
W	=	crosswind width of the area source, m
H	=	mixing height, m

E and U are the same as defined or calculated above. The mixing area is based upon the area of the site estimated to be excavated during one hour. The area of SEAD-63, 16,188 square meters, may be excavated during 2000 hours of construction activity. The average hourly area worked then is: 16,188 ÷ 2000 = 8 square meters. This area is assumed to be square, and W is the square root of 8 m^2, or 2.8 meters. H is assumed to be the height of the breathing zone, or 1.75 meters.

With these values, the PM_{10} exposure concentration for a construction worker is calculated as 0.51 mg/m^3. All of this PM_{10} was assumed to be airborne soil released from the site as represented by total soils (surface and subsurface).

The concentration of particulate-associated chemicals in ambient air, then, is:

$$\mathbf{CA = CS \times PM_{10} \times CF}$$

Where:

CA	=	chemical concentration in air (mg/m^3)
CS	=	chemical concentration in soil (mg/kg soil)
PM_{10}	=	PM_{10} concentration (ug/m^3)
CF	=	conversion factor (10^{-9} kg/ug)

These calculated CA values are the inhalation EPCs for the dust inhalation scenarios. **Table A-1** (in **Attachment A**) show the inhalation EPCs for the future construction workers.

Park Worker, Recreational Visitor, and Residential Receptors

Ambient air normally contains particulate matter derived from various natural and anthropogenic sources, including soil erosion, fuel burning, automobiles, etc. The concentrations of airborne particulate matter were measured at SEDA over a four month period (April-July) in 1995. A summary of the data collected in this air sampling program is shown in **Table F-7**. Both Total Suspended Particulate Matter (TSP) and particulate matter less than 10µm aerodynamic diameter (PM_{10}) were measured. TSP includes all particles that can remain suspended in air, while PM_{10}

includes only smaller particles that can be inhaled (particles larger than 10μm diameter typically cannot enter the narrow airways in the lung).

For this assessment, the highest 4-month average PM_{10} concentration measured at any of the four monitoring stations was assumed to represent ambient air at the site. The entire particulate loading was assumed to be airborne soil released from SEAD-63 as represented by the surface soil EPCs for the site.

The concentration of particulate-associated chemicals in ambient air, (CA), was calculated with the same equation [$CA = CS \times PM_{10} \times CF$] used for the construction worker, above.

The ambient air exposure point concentrations used in the intake calculations are shown in **Attachment A.**

The equation for intake is as follows (EPA, 1989a):

$$\textbf{Intake (mg/kg/day)} = \frac{\textbf{CA x IR x EF x ED}}{\textbf{BW x AT}}$$

Where:

CA	=	Chemical concentration in air (mg/m^3)
IR	=	Inhalation Rate (m^3/day)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Bodyweight (kg)
AT	=	Averaging Time (days)

The results of these calculations are shown in **Attachment A**.

F.3.5.4 Incidental Ingestion of Soil

The soil data collected from SEAD-63 were compiled and the EPCs were selected for each compound. For the park worker, recreational visitor, and residential receptor exposures, soil data collected from the 0 to 2 foot interval were used in this analysis, since no surface soil samples were collected. For the construction worker exposure, all soil data were used as it is assumed that the construction worker will engage in intrusive activities.

The equation for intake is as follows (EPA 1989a):

$$\text{Intake (mg/kg-day)} = \frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical Concentration in Soil (mg/kg soil)
IR	=	Ingestion Rate (mg soil/day)
CF	=	Conversion Factor (1 Kg/10^6 mg)
FI	=	Fraction Ingested from Contaminated Source (unitless)
EF	=	Exposure Frequency (days/years)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged -- days)

The results of these calculations are shown in **Attachment A.**

F.3.5.5 Dermal Contact with Soils/Sediments

The same receptors considered to have the potential to ingest soil may also contact the same soils dermally. These receptors include the park worker, construction worker, recreational visitor, and residential receptors. Risks due to exposure to sediments via dermal contact for park workers, recreational visitors, and residential receptors were also evaluated.

As with the soil ingestion scenarios, the chemical concentration of the soils taken from the 0 to 2 foot depth were used as the exposure point concentrations for the park worker and recreational visitor. The chemical concentration of all soils was used as the exposure point concentration for the construction worker scenario. The measured maximum sediment concentrations were used as exposure point concentrations for the park worker and recreational visitor.

The equation for the absorbed dose from dermal exposure is as follows, based on guidance in EPA 1992:

$$\text{Absorbed Dose (mg/kg-day)} = \frac{CS \times CF \times AF \times ABS \times SA \times EF \times ED}{BW \times AT}$$

Where:

CS	=	Chemical Concentration in Soil/Sediment (mg/kg soil)
CF	=	Conversion Factor (10^{-6} kg/mg)
AF	=	Soil to Skin Adherence Factor (mg/cm^2)

ABS	=	Absorption Factor (unitless)
SA	=	Skin Surface Area Available for Contact (cm^2)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
BW	=	Body Weight (kg)
AT	=	Averaging Time (period over which exposure is averaged -- days)

The product of the terms CS, AF, and ABS represents the absorbed dose per event as defined in the EPA 1992 guidance.

The exposure calculations are summarized in **Attachment A.**

Dermal exposure involves several unique exposure factors discussed briefly here. Specifically, the dermal exposure calculation considers the amount of exposed skin, the amount of soil/sediment that adheres to the skin and the degree to which a chemical may be adsorbed through the skin.

The surface area of exposed skin depends on the size of an individual (especially adult vs. child), clothing worn, and the specific parts of the body that may directly contact the medium of concern (e.g., soil or groundwater during showering). USEPA recommendations were followed to select exposed skin surface areas for each scenario in this assessment.

The assumptions for dermal exposure are listed in Table F-6. Selected assumptions regarding skin surface areas for dermal exposure for construction worker, park worker, and recreational visitor receptors are presented as follows:

Construction Worker (Soil): The construction worker was assumed to wear a short-sleeved shirt, long pants, and shoes; therefore, the exposed skin surface is limited to the head, hands, and forearms. The USEPA's recommended surface area exposed to contaminated soil for the adult commercial/industrial receptor, 3300 cm^2 (USEPA, 1999), was used to represent the RME scenario for the construction worker.

Park Worker (Soil/Sediment): The park worker was conservatively assumed to address the same as an adult resident, wearing a short-sleeved shirt, shorts and shoes. Therefore, the exposed skin surface is limited to the head, hands, forearms, and lower legs. The USEPA (1999) recommended value of 5700 cm^2 for the adult residential receptor was used to represent the RME scenario for the parker worker.

Recreational Visitor - Child (Soil/Sediment): The recreational child was assumed to wear a short-sleeved shirt and shorts (no shoes) and therefore, the exposed skin is limited to the head, hands, forearms, lower legs, and feet. The recommended surface area exposed to contaminated soil for the child is 2800 cm^2 for a RME scenario (USEPA, 1999).

The potential magnitude of exposure depends on the amount of soil that adheres to the exposed skin. Certain chemicals may be readily absorbed through the skin while others penetrate much more slowly or not at all. In the case of soil, some chemicals may be strongly bound to the matrix, which reduces their ability to absorb through the skin. Chemical-specific absorption factors as provided by USEPA (1999) were used in this assessment. USEPA (1999) recommends dermal absorption fraction from soil for cadmium, arsenic, chlordane, DDT, Lindane, PAHs, PCBs, dioxins/furans, 2,4-Dichlorophenoxyacetic acid, and pentachorophenol. The USEPA 1999 guidance also provides default dermal absorption factors for semivolatile organic compounds of 10% as a screening method for the majority of SVOCs without dermal absorption factors. There are no default dermal absorption values presented for volatile organic compounds nor inorganic classes of compounds. The uncertainty related to the dermal exposure route will be addressed in the uncertainty assessment section (F.5.4).

F.3.5.6 Groundwater Ingestion

All future receptors may drink groundwater. The groundwater data collected from the site were compiled and the EPCs were selected for each compound.

The equation for intake is as follows (EPA, 1989a):

$$\textbf{Intake (mg/kg-day)} = \frac{\textbf{CW x IR x EF x ED}}{\textbf{BW x AT}}$$

Where:

CW	=	Chemical Concentration in Water (mg/liter)
IR	=	Ingestion Rate (liters/day)
EF	=	Exposure Frequency (days/year)
ED	=	Exposure Duration (years)
BW	=	Bodyweight (kg)
AT	=	Averaging time (days)

The results of these calculations are shown in **Attachment A.**

F.3.5.7 Dermal Contact to Groundwater or Surface Water while Showering/Bathing/Wading

Recreational visitors may be exposed to groundwater while showering/bathing. Risks to residential receptors via dermal contact with groundwater or surface water while showering/bathing/wading were evaluated for comparative purposes only. The EPCs developed for ingestion of groundwater were used for this exposure route. Recreational visitors may also be exposed to surface water in the ditches during a wading event. The measured maximum surface water concentrations were used as EPCs for this scenario. The equation for the absorbed dose, taken from RAGS (EPA, 1989a) is as follows:

$$\textbf{Absorbed Dose (mg/kg-day)} = \frac{\textbf{DA x SA x EF x ED}}{\textbf{BW x AT}}$$

Where:

DA	=	Absorbed dose per event per area of skin exposed (mg/cm^2 - event)
SA	=	Skin surface area available for Contact (cm^2)
EF	=	Exposure frequency (days/year)
ED	=	Exposure duration (years)
BW	=	Body weight (kg)
AT	=	Averaging time (period over which exposure is averaged, days)

DA (mg/cm^2 - event) was calculated as described in USEPAs Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplemental Guidance: Dermal Risk Assessment Interim Guidance (USEPA, 1999). The following equations were used to evaluate the dermal absorbed dose per event per area of skin exposed:

For organic compounds:

If ET ≤ t*, then: $$\mathbf{DA = 2\ K_p\ x\ CW\ x\ CF}\sqrt{\frac{6 \times \tau \times ET}{\pi}}$$

If ET > t*, then: $$\mathbf{DA_{event} = K_p\ x\ CW\ x\ CF}\left[\frac{ET}{1+B} + 2\tau\left(\frac{1+3B+3B^2}{(1+B)^2}\right)\right]$$

where for both equations:

K_p	=	Dermal permeability coefficient (cm/hr)
CW	=	Chemical Concentration in Water (mg/l)
ET	=	Exposure Time (hours/event)
B	=	Dimensionless ratio of the permeability of the stratum corneum relative to the permeability across the viable epidermis (and any other limitations to chemical transfer through the skin, including clearance into the cutaneous blood).
τ	=	Lag time per event (hours/event)
t*	=	Time to reach steady-state (hr) = 2.4τ
CF	=	Volume Conversion Factor = 0.001L/cm^3

The exposure time for showering or wading was assumed to be 1 hour/day for the RME, as recommended in the Dermal Risk Assessment Interim Guidance (USEPA, 1999) for the showering scenario. The entire body surface may be exposed during showering. EPA 1999 recommends a surface area value of 6600 cm^2 for the RME as representative of the entire body of a child. For the wading scenario, skin contact surface was conservatively assumed to be as half of the total body surface, 3300 cm^2.

Lag times per event (τ), B, and Kp were taken from a list in Table B.2 of the Dermal Risk Assessment Interim Guidance. All chemicals not having lag times were derived using the following equation:

$$\tau = \frac{l_{sc}^2}{6D_{sc}}$$

where:

l_{sc}	=	Apparent thickness of skin, assumes 0.001 cm
D_{sc}	=	Effective diffusivity for chemical transfer through the skin (cm^2/hr), $D_{sc} = l_{sc} \times 10^{(-2.80-0.0056MW)}$
MW	=	Molecular weight of the compound.

When no organic K_p value was available, a value was calculated using the following equation:

$$\text{Log } K_p = -2.80 + 0.67 \log K_{ow} - 0.0056 \text{ MW}$$

Where:

Kow = Octanol/water partition coefficient

For inorganics, DA was calculated by:

$$DA = K_p \times CW \times ET \times CF$$

Kp values for inorganic chemicals were taken from Table 3.1 of the Dermal Risk Assessment Interim Guidance (USEPA, 1999). As recommended by USEPA (1999), a default value of 1 x 10^{-3} cm/hr was used for all inorganics with no specific Kp values.

Exposure to chemicals in groundwater during showering occurs via two routes: inhalation of volatile chemicals, which partition into the air from the hot shower water, and dermal contact. The analysis of these two exposure routes assumes that release of volatile chemicals to the air occurs quickly, and that only the quantities which remain in the water stream are available for dermal contact. The calculations of exposure from inhalation assume that the water from the shower nozzle has the same concentration as groundwater, and the groundwater EPC is used. However, for dermal contact, the EPCs are most correctly first adjusted to subtract the amount of each chemical that partitions into the air. This adjustment prevents "double counting" the potential effect of the portion of certain chemicals that escape the water into the air of the shower.

For SEAD-63, the groundwater EPC was not adjusted to account for volatile losses during showering before considering dermal exposure. Although inhalation and dermal exposures from showering were assessed for SEAD-63, volatile losses during showering were determined to be one percent or less for any compound, and there were no toxicity factors for any compounds which might be inhaled during showering. For simplicity, the groundwater EPC was used directly to assess dermal exposures from shower water for this site.

The dermal exposure calculations, where applicable, are summarized in **Attachment A.**

F.3.5.8 Inhalation of Groundwater or Surface Water while Showering/Bathing

While showering, a receptor may inhale organic compounds released from the hot water supply. Most inorganic compounds potentially found in groundwater, such as metals, are nonvolatile. Therefore, this pathway is not complete for inorganics in water.

No volatile organic compounds were detected in the groundwater at SEAD-63. Therefore, this pathway was not evaluated further in this risk assessment.

F.4 Toxicity Assessment

The objective of the toxicity assessment is to weigh available evidence regarding the potential of the chemicals to cause adverse effects in exposed individuals, and to provide, where possible, an estimate of the relationship between the extent of exposure to a chemical and the increased likelihood and/or severity of adverse effects. The types of toxicity information considered in this assessment include the reference dose (RfD) and reference concentration (RfC) used to evaluate noncarcinogenic effects, and the slope factor and unit risk to evaluate carcinogenic potential. Most toxicity information used in this evaluation was obtained from the Integrated Risk Information System (IRIS). If values were not available from IRIS, the *Health Effects Assessment Summary Tables* (HEAST) (EPA, 1997) were consulted. Finally, the toxicity values withdrawn from IRIS and other values quoted by EPA Region III RBC table USEPA were consulted to provide any additional values not included in these two sources. The toxicity factors used in this evaluation are summarized in **Table F-8** for both noncarcinogenic and carcinogenic effects.

F.4.1 Noncarcinogenic Effects

For chemicals that exhibit noncarcinogenic (i.e., systemic) effects, authorities consider organisms to have repair and detoxification capabilities that must be exceeded by some critical concentration (threshold) before the health effect is manifested. For example, an organ can have a large number of cells performing the same or similar functions that must be significantly depleted before the effect on the organ is seen. This threshold view holds that a range of exposures from just above zero to some finite value can be tolerated by the organism without an appreciable risk of adverse effects. Health criteria for chemicals exhibiting noncarcinogenic effects for use in risk assessment are generally developed using USEPA RfDs and RfCs developed by the RfD/RfC Work Group and included in the IRIS. In general, the RfD/RfC is an estimate of an average daily exposure to an individual (including sensitive individuals) below

TABLE F-8
TOXICITY VALUES
SEAD-63 EE/CA
Seneca Army Depot Activity

Analyte	Oral RfD (mg/kg-day)		Inhalation RfD (mg/kg-day)		Carc. Slope Oral (mg/kg-day)-1		Rank Wt. of Evidence	Carc. Slope Inhalation (mg/kg-day)-1		Dermal RfD (mg/kg-day)		Carc. Slope Dermal (mg/kg-day)-1		Oral Absorption Factor	
Volatile Organics															
Acetone	1.00E-001	a	NA	a	NA	a	D	NA	a	1.00E-001	f	NA		1.00	j
Benzene	3.00E-003	i	1.71E-003	i	2.90E-002	a	A	2.73E-002	a	3.00E-003	f	2.90E-002	g	1.00	j
Chloroform	1.00E-002	a	NA	a	6.10E-003	a	B2	8.05E-002	a	1.00E-002	f	6.10E-003	g	1.00	j
Methyl ethyl ketone	6.00E-001	a	2.86E-001	a	NA	a	D	NA	a	6.00E-001	f	NA		1.00	j
Toluene	2.00E-001	a	1.14E-001	a	NA	a	D	NA	a	2.00E-001	f	NA		1.00	j
Total Xylenes	2.00E+000	a	NA	e	NA	a	D	NA	a	2.00E+000	f	NA		1.00	j
Semivolatiles*															
4-Methylphenol	5.00E-003	b	NA	a	NA	a	C	NA	a	NA		NA		1.00	j
Benzo(a)anthracene	NA	a	NA	a	7.30E-001	c	B2	NA	a	NA		7.30E-001	g	1.00	j
Benzo(a)pyrene	NA	a	NA	a	7.30E+000	a	B2	NA	a	NA		7.30E+000	g	1.00	j
Benzo(b)fluoranthene	NA	a	NA	a	7.30E-001	c	B2	NA	a	NA		7.30E-001	g	1.00	j
Benzo(ghi)perylene	NA	a	NA	a	NA	a	D	NA	a	NA		NA		1.00	j
Benzo(k)fluoranthene	NA	a	NA	a	7.30E-002	c	B2	NA	a	NA		7.30E-002	g	1.00	j
Butylbenzylphthalate	2.00E-001	b	NA	a	NA	a	C	NA	a	2.00E-001	f	NA		1.00	j
Carbazole	NA	a	NA	a	2.00E-002	b	B2	NA	a	NA		2.00E-002	g	1.00	j
Chrysene	NA	a	NA	a	7.30E-003	c	B2	NA	a	NA		7.30E-003	g	1.00	j
Dibenz(a,h)anthracene	NA	a	NA	a	7.30E+000	c	B2	NA	a	NA		7.30E+000	g	1.00	j
Dibenzofuran	NA	a	NA	a	NA	a	D	NA	a	NA		NA		1.00	j
Diethyl phthalate	8.00E-001	b	NA	a	NA	a	D	NA	a	8.00E-001	f	NA		1.00	j
Di-n-butylphthalate	1.00E-001	a	NA	a	NA	a	D	NA	a	1.00E-001	f	NA		1.00	j
Di-n-octylphthalate	2.00E-002	b	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Fluoranthene	4.00E-002	a	NA	a	NA	a	D	NA	a	4.00E-002	f	NA		1.00	j
Fluorene	4.00E-002	a	NA	a	NA	a	D	NA	a	4.00E-002	f	NA		1.00	j
Indeno(1.2.3-cd)pyrene	NA	a	NA	a	7.30E-001	c	B2	NA	a	NA		7.30E-001	g	1.00	j
Naphthalene	2.00E-002	a	8.60E-004	a	NA	a	C	NA	a	2.00E-002	f	NA		1.00	j
Pentachlorophenol	3.00E-002	a	NA	a	1.20E-001	a	B2	NA	a	3.00E-002	f	1.20E-001	g	1.00	j
Phenanthrene	NA	a	NA	a	NA	a	D	NA	a	NA		NA		1.00	j
Phenol	6.00E-001	a	NA	a	NA	a	D	NA	a	6.00E-001	f	NA		1.00	j
Pyrene	3.00E-002	a	NA	a	NA	a	D	NA	a	3.00E-002	f	NA		1.00	j
bis(2-Ethylhexyl)phthalate	2.00E-002	a	NA	a	1.40E-002	a	B2	NA	a	2.00E-002	f	1.40E-002	g	1.00	j
Pesticides/PCBs															
4,4'-DDD	NA	a	NA	a	2.40E-001	a	B2	NA	a	NA		2.40E-001	g	1.00	j
4,4'-DDE	NA	a	NA	a	3.40E-001	a	B2	NA	a	NA		3.40E-001	g	1.00	j
4,4'-DDT	5.00E-004	a	NA	a	3.40E-001	a	B2	3.40E-001	a	5.00E-004	f	3.40E-001	g	1.00	j
Aroclor-1260	2.00E-005	l	NA	a	2.00E+000	a	B2	4.00E-001	a	2.00E-005	f	2.00E+000	g	1.00	j
Endosulfan I	6.00E-003	n	NA	a	NA	a	NA	NA	a	6.00E-003	f	NA		1.00	j
Endosulfan sulfate	6.00E-003	n	NA	a	NA	a	NA	NA	a	6.00E-003	f	NA		1.00	j
Endrin	3.00E-004	a	NA	a	NA	a	D	NA	a	3.00E-004	f	NA		1.00	j
Endrin aldehyde	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Endrin ketone	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Heptachlor epoxide	1.30E-005	a	NA	a	9.10E+000	a	B2	9.10E+000	a	1.30E-005	f	9.10E+000	g	1.00	j
alpha-Chlordane	5.00E-004	o	2.00E-004	o	3.50E-001	o	B2	3.50E-001	o	5.00E-004	f	3.50E-001	g	1.00	j
gamma-Chlordane	5.00E-004	o	2.00E-004	o	3.50E-001	o	B2	3.50E-001	o	5.00E-004	f	3.50E-001	g	1.00	j
Metals															
Aluminum	1.00E+000	i	1.00E-003	i	NA	a	D	NA	a	1.00E+000	f	NA		1.00	j
Arsenic	3.00E-004	a	NA	e	1.50E+000	d	A	1.51E+001	a	3.00E-004	f	1.50E+000	g	1.00	j
Barium	7.00E-002	a	1.43E-004	b	NA	a	D	NA	a	4.90E-003	f	NA		0.07	j
Beryllium	2.00E-003	a	6.00E-006	a	NA	a	B2	8.40E+000	a	1.40E-005	f	NA		0.007	j
Cadmium	5.00E-004	p	NA	a	NA	a	B1	6.30E+000	a	1.25E-005	f	NA		0.025	k,j
Calcium	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Chromium	3.00E-003	q	2.86E-005	q	NA	a	A	4.20E+001	q	7.50E-005	f	NA		0.025	q,j
Cobalt	2.00E-002	m	5.00E-006	a	NA	a	NA	NA	a	2.00E-002		NA		1.00	j
Copper	4.00E-002	b	NA	a	NA	a	D	NA	a	4.00E-002	f	NA		1.00	j
Iron	3.00E-001	e	NA	a	NA	a	NR	NA	a	3.00E-001	f	NA		1.00	j
Lead	NA	a	NA	a	NA	a	B2	NA	a	NA		NA		1.00	j
Magnesium	NA	a	NA	a	NA	a	D	NA	a	NA		NA		1.00	j
Manganese	5.00E-002	r	1.40E-005	a	NA	a	D	NA	a	2.00E-003	f	NA		0.04	j
Mercury	3.00E-004	s	8.57E-005	a	NA	a	D	NA	a	2.10E-005	f	NA		0.07	s,j
Nickel	2.00E-002	a	NA	a	NA	a	NR	NA	a	8.00E-004	f	NA		0.04	j
Potassium	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Selenium	5.00E-003	a	NA	a	NA	a	D	NA	a	5.00E-003	f	NA		1.00	j
Silver	5.00E-003	a	NA	a	NA	a	D	NA	a	2.00E-004	f	NA		0.04	j
Sodium	NA	a	NA	a	NA	a	NA	NA	a	NA		NA		1.00	j
Thallium	8.00E-005	t	NA	a	NA	a	D	NA	a	8.00E-005	f	NA		1.00	j
Vanadium	7.00E-003	b	NA	a	NA	a	D	NA	a	1.82E-004	f	NA		0.026	j
Zinc	3.00E-001	a	NA	a	NA	a	D	NA	a	3.00E-001	f	NA		1.00	j

a = Taken from the Integrated Risk Information System (IRIS) (Online October 2001)
b = Taken from HEAST 1997
c = Calculated using TEF
d = Calculated from proposed oral unit risk value

TABLE F-8
TOXICITY VALUES
SEAD-63 EE/CA
Seneca Army Depot Activity

Analyte	Oral RfD (mg/kg-day)	Inhalation RfD (mg/kg-day)	Carc. Slope Oral (mg/kg-day)-1	Rank Wt. of Evidence	Carc. Slope Inhalation (mg/kg-day)-1	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Oral Absorption Factor

e = Provisional health guideline from EPA Risk Assessment Issue Papers (1999) provided by EPA Technical Support Center.
(Inhalation RfD's were derived from EPA RfC's based on the assumption of 20 m3/day inhalation rate and 70 kg body weight.)
f = Calculated from oral RFD value. (Dermal Rfd = Oral Rfd * Oral Absorption Factor)
g = Calculated from oral slope factor (Dermal Slope Factor = Oral Slope Factor/Oral Absorption Factor)
i = Provisional health guideline from EPA Risk Assessment Issue Papers (1996-1997) provided by EPA Technical Support Center.
(Inhalation RfD's were derived from EPA RfC's based on the assumption of 20 m3/day inhalation rate and 70 kg body weight.)
j = Based upon EPA Human Health Evaluation Manual Supplemental Guidance: Dermal Risk Assessment Interim Guidance, 1999.
k = More than 1 oral absorption factor values are available and the most conservative, i.e., the lowest value is presented.
l = Value for Aroclor-1254.
m = EPA-NCEA provisional value, quoted by EPA Region III RBC Table
n = Value for Endosulfan.
o = Value for Chlordane.
p = Two RfDs are available for cadmium and the most conservative is presented.
q = Values for Chromium VI.
r = For managenese, for dietary intake, a RfD of 0.14 mg/kg/day is presented in IRIS. For non-dietary intake (groundwater/soil), IRIS recommends applying a modifying factor of 3, resulting in an RfD of 0.05 mg/kg/day.
s = Value for mercuric chloride.
t = Value for thallium chloride.
NA = Not Available

which there will not be an appreciable risk of adverse health effects. The RfD/RfC is derived using uncertainty factors (e.g., to adjust from animals to humans and to protect sensitive subpopulations) to ensure that it is unlikely to underestimate the potential for adverse noncarcinogenic effects to occur. The purpose of the RfD/RfC is to provide a benchmark against which an intake (or an absorbed dose in the case of dermal contact) from human exposure to various environmental conditions might be compared. Intake of doses that are significantly higher that the RfD/RfC may indicate that an inadequate margin of safety could exist for exposure to that substance and that an adverse health effect could occur.

F.4.1.1 References Doses for Oral and Inhalation Exposure

The types of toxicity values used to evaluate the noncarcinogenic effects of chemicals include RfDs for oral exposure, and RfCs for inhalation exposure. RfDs and RfCs represent thresholds for toxicity. They are derived such that human lifetime exposure to a given chemical via a given route at levels at or below the RfD or RfC, as appropriate, should not result in adverse health effects, even for the most sensitive members of the population. The chronic RfD or RfC for a chemical is ideally based on studies where either animal or human populations were exposed to a given chemical by a given route of exposure for the major portion of the life span (referred to as a chronic study). Various effect levels may be determined in a study; however, the preferred effect level for calculating noncarcinogenic toxicity values is the no-observed-adverse-effect level, or NOAEL. Second to the NOAEL is the lowest-observed-adverse-effect level, or LOAEL.

The oral RfD is derived by determining dose-specific effect levels from all the available quantitative studies, and applying uncertainty factors and/or a modifying factor to the most appropriate effect level. Uncertainty factors are intended to account for 1) the variation in sensitivity among members of the human population, 2) the uncertainty in extrapolating animal data to humans, 3) the uncertainty in extrapolating from data obtained in a study that is less than lifetime exposure, 4) the uncertainty in using LOAEL data rather than NOAEL data, and 5) the uncertainty resulting from inadequacies in the data base. The modifying factor may be used to account for other uncertainties such as inadequacy of the number of animals in the critical study. Usually each of these uncertainty factors is set equal to 10, while the modifying factor varies between one and 10. RfDs are reported as doses in milligrams of chemical per kilogram body weight per day (mg/kg-day).

The inhalation RfC is derived by determining concentration-specific effect levels from all of the available literature and transforming the most appropriate concentration to a human RfC. Transformation usually entails converting the concentration and exposure duration used in the study to an equivalent continuous 24-hour exposure, transforming the exposure-adjusted value to account for differences in animal and human inhalation, and then applying uncertainty factors and/or a modifying factor to the adjusted human exposure concentration to arrive at an RfC. The uncertainty factors potentially used are the same ones used to arrive at an RfD (see above). RfCs are reported as concentrations in milligrams of chemical per cubic meter of air (mg/m^3). To use the RfCs in calculating risks, they were converted to inhalation reference doses in units of milligrams of chemical per kilogram of body weight per day (mg/kg/day). This conversion was made by assuming an inhalation rate of 20 m^3/day and an adult body weight of 70 kg. Thus:

$$\textbf{Inhalation Reference Dose (mg/kg/day)} = RfC\left(\frac{mg}{m^3}\right)x\left(\frac{20m^3}{day}\right)x\left(\frac{1}{70kg}\right)$$

F.4.1.2 Reference Doses for Dermal Exposure

At this time, chemical specific dermal toxicity factors are not available. This risk assessment evaluated risks from dermal contact with contaminants according to the most recent EPA guidance on dermal risk assessment (USEPA, 1999). The guidance provides an approach which accounts for the fact that most oral RfDs are expressed as the amount of substance administered per unit time and body weight, whereas exposure estimates for the dermal pathway are expressed as absorbed dose. Primarily, a dermal RfD was estimated from the oral RfD by adjusting for the gastrointestinal absorption efficiency. For compounds recommended by Table 4.1 of the guidance for adjustment of toxicity factors, the GI absorption efficiency values in the table were used to calculate the dermal RfD. For all other compounds, oral RfDs were used to evaluate dermal exposure risks, i.e., a GI absorption efficiency value of 1 was used. Oral absorption factors and the calculated dermal RfDs are shown in **Table F-8**.

F.4.1.3 Exposure Periods

As mentioned earlier, chronic RfDs and RfCs are intended to be set at levels such that human lifetime exposure at or below these levels should not result in adverse health effects, even for the most sensitive members of the population. These values are ideally based on chronic exposure studies in humans or animals. Chronic exposure for humans is considered to be exposure of roughly seven years or more, based on exposure of rodents for one year or more in animal toxicity studies. For day care children and construction workers, chronic RfDs and RfCs were used to conservatively assess risks for shorter exposure periods.

F.4.2 <u>Carcinogenic Effects</u>

For chemicals that exhibit carcinogenic effects, most authorities recognize that one or more molecular events can evoke changes in a single cell or a small number of cells that can lead to tumor formation. This is the non-threshold theory of carcinogenesis, which purports that any level of exposure to a carcinogen can result in some finite possibility of generating the disease. Generally, regulatory agencies assume the non-threshold hypothesis for carcinogens in the absence of information concerning the mechanisms of action for the chemical of concern.

USEPA's Carcinogen Risk Assessment Verification Endeavor (CRAVE) has developed slope factors and unit risks (i.e., dose-response values) for estimating excess lifetime cancer risks associated with various levels of lifetime exposure to potential human carcinogens. The carcinogenic slope factors can be used to estimate the lifetime excess cancer risk associated with exposure to a potential carcinogen. Risks estimated using slope factors are considered unlikely to underestimate actual risks, but they may overestimate actual risks. Excess lifetime cancer risks are generally expressed in scientific notation. An excess lifetime cancer risk of 1×10^{-6} (one in a million), for example, represents the probability of an individual developing cancer over a lifetime as a result of exposure to the specific carcinogenic chemical. USEPA considers total excess lifetime cancer risks within the range of 10^{-4} (one in ten thousand) to 10^{-6} (EPA, 1989a) to be acceptable when developing remedial alternatives for cleanup of Superfund Sites.

In practice, slope factors are derived from the results of human epidemiology studies or chronic animal bioassays. The data from animal studies are fitted to the linearized, multistage model and a dose-response curve is obtained. The upper limit of the 95th percentile confidence-interval slope of the dose-response curve is subjected to various adjustments, and an interspecies scaling factor is applied to conservatively derive the slope factor for humans. This linearized multistage procedure leads to a plausible upper limit of the risk that is consistent with some proposed mechanisms of carcinogenesis. Thus, the actual risks associated with exposure to a potential carcinogen are not likely to exceed the risks estimated using these slope factors, but they may be much lower. Dose-response data derived from human epidemiological studies are fitted to dose-time-response curves on an ad-hoc basis. These models provide rough but plausible estimates of the upper limits on lifetime risk. Slope factors based on human epidemiological data are also derived using very conservative assumptions and, as such, are considered unlikely to underestimate risks. In summary, while the actual risks associated with exposures to potential carcinogens are unlikely to be higher than the risks calculated using a slope factor, they could be considerably lower.

In addition, there are varying degrees of confidence in the weight of evidence for carcinogenicity of a given chemical. The USEPA system involves characterizing the overall weight of evidence for a chemical's carcinogenicity based on availability of animal, human, and other supportive data. The weight-of-evidence classification is an attempt to determine the likelihood that the agent is a human carcinogen, and thus qualitatively affects the estimation of potential health risks. Three major factors are considered in characterizing the overall weight of evidence for carcinogenicity: (1) the quality of evidence from human studies, (2) the quality of evidence from animal studies, which are combined into a characterization of the overall weight of evidence for human carcinogenicity; and (3) other supportive information which is assessed to determine whether the overall weight of evidence should be modified. USEPA's final classification of the overall weight of evidence includes the following five categories:

Group A - Human Carcinogen – There is sufficient evidence from epidemiological studies to support a causal association between an agent and cancer.

Group B - Probable Human Carcinogen – There is at least limited evidence from epidemiological studies of carcinogenicity to humans (Group B1) or that, in the absence of adequate data on humans, there is sufficient evidence of carcinogenicity in animals (Group B2).

Group C - Possible Human Carcinogen – There is limited evidence of carcinogenicity in animals in the absence of data on humans.

Group D - Not Classified – The evidence for carcinogenicity in animals is inadequate.

Group E - No Evidence of Carcinogenicity to Humans – There is no evidence for carcinogenicity in at least two adequate animal tests in different species, or in both epidemiological and animal studies.

Slope factors and unit risks are developed by the USEPA based on epidemiological or animal bioassay data for a specific route of exposure, either oral or inhalation. For some chemicals, sufficient data are available to develop route-specific slope factors for inhalation and ingestion. For chemicals with only one route-specific slope factor but for which carcinogenic effects may also occur via another route, the available slope factor may be used by the USEPA to evaluate risks associated with several potential routes of exposure (EPA, 1989b).

A number of the chemicals of potential concern have been classified as carcinogens or potential carcinogens by USEPA, and each of these has also been assigned a carcinogenicity weight-of-evidence category, as shown in **Table F-8**. These chemicals are:

Group A - Human Carcinogens

Arsenic
Benzene

Chromium VI
Nickel

Group B - Probable Human Carcinogens

Chloroform
Benzo(a)anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Carbazole
Chrysene
Dibenz(a,h)anthracene
Indeno(1,2,3-cd)pyrene
bis(2-Ethylhexyl)phthalate
DDD, 4,4'-
DDE, 4,4'-
DDT, 4,4'-
Dieldrin
Heptachlor epoxide
Chlordane
Antimony
Beryllium
Cadmium
Lead
Aroclor-1260
Pentachlorophenol

Group C - Possible Human Carcinogens

4-Methylphenol
naphthalene

All remaining chemicals of concern are either not found to have weight of evidence rankings or are Group D or E. Group D classification means that the data are insufficient to make a determination regarding carcinogenic potential while Group E compounds have been conclusively found to be non-carcinogenic. Chemicals of potential concern found at the AOCs with potential carcinogenic effects are shown in **Table F-8** along with their cancer slope factors.

F.4.2.1 Cancer Slope Factors for Oral and Inhalation Exposure

The types of toxicity values used to evaluate the carcinogenic effects of chemicals include slope factors (SFs) for oral exposure, and unit risk factors (URFs) for inhalation exposure. Oral slope factors are reported as risk per dose $(mg/kg\text{-}day)^{-1}$. Inhalation unit risk factors are reported in units of risk per concentration $(mg/m^3)^{-1}$. To make use of the unit risk factors in calculating risks they first had to be converted to inhalation slope factors in units of $(mg/kg\text{-}day)^{-1}$. This conversion was made by assuming an inhalation rate of 20 m^3/day and an adult bodyweight of 70 kg. Thus:

$$\textbf{Inhalation slope factor (mg/kg-day)}^{-1} = UnitRisk\left(\frac{ug}{m^3}\right)^{-1} \times \frac{day}{20m^3} \times 70kg \times \frac{1000ug}{mg}$$

F.4.2.2 Cancer Slope Factors for Dermal Exposure

As discussed above, USEPA has not derived toxicity values for the dermal route of exposure. In the absence of dermal reference toxicity values, USEPA has suggested (EPA, 1999) that it is appropriate to modify an oral slope factor so it can be used to estimate the risk incurred by dermal exposure. The oral slope factors were converted to dermal slope factors by dividing by the oral absorption efficiency recommended by EPA. The same values presented in Section 5.4.1.2 were used, however, if chemical specific modification factors were unavailable, oral values were used without adjustment.

F.4.2.3 Toxic Equivalency Factors

When slope factors and unit risks were not available for all potentially carcinogenic members of a chemical class, toxicity values were calculated using toxicity equivalency factors (TEFs). TEFs are values that compare the carcinogenic potential of a given chemical in a class to the carcinogenic potential of a chemical in the class that has a verified slope factor and/or unit risk. USEPA has provided TEFs for PAHs (EPA, 1993b). TEF values are as follows:

PAH	TEF
Benzo(a)pyrene	1.0
Benzo(a)anthracene	0.1
Benzo(b)fluoranthene	0.1
Benzo(k)fluoranthene	0.01
Dibenzo(a,h)anthracene	1.0
Chrysene	0.001

Indeno(1,2,3-cd)pyrene 0.1

To calculate a slope factor or unit risk for a given PAH the appropriate TEF value is multiplied by the slope factor or unit risk for benzo(a)pyrene.

F.5 Risk Characterization

F.5.1 Introduction

To characterize risk, toxicity and exposure assessments were summarized and integrated into quantitative and qualitative expressions of risk. To characterize potential noncarcinogenic effects, comparisons were made between projected intakes of substances and toxicity values. To characterize potential carcinogenic effects, probabilities that an individual will develop cancer over a lifetime of exposure are estimated from projected intakes and chemical-specific dose-response information. Major assumptions, scientific judgments, and, to the extent possible, estimates of the uncertainties embodied in the assessment are also presented.

F.5.1.1 Noncarcinogenic Effects

The potential for noncarcinogenic effects is evaluated by comparing an exposure level over a specified time period with an RfD derived for a similar exposure period. This ratio of exposure to toxicity is called a hazard quotient according to the following equation:

Noncancer Hazard Quotient = E/RfD

Where:

E = Exposure level or intake (mg/kg-day), and
RfD = Reference Dose (mg/kg-day)

The noncancer hazard quotient assumes that there is a level of exposure (i.e., an RfD) below which it is unlikely for even sensitive populations to experience adverse health effects. If the exposure level (E) exceeds the threshold (i.e., If E/RfD exceeds unity) there may be concern for potential noncancer effects.

To assess the overall potential for noncarcinogenic effects posed by more than one chemical, a hazard index (HI) approach has been developed by the USEPA. This approach assumes that simultaneous sub-threshold exposures to several chemicals could result in an adverse health effect. It also assumes that the magnitude of the adverse effect will be proportional to the sum of the ratios of the subthreshold exposures to respective acceptable exposures.

This is expressed as:

$$HI = E_1/RfD_1 + E_2/RfD_2 + ... + E_i/RfD_i$$

Where:

E_i = the exposure level or intake of the I toxicant, and
RfD_i = reference dose for the i^{th} toxicant.

While any single chemical with an exposure level greater than the toxicity value will cause the HI to exceed unity, for multiple chemical exposures, the HI can also exceed unity even if no single chemical exposure exceeds its RfD. The assumption of dose additivity reflected in the HI is best applied to compounds that induce the same effects by the same mechanisms. Applying the HI to cases where the known compounds do not induce the same effect may overestimate the potential for effects. To assess the overall potential for noncarcinogenic effects posed by several exposure pathways, the total HI for chronic exposure is the sum of the HI's for each pathway, for each receptor.

F.5.1.2 Carcinogenic Effects

For carcinogens, risks are estimated as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the potential carcinogen (i.e., excess individual lifetime cancer risk). The slope factor converts estimated daily intakes averaged over a lifetime of exposure directly to incremental risk of an individual developing cancer. It can generally be assumed that the dose-response relationship will be linear in the low-dose portion of the multistage model dose-response curve. Under this assumption, the slope factor is a constant, and risk will be directly related to intake. Thus, the following linear low-dose equation was used in this assessment:

$$Risk = CDI \times SF$$

Where:

Risk = A unitless probability of an individual developing cancer,
CDI = Chronic Daily Intake over 70 years (mg/kg-day), and
SF = Slope Factor $(mg/kg\text{-}day)^{-1}$

Because the slope factor is often an upper 95th-percentile confidence limit of the probability of a response and is based on animal data used in the multistage model, the carcinogenic risk will generally be an upper-bound estimate. This means that the "true risk" is not likely to exceed the risk estimate derived through this model and is likely to be less than predicted.

For simultaneous exposure to several carcinogens, the USEPA assumes that the risks are additive. That is to say:

$$\mathbf{Risk_T = Risk1 + Risk2 + ... + Risk_i}$$

Where:

$Risk_T$ = Total cancer risk, expressed as a unitless probability, and
$Risk_i$ = Risk estimate for the ith substance.

Addition of the carcinogenic risks is valid when the following assumptions are met:

- doses are low,
- no synergistic or antagonistic interactions occur, and
- similar endpoints are evaluated.

According to guidance in the National Contingency Plan, the target overall lifetime carcinogenic risks from exposures for determining clean-up levels should range from 10^{-4} to 10^{-6}.

F.5.2 Risk Summary

Human health risks were calculated for three future exposure scenarios at SEAD-63. The receptors and exposure scenarios were based on the expected future land use for SEAD-63, which is as a conservation and recreation area. The potential exposure pathways associated with each receptor are summarized in **Figure 2-12** in **Section 2** of **Appendix A.**

The potential exposure routes associated with each exposure scenario are as follows:

Park worker: Inhalation of ambient air, ingestion of soil, dermal contact with soil, ingestion of groundwater, dermal contact with ditch water, and dermal contact with ditch sediment.

Construction worker: Inhalation of ambient air, ingestion of soil, and dermal contact with soil.

Recreational visitor (child): Inhalation of ambient air, ingestion of soil, dermal contact with soil, ingestion of groundwater, dermal contact with groundwater while showering, dermal contact with ditch water, and dermal contact with ditch sediment.

In addition, inhalation of ambient air, ingestion of soil, dermal contact with soil, ingestion of groundwater, dermal contact with groundwater while showering, dermal contact with ditch water, and dermal contact with ditch sediment were evaluated for residential receptors for comparative purposes only. Future residential use of the site is highly unlikely.

Cancer and non-cancer risks at SEAD-63 were calculated for all applicable exposure routes and are presented in **Table F-9**. The table also serves as a guide to the tables in **Attachment A** that show risk calculations for each exposure route. The USEPA defined targets for lifetime cancer risk range from 10^{-4} to 10^{-6}; the non-cancer hazard index is less than one. The total cancer risk for the Park worker (5E-05), the Construction worker (9E-08), and the recreational visitor (child) (8E-05) is within the USEPA target risk range. The total non-cancer hazard index from all

TABLE F-9
CALCULATION OF TOTAL NONCARCINOGENIC AND CARCINOGENIC RISKS
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
Engineering Evaluation/Cost Analysis
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	EXPOSURE/RISK CALCULATIONS Table Number	HAZARD INDEX	CANCER RISK
PARK WORKER	Inhalation of Dust in Ambient Air	Table A-1	7E-07	1E-09
	Ingestion of Soil	Table A-4	1E-03	5E-08
	Dermal Contact to Soil	Table A-6	4E-04	8E-08
	Ingestion of Groundwater	Table A-9	1E-01	NQ
	Dermal Contact to Surface Water	Table A-13	4E-03	5E-05
	Dermal Contact to Sediment	Table A-14	1E-03	1E-06
	TOTAL RECEPTOR RISK (Nc & Car)		**2E-01**	**5E-05**
RECREATIONAL VISITOR (CHILD)	Inhalation of Dust Ambient Air	Table A-1	1E-06	5E-10
	Ingestion of Soil	Table A-4	4E-03	4E-08
	Dermal Contact to Soil	Table A-6	4E-04	2E-08
	Ingestion of Groundwater	Table A-8	3E-01	NQ
	Dermal Contact to Groundwater	Table A-11	5E-02	NQ
	Dermal Contact to Surface Water	Table A-13	4E-02	8E-05
	Dermal Contact to Sediment	Table A-15	1E-02	3E-06
	TOTAL RECEPTOR RISK (Nc & Car)		**4E-01**	**8E-05**
CONSTRUCTION WORKER	Inhalation of Dust in Ambient Air	Table A-1	9E-05	3E-08
	Ingestion of Soil	Table A-4	2E-01	4E-08
	Dermal Contact to Soil	Table A-6	2E-02	1E-08
	TOTAL RECEPTOR RISK (Nc & Car)		**3E-01**	**9E-08**
ADULT RESIDENT (Hazard Index)	Inhalation of Dust Ambient Air	Table A-2	3E-06	See risk below
	Ingestion of Soil	Table A-5	2E-03	
	Dermal Contact to Soil	Table A-7	3E-04	
	Ingestion of Groundwater	Table A-9	6E-01	
	Dermal Contact to Groundwater	Table A-12	1E-01	
	Dermal Contact to Surface Water	Table A-14	5E-03	
	Dermal Contact to Sediment	Table A-16	1E-03	
	TOTAL RECEPTOR RISK (Nc & Car)		**7E-01**	
CHILD RESIDENT (Hazard Index)	Inhalation of Dust Ambient Air	Table A-2	7E-06	See risk below
	Ingestion of Soil	Table A-5	2E-02	
	Dermal Contact to Soil	Table A-7	2E-03	
	Ingestion of Groundwater	Table A-9	1E+00	
	Dermal Contact to Groundwater	Table A-12	2E-01	
	Dermal Contact to Surface Water	Table A-14	4E-02	
	Dermal Contact to Sediment	Table A-16	1E-02	
	TOTAL RECEPTOR RISK (Nc & Car)		**2E+00**	
RESIDENT (Total Lifetime Cancer Risk)	Inhalation of Dust Ambient Air	Table A-2	See risk above	8E-09
	Ingestion of Soil	Table A-5		3E-07
	Dermal Contact to Soil	Table A-7		1E-08
	Ingestion of Groundwater	Table A-9		NQ
	Dermal Contact to Groundwater	Table A-12		NQ
	Dermal Contact to Surface Water	Table A-14		1E-04
	Dermal Contact to Sediment	Table A-16		4E-06
	TOTAL RECEPTOR RISK (Nc & Car)			**1E-04**

NQ = Not Quantified due to lack of toxicity data
Non-cancer risk is reported for adults and child residents separately Cancer risk is considered over a lifetime, therefore the adult and child values are summed

p \pit\projects\seneca\s63eeca\eeca\tables\fintbl2\TOTRISK XLS exposure routes is less than one for the Park worker, Construction worker, and Recreational visitor (child). The total non-cancer hazard index for a child resident and the lifetime cancer risk for a resident slightly exceed USEPA target risk range (non-cancer hazard index of 2 for the child and cancer risk of 1E-4 for the resident). The total non-cancer hazard index for an adult resident is 0.7, which is within the USEPA target risk range.

The driven risks for recreational visitor (child) and resident receptors are exposure to benzo(a)pyrene and dibenz(a,h)anthracene in surface water. These two constituents were only detected in one out of 22 samples. In addition, the ditch at the site is usually dry except during storm period. The vegetation observed in the ditches, i.e., cattail, verifies this conclusion since cattails prefer saturated soil conditions to flooded conditions. Therefore, risks driven by these two constituents are most likely significantly lower than indicated by the mini-risk assessment.

F.5.3 Risk Characterization for Lead

Lead was not detected above background levels in soil or groundwater. Therefore, lead is not a compound of concern.

F.5.4 Uncertainty Assessment

All risk assessments involve the use of assumptions, judgements, and imperfect data to varying degrees. This results in uncertainty in the final estimates of risk. There are uncertainties associated with each component of the risk assessment from data collection through risk characterization. For example, there is uncertainty in the initial selection of substances used to characterize exposures and risk on the basis of the sampling data and available toxicity information. Other sources of uncertainty are inherent in the toxicity values for each substance and the exposure assessments used to characterize risk. Finally, additional uncertainties are incorporated into the risk assessment when exposures to several substances across multiple pathways are summed. Areas of uncertainty in each risk assessment step are discussed below.

F.5.4.1 Uncertainty in Data Collection and Evaluation

Uncertainties in the data collection/evaluation step of the risk assessment focus on determining whether enough samples were collected to adequately characterize the risk, and if sample analyses were conducted in a qualified manner to maximize the confidence in the results. Results of the sample analyses were used to develop a database, which includes a complete list of the chemicals, by media and their representative concentrations used in the risk assessment. The sampling and analysis addressed various objectives in addition to the risk assessment. Therefore, the samples were not collected randomly but were collected from areas of the site with the greatest likelihood to be contaminated. This type of non-random sampling biases the data collected toward overestimating chemical concentrations from the site.

All chemicals detected that were potentially site-related were retained in this assessment. Chemicals that were never detected were eliminated from the assessment. This practice may slightly underestimate risks due to low levels (i.e., below the sample quantitation limit) of eliminated chemicals. Since samples were collected at areas where concentrations were expected to be high and the maximum concentrations were used for the assessment, it is very unlikely that any chemicals were present at the site at health-significant levels and not detected in at least one sample. However, if this did occur, this assumption will underestimate risk. The maximum concentrations were used to calculate site-related risks. Since that assumption implies chronic exposure to the maximum concentration, this assumption is likely to overestimate risk.

F.5.4.2 Uncertainty in Exposure Assessment

There are inherent uncertainties in predicting future land uses and future chemical concentrations. Future land use scenarios were based on current plans to develop this portion of SEDA into a recreation and conservation area.

A large part of the risk assessment is the estimation of risks for a broad set of exposure scenarios and pathways. If exposure does not occur, no risks are present. This assessment does not factor in the probability of the exposure occurring. For certain pathways, exposure may be extremely unlikely. For example, the future receptors are assumed to drink groundwater. It is unlikely that this will occur, since the aquifer beneath the site is not believed to be productive enough to supply a continuous source of potable water. This assumption yields an overestimate of risk for this scenario.

Once pathways are identified, exposure point concentrations must be estimated. There is always some doubt as to how well an exposure model approximates the actual conditions receptors will be exposed to at a given site. Key assumptions in estimating exposure point concentrations and exposure assumptions and their potential impact on the assessment are described in the following paragraphs.

As summarized in **Table F-9**, there are many factors that determine the level of exposure for each exposure pathway. These factors include inhalation rates, ingestion rates, exposure frequencies, exposure durations, body weight, etc. The values for these exposure factors must be selected by the risk assessor to represent each receptor. For the scenarios in this risk assessment, upper bound values were selected for each exposure factor. In the calculations of exposure, these multiple upper-bound exposure factor estimates compound to yield intakes and absorbed doses that overestimate likely exposure levels.

The EPCs (i.e., maximum concentrations) derived from the measured chemical concentrations are assumed to persist without change for the entire duration of each exposure scenario. It is likely that some degradation would occur over time, particularly for some of the organic compounds, which would reduce the current concentrations. Therefore, this steady state assumption tends to overestimate exposure levels.

F.5.4.3 Uncertainty in Toxicity Assessment

Of the chemicals of potential concern, a number had no reference dose or slope factors. They are:

- dibenzofuran
- phenanthrene
- calcium
- lead
- magnesium
- potassium
- sodium

Several of these compounds have toxicity information such as weight of evidence classification indicating a strong potential for adverse health effects, particularly lead. The absence of toxicity values for these chemicals tends to underestimate risks.

There is considerable uncertainty inherent in the toxicity values for both carcinogens and noncarcinogens. Many of the studies are based on animals and extrapolated to humans, and in some cases, subchronic studies must be used to assess chronic effects. Most cancer slope factors are calculated using a model that extrapolates low dose effects from high dose animal studies. Because toxicity constants are generally based on the upper limit of the 95th-percentile confidence interval or incorporate safety factors to compensate for uncertainty, chemical-specific risks may be overestimated.

For dermal exposure, a default dermal absorption factor of 0.1 was used for semivolatile organic compounds, and therefore led to the uncertainty of risks associated with dermal exposure. Oral toxicity values were used to evaluate risks associated with dermal exposure by adjusting gastrointestinal absorption efficiency recommended by USEPA (1999). EPA recommends a 100% gastrointestinal absorption efficiency value for chemicals not listed in Table 4.1 of the Dermal Risk Assessment Interim Guidance (USEPA, 1999). This assumption may contribute to an underestimate of risks for compounds that are actually poorly absorbed. In addition, dermal contact with a chemical may also result in direct dermal toxicity, such as allergic contact dermatitis, urticarial reactions, chemical irritations, and skin cancer, which was not evaluated using the USEPA's recommended approach. Therefore, dermal risks evaluated in the report does not address potential dermal toxicity associated with direct contact.

F.5.4.4 Uncertainty in Risk Characterization

Uncertainties in the toxicity assessment are compounded under the assumption of dose additivity for multiple substance exposure. That assumption ignores possible synergisms and antagonisms among chemicals, and assumes similarity in mechanisms of action and metabolism. Overall, these assumptions would tend to overestimate risk. Similarly, risks summed for chemicals having various weight-of-evidence classifications as well as different target organs may also tend to overestimate risk.

F.6 Ecological Risk Assessment (ERA)

F.6.1 Objectives and Overview

In addition to the evaluation of human health, this mini-risk assessment considers the risk posed by the site to its ecological communities. This ecological risk assessment (ERA) is intended to indicate the potential, if any, of chemicals found at the site to pose a risk or stress to plants or animals that may inhabit or visit the land proposed to be developed into a conservation and recreation area.

An ecological field survey specific to SEAD-63 has not been performed. However, other areas of SEDA have been studied to characterize the ecological communities at SEDA in general and at specific SEADs (e.g. SEADs 16, 17, 25 and 26). Field surveys during the Remedial Investigations of these SEADs produced an understanding of the habitat, vegetative communities and wildlife species present at the site. Since the land at SEAD-63 is environmentally similar to the other areas at SEDA studied in depth, the existing ecological characterizations are considered to apply as well to SEAD-63, and this mini-ERA is based upon the findings of these prior field surveys.

As preceding sections of this report have indicated, the existing SEAD-63-specific database of chemical and physical information was developed to characterize the types, locations, and concentrations of chemicals in soil, groundwater, surface water and sediment. Calculations in this mini-ERA are conservatively based on the maximum concentrations of each chemical detected in each medium of potential concern to ecological receptors (soil for SEAD-63).

The ERA addresses potential risks to the following biological groups and special-interest resources associated with the site: vascular vegetation, wildlife, aquatic life, endangered and threatened species, and wetlands. The focus of the ERA lies in the evaluation of the potential toxicity of each constituent of potential concern (COPC) in soil and defines toxicity benchmark values that will be used to calculate the ecological risk quotient.

The purpose of the ERA is to evaluate the likelihood that adverse ecological effects are occurring or may occur as a result of exposure to chemicals associated with the site based on a weight-of-evidence approach. An ecological risk does not exist unless a given contaminant has the ability to cause one or more adverse effects and it is contacted by, an ecological receptor for a sufficient length of time, or at a sufficient intensity to elicit the identified adverse effect(s) (EPA, 1994b).

In this ERA, ecological receptors were determined based on prior studies at SEDA. Impacts from exposure to these receptors are determined using conservative assumptions to assure that a reasonable degree of protection is maintained. Ecological risk is then presented in terms of a hazard quotient (HQ), which is defined as the ratio of the estimated exposure point concentration to an appropriate toxicity reference value (TRV). Separate HQs are calculated for each contaminant/receptor pair and are summed, if appropriate, to derive a site-wide hazard index (HI). Uncertainties are the greatest and arise from extrapolation of the available toxicity data and inference regarding exposure. In general, ratios of exposure point concentration to TRV greater than 1 are considered to indicate a potential risk. Due to the uncertainties associated with using this approach, safety factors are considered in interpreting the findings. HQs between 1 and 10 are interpreted as having some potential for adverse effects; whereas, HQs between 10 and 100 indicate a significant potential for adverse effects. HQs greater than 100 indicate that adverse effects can be expected.

F.6.2 Problem Formulation

Problem formulation establishes the goals, breadth, and focus of the ERA through the following:

- Identification of the ecological COPCs
- Characterization of ecological communities
- Selection of assessment endpoints
- Presentation of an ecological conceptual site model
- Selection of an analysis plan (including measures of effects).

Each of these steps is described in the following sections.

F.6.2.1 Identification of Ecological Constituents of Potential Concern

Samples of four environmental media, soil, groundwater, surface water, and sediment were collected during the investigations of SEAD-63. However, only the chemicals detected found in soil and sediment have been evaluated to determine their potential effect on the ecological community. Chemicals detected in the groundwater have not been considered because there is no indication of a direct link between the selected ecological receptors and the groundwater. The effects of chemicals detected in surface water have also not been evaluated because the surface water bodies found at SEAD-63 are highly intermittent in nature, resulting only from storm run-off events, and are identified as incapable of supporting ecological communities.

The potential effects of chemicals found in shallow (i.e., collected at sample depths of less than 2 feet below grade) soil and sediment samples have been assessed by combining the two datasets into a single composite dataset. **Table F-1** presents a summary of the combined dataset. The maximum concentration of any chemical, other than metals where a preliminary screening of the combined dataset against the existing background dataset was completed, was then considered as constituents of potential concern (COPCs) for the ERA. The results of the screening of metals found in SEAD-63 shallow soil and sediments versus site background soils are presented in **Table F-4**.

The highest concentration for each remaining COPC measured at the site was used as the exposure point concentration (EPC) in the calculations presented later in this section.

F.6.2.2 Site Habitat Characterization

Characterizations of site habitat and ecological communities developed as part of the RIs for SEADs-16, 17, 25 and 26 and the Open Burning (OB) Grounds were assumed to be representative of SEAD-63 discussed in this mini-ERA. Key aspects of these characterizations relevant to this mini-risk assessment are presented here.

Ecological site characterizations were based on compilation of existing ecological information and on-site reconnaissance activities. The methods used to characterize the ecological resources included site walkovers for the evaluation of existing wildlife and vegetative communities; interviews with local, state, and SEDA resource personnel; and review of environmental data obtained from previous Army reports. SEDA has a strong wildlife management program that is reviewed and approved by the New York Fish and Game Agency. The depot manages an annual white-tailed deer (Odocoileus virginiana) harvest and has constructed a large wetland called the "duck pond" in the northeastern portion of the facility to provide a habitat for migrating waterfowl. Winter deer counts estimate the hard size at approximately 600 animals, between 250-300 animals are harvested each fall.

The NYSDEC Natural Heritage Program Biological and Conservation Data System identifies no known occurrences of federal- or state-designated threatened or endangered plant or animal species within a 2-mile radius of the site. No species of special concern are documented within the depot property.

Significant Terrestrial Wildlife Resources and Resources Used by Humans

The only significant terrestrial resource known to occur at SEDA is the population of white-pelaged white-tailed deer (Odocoileus virginiana), which inhabits the fenced Depot. Annual deer counting at the depot indicate the herd size is approximately 600 animals, approximately one-third (200) are white-pelaged. Since the depot is totally enclosed, the white-pelaged deer is thought to occur as a result of inbreeding within the herd. To prevent overgrazing and starvation of the deer, the depot maintains the herd through an annual hunting season on the depot. The New York State DFW conducts the management plan of the herd. The normal brown-pelaged deer are also common. White-tailed deer are not listed as a rare or endangered species.

In the vicinity of SEDA, agricultural crops and deciduous forests comprise the vegetative resources used by humans. Although no crops are grown on the Depot, farmland is the predominant land use in the surrounding private lands. Crops including corn, wheat, oats, beans and hay mixtures, are grown primarily for livestock feed. Deciduous forestland on the depot and surrounding private lands is under active forest management. Timber and firewood are harvested from private woodlots. No timber harvesting occurs on the Depot.

In the vicinity of SEDA, there are several wildlife species that are hunted and trapped on private lands. Game species hunted include the eastern cottontail, white-tailed deer, ruffed grouse, ring-necked pheasant and various waterfowl. Gray squirrel and wild turkey are hunted to a lesser extent. Fur-bearing species trapped in this study area include red and gray fox and raccoon. Muskrat and beaver are trapped to a lesser extent (Woodruff 1992). On the Depot, deer, waterfowl and small game hunting is allowed, although the designated waterfowl hunting area is outside the study area. Trapping is also permitted (SEDA 1992).

Commonly occurring small game mammals in the installation include eastern cottontail and gray squirrel, raccoon, snowshoe hare, muskrat, beaver, eastern coyote, red fox, and gray fox. Mourning doves, American Robin, Ruffed grouse, ring-necked pheasant, and wild turkey also inhabit the depot. Waterfowl are attracted to wetlands on and around the depot, particularly the

87-acre "duck ponds" created in the northeast corner of the property during the 1970s. Many non-game species also are present in the depot and potentially utilize available habitat.

F.6.2.3 Ecological Assessment Endpoint(s)

EPA's draft Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA, 1994b) states that the selection of assessment endpoints depends on the following:

1. The constituents present and their concentrations,
2. Mechanisms of toxicity to different groups of organisms,
3. Potential species present, and
4. Potential complete exposure pathways.

The constituents and concentrations are discussed in detail in **Section F.2.** Mechanisms of toxicity are evaluated conceptually in the analysis plan in **Section F.6.2.4**. Potential species present were discussed in **Section F.6.2.2**. Potential complete exposure pathways and receptor selection are described below.

To assess whether adverse ecological effects have occurred or may occur at the site as a result of ecological receptors' exposure to COPCs, ecological endpoints were selected. An ecological endpoint is a characteristic of an ecological component that may be affected by exposure to a stressor, such as a chemical. Assessment endpoints represent environmental values to be protected and generally refer to characteristics of populations and ecosystems (EPA, 1994b). Unlike the human health risk assessment process, which focuses on individual receptors, the ERA focuses on populations or groups of interbreeding non-human, non-domesticated receptors. In the ERA process, risks to individuals are assessed only if they are protected under the Endangered Species Act, as well as species that are candidates for protection or are considered rare.

Given the diversity of the biological world and the multiple values placed on it by society, there is no universally applicable list of assessment endpoints. Therefore, EPA, in the *Proposed Guidelines for Ecological Risk Assessment* (EPA, 1996a) has suggested three criteria that should be considered in selecting assessment endpoints suitable for a specific ecological risk assessment. These criteria are: ecological relevance, susceptibility to the contaminant(s), and representation of management goals.

- Ecological relevance. The assessment endpoint should have biological/ecological significance to a higher level of the ecological hierarchy. Relevant endpoints help sustain the natural structure, function, and biodiversity of an ecosystem. For example, an increase in mortality or a decrease in fecundity of individuals is ecologically significant if it affects the size or productivity of the population. Likewise, a decrease in the size of a population is ecologically significant if it affects the number of species, the productivity, or some other property of the ecosystem.

- Susceptibility to the contaminant(s). The assessment endpoint should be susceptible to exposure to the contaminant(s) and should be responsive/sensitive to such exposure. That is, assessment endpoints should be chosen that are likely to be exposed to contaminants at the site, either directly or indirectly (e.g., through the food chain), and they should be sensitive enough that such exposure may elicit an adverse response. Ideally, this sensitivity should be at such a level that other site-related receptors of potential concern are adequately protected under the selected endpoint's response threshold.

- Representation of management goals. The value of a risk assessment depends on whether it can support quality management decisions. Therefore the assessment is based on values and organisms that reflect management goals. The protection of ecological resources (e.g., habitats and species of plants and animals) is a principal motivation for conducting ERAs. Key aspects of ecological protection are presented as policy goals, which are general goals established by legislation or agency policy based on societal concern for the protection of certain environmental resources. For example, environmental protection is mandated by a variety of legislation and government agency policies (e.g., CERCLA, National Environmental Policy Act). Other legislation includes the Endangered Species Act, 16 U.S.C. 1531-1544 (1993, as amended) and the Migratory Bird Treaty Act, 16 U.S.C. 703-711 (1993, as amended). **Table F-10** shows the policy goals established for the site. To determine whether these protection goals are met at the site, assessment and measurement endpoints are formulated that define the specific ecological values to be protected and the degree to which each may be protected.

The Depot does not provide habitat for any threatened or endangered species; therefore, the assessment endpoint of no reduction in numbers of any threatened/endangered species is met. However, the available field surveys indicate that the site is likely to be used by mammal populations. Accordingly, the assessment endpoint that has been selected to represent the policy

TABLE F-10
POLICY GOALS, ECOLOGICAL ASSESSMENT AND MEASUREMENT ENDPOINTS, AND DECISION RULES
SEAD-63 EE/CA
Seneca Army Depot Activity

Policy Goals	Assessment Endpoint	Measurement Endpoint	Decision Rule
Policy Goal 1: The conservation of threatened and endangered species (TES) and their critical habitats	**Assessment Endpoint 1:** No reduction in numbers of any state- or federally-designated TES	**Measurement Endpoint 1:** Biosurveys for TES plants and animals; COPC concentration in physical media and predicted concentration in prey species	**Decision Rule for Assessment Endpoint 1:** If TES are not present, or COPC Maximum concentrations in the media do not exceed toxicity screening thresholds or dietary NOAELS (i.e., HQ<1), the assessment endpoint is met and TES are not at risk
Policy Goal 2: The protection of terrestrial populations and ecosystems	**Assessment Endpoint 2:** No substantial adverse effect on populations of small mammals (i.e., deer mouse)	**Measurement Endpoint 2:** Lowest chronic, dietary, non-lethal effect level of COPCs on mice	**Decision Rule for Assessment Endpoint 2:** If ratios of estimated exposure concentrations predicted from COPC Maximum concentrations in soil to dietary limits corresponding to LOAEL toxicity reference values for adverse effects on deer mice (HQs) are <1, th

COPC = constituent of potential concern.
TES = threatened and endangered species.
NOAEL = no observed adverse effect level.
LOAEL = lowest observed adverse effect level.
HQ = hazard quotient.

goal of protection of terrestrial populations and ecosystems is "no substantial adverse effect on survival, growth, and reproduction of resident mouse populations."

Surface water as it exists intermittently in drainage ditches at the site does not directly support aquatic life. Sediment sampled from the drainage ditches is more similar to soil than sediment associated with a surface water body (e.g., river or lake), from an ecological exposure standpoint. Therefore, these media do not pose an ecological risk to aquatic life. Exposure to chemicals found in surface water was not quantitatively assessed for potential impacts to terrestrial receptors. As is discussed above in **Section F6.2**, exposure to chemicals found in site sediments was assessed by combining the SEAD-63 sediment and shallow soil datasets.

Receptor Selection

Site-specific receptors were selected to represent assessment endpoints based principally on their importance in the community food web; their susceptibility (through exposure and sensitivity) to the site-related constituents, the amount of available data describing their potential for exposure and the toxicological effects that may result from exposure; and the extent to which they represent management goals. The native mouse species inhabiting areas of SEDA are the most appropriate receptor species for soil, and the relevant assessment endpoint was defined as "no substantial adverse effect on resident mouse populations." Given the predominately herbaceous nature of the site, the deer mouse (*Peromyscus maniculatus*) was selected as the species with the niche best met by conditions present at the site. These are the vertebrate receptors most likely to be maximally exposed to contaminants in soil at the site. They also represent a significant component of the food chain, feeding on seeds and berries and soil invertebrates and providing prey for predators. Therefore, the deer mouse was selected as the receptor species at this site and measures of effects (measurement endpoints) were selected that could be extrapolated to predict effects on the assessment endpoints. Databases and available literature were searched for toxicity data for deer mice or other native rodent species. In the absence of site-specific data, laboratory-derived data on mortality or reproductive effects were used as measurement endpoints. In the absence of data on native species, data for laboratory rodents such as laboratory mice (*Mus musculus*) and laboratory rats (*Rattus norvegicus*) were used.

A second terrestrial receptor, the short-tail shrew, was also evaluated. The shrew was selected because more of its diet is derived from soil invertebrates than the deer mouse. Therefore, the shrew may be more susceptible than the mouse to the effects of COPCs that bioaccumulate in soil biota. The shrew is a more conservative receptor than the mouse for COPCs that may bioaccumulate.

A raptor, such as a red-tailed hawk, was initially considered as a potential receptor for this ERA. However, the home range of a hawk, approximately 1800 acres or more (USEPA 1993, Wildlife Exposure Factors Handbook), is much greater than the area of the site considered in this assessment. SEAD-63 is approximately 4 acres in area. Therefore, it is unlikely that a hawk would derive a significant portion of its diet from prey at the site. As a result, the raptor was not further evaluated in this ERA.

In order to further evaluate the potential effects of contaminants uptaken by plants, a seed eating species was selected. The mourning dove, a granivorous bird, was selected. It was assumed that the majority of the doves diet consists of plant matter with minor contributions from surface soil and animal matter. The dove was considered to be representative of the maximum exposure for seed-eating birds.

A second bird receptor, the American robin, was also evaluated. The American robin was selected because a larger portion of its diet is derived from soil invertebrates than the mourning dove. Therefore, the robin may be more susceptible than the dove to the effects of COPCs that bioaccumulate in soil biota. The robin is a more conservative receptor than the mouse for COPCs that may bioaccumulate.

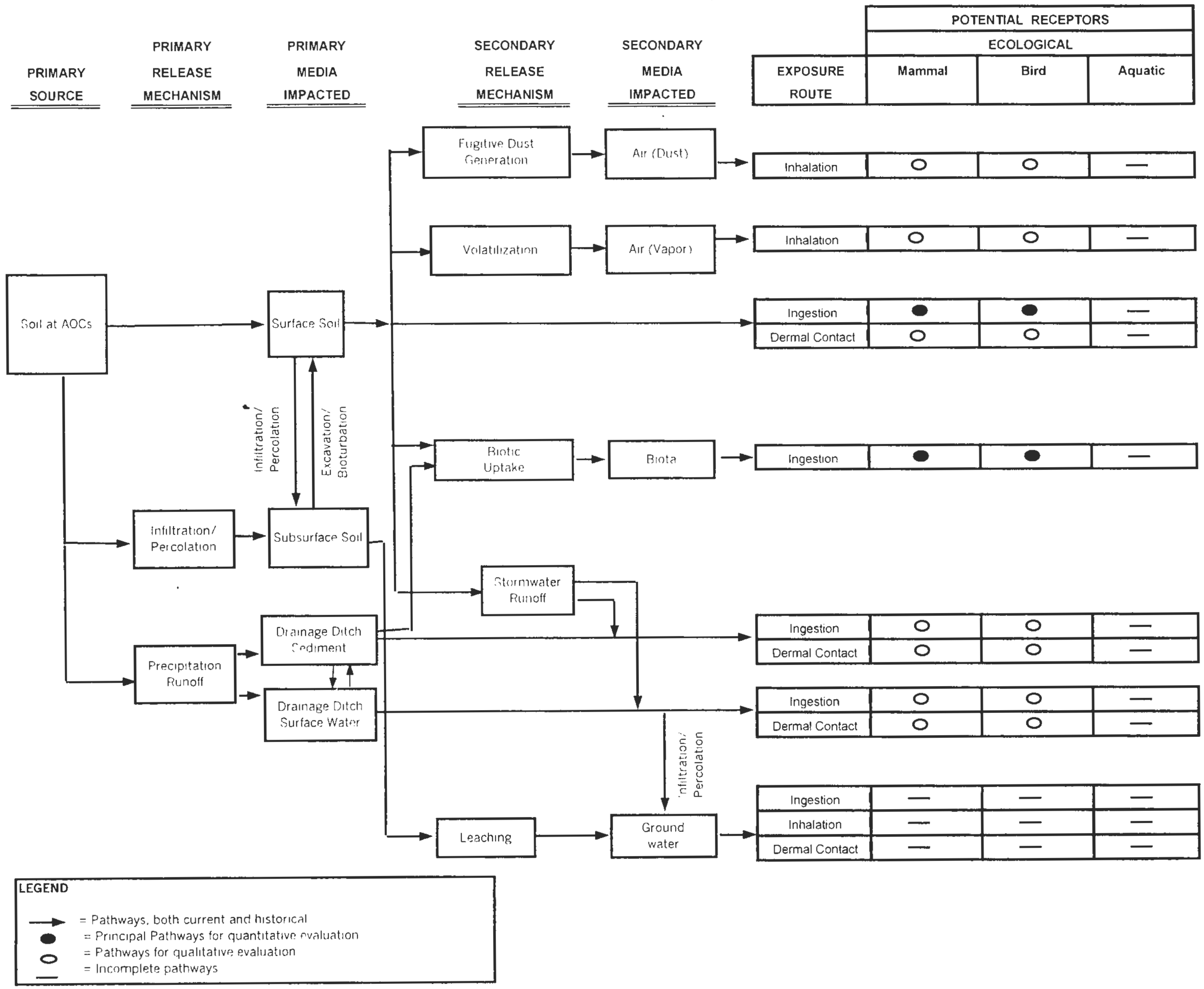
Ecological Conceptual Site Model

The conceptual site model (CSM) presents the ecological receptors at the site that are potentially exposed to hazardous substances in soil across several pathways (**Figure F-2**). A complete exposure pathway consists of the following four elements:

- A source and mechanism of contaminant release to the environment
- An environmental transport mechanism for the released contaminants
- A point of contact with the contaminated medium
- A route of contaminant entry into the receptor at the exposure point.

If any of these elements is missing, the pathway is incomplete and is not considered further in the ERA. A pathway is complete when all four elements are present and permit potential exposure of a receptor to a source of contamination. Quantification of some potentially complete pathways may not be warranted because of minimal risk contribution relative to other major pathways. The dominant pathways from sources and exposure media through the food web to ecological receptors potentially exposed to ecological COPCs at the site are presented in **Figure F-2**.

Figure 5.6-1 Ecological Conceptual Site Model
SENECA ARMY DEPOT ACTIVITY



The CSM will serve as a conceptual hypothesis for the exposure characterization, the objective of which is to gather information from which to determine the pathways and media through which ecological receptors may be exposed to COPCs. The exposure characterization typically involves determining the following (EPA, 1994b):

1. The ecological setting of the site
2. The inventory of constituents that are or may be present at the site
3. The extent and magnitude of the constituent concentrations present, along with spatial and temporal variability of those concentrations
4. The environmental fate and transport of the constituents.

The ecological setting was described in **Section F.6.2.2** and the extent and magnitude of contaminants is presented in **Section F.2**. Environmental fate of the COPCs and the potential exposure pathways are discussed in the following paragraphs.

The primary source of contaminants at the site is the residues that may be present in the soil from prior activities at the site. Contamination, if present, can migrate due to bioturbation or excavation. Volatile compounds can move through the soils. Infiltrating rainwater can leach contaminants and transport them into groundwater, and surface water runoff can also carry contaminants onto adjacent soils or drainage ditches.

Exposure to surface soil contaminants may occur directly through ingestion, inhalation, and/or dermal contact. Chemicals also may migrate further in the environment by a variety of pathways following secondary release from surface soil and deeper soil. The following pathways result from these secondary release mechanisms:

- Suspension and dispersal by the wind of particulate contaminants or contaminants adsorbed to surface soil particles
- Direct volatilization of volatile organic compounds from surface soil to air
- Uptake of soil contaminants by terrestrial organisms
- Transport of chemicals to surface water and sediment by surface runoff of water and soil particles

As shown in the CSM, there are five media through which ecological receptors could be exposed to site-related contaminants: air (dust and vapor), soil, surface water, sediment, and organisms in the food chain. An exposure point is a location where a receptor could potentially come into contact with a contaminated medium. An exposure route is the means by which a receptor comes into contact with a contaminated medium at an exposure point. Exposure to COPCs may occur through the routes of ingestion, inhalation, and dermal contact.

Probable exposure routes (i.e., potentially complete pathways) were identified for each medium based on the physical characteristics of the site and the potential ecological receptors that may occur there. Exposure routes were also identified for ecological receptors. Principal pathways for which analytical data were available for quantitative evaluation of soil COPCs include: ingestion of soil and ingestion of other animals and plants that have accumulated contaminants.

Terrestrial animals could potentially be directly exposed to soil contaminants through ingestion of, dermal contact with, and/or inhalation from site soils. For species such as deer, raccoon, opossum, rabbits, rodents, and birds, such exposures would likely be associated with foraging activities. Burrowing species, such as rabbits, mice, moles, and shrews, would probably receive the greatest exposures among vertebrates. Invertebrates living on and within the soil also may experience significant exposures. Although ingestion is the principal soil exposure route, dermal contact also may be important, particularly for burrowing species. However, the limited dermal permeability database available for ecological receptors and surrogate species precluded quantitative evaluation of the dermal exposure pathway.

Ecological receptors could potentially be exposed to site-related contaminants via the air medium. Contaminants in air may be in the form of vapor from volatile organic compounds, or in particulate form (as dusts or adsorbed to soil particles) suspended by wind. In either form, ecological receptors could be exposed to contaminants through inhalation. However, the lack of applicable inhalation toxicity data for ecological receptors or similar species precluded quantitative evaluation of potential risks.

Plants may be considered ecological receptors as well as a pathway or medium through which wildlife receptors can be exposed to contaminants. Plants may absorb site-related contaminants from soil through their roots. Contaminants absorbed by plants may then be transferred to wildlife when the plants are ingested for food. This exposure pathway was addressed by use of chemical-specific soil-to-plant uptake factors (obtained from the scientific literature) in the animal receptor exposure calculations. No plants on or near the site showed visible signs of stress during the field reconnaissance.

Under the future land use scenarios for the site, it is assumed that contaminated soils may be excavated during construction and distributed on the ground surface. As under current conditions, ecological receptors could potentially be exposed to chemicals in soil through ingestion and dermal contact. Other exposure pathways also were assumed to remain essentially the same as under current conditions, except that possible inhalation exposures are likely to be reduced by paving and vegetation (e.g., lawns). The abundance and diversity of some ecological receptors on the site may likely be reduced due to the development.

F.6.2.4 Analysis Plan

The analysis plan is the final stage of problem formulation. In this step, risk hypotheses presented in the CSM are evaluated to determine how these hypotheses will be assessed using site-specific data. The analysis plan includes three categories of measures to evaluate the risk hypotheses identified in the CSM: measures of effect (also termed measurement endpoints), measures of exposure, and measures of ecosystem and receptor characteristics.

Measures of Effect

Measurement endpoints are measurable responses to a stressor that are related to the valued characteristics chosen as assessment endpoints (EPA, 1992). Assessment endpoints generally refer to characteristics of populations and ecosystems. It is usually impractical to measure changes in these characteristics as part of an assessment. Consequently, measurement endpoints are selected that can be measured and extrapolated to predict effects on assessment endpoints (EPA, 1992). The most appropriate measurement endpoint relating to the assessment endpoint is the lowest concentration of the constituent that, in chronic toxicity tests, is associated with non-lethal effects to a deer mouse or short-tailed shrew. Because the assessment endpoint focuses on maintenance of the population of deer mice, shrews, robins and doves, a measure of effect equivalent to "no effect" would be overly conservative, in that it would reflect protection of the individual, not the population. A more appropriate measure of effect, reflecting population level response, is the lowest non-lethal effect level. Toxicity data from tests that measure responses that influence reproduction, health, and longevity of the mouse will conform to the assessment endpoint. Therefore, the lowest concentration of the constituent that produces such effects will be used as a measure of effects.

Reliable measures of effects are not available for each exposure route for each constituent. Effects from exposure through inhalation and dermal contact are not well developed for ecological receptors; consequently, these exposure routes are analyzed qualitatively.

The measures of ecosystem and receptor characteristics include such characteristics as the behavior and location of the receptor and the distribution of a contaminant, both of which may affect the receptor's exposure to the contaminant. The typical foraging area of the receptor as well as the quality of the habitat in the site have been considered in the estimation of exposure, as discussed in **Section F.6.3.**

Measures of Exposure

Measures of exposure are the amounts, in dosage or concentration, that the receptors are hypothesized to receive. These include concentrations of constituents in the impacted media and concentrations or dosages of the constituents to which the receptor is exposed.

Decision rules are specified for evaluating effects on the assessment endpoints. **Table F-10** shows the decision rules that describe the logical basis for choosing among alternative actions for the assessment endpoints based on the results of the measurement endpoints. Together, the assessment endpoint, measurement endpoint, and decision rule define the following:

- An entity (e.g., deer mouse population)
- A characteristic of the entity (e.g., health of the individuals in the population)
- An acceptable amount of change in the entity (e.g., loss of no more than 20 percent of a population)
- A decision whether the protection goal is or is not met.

For soil exposures, the results of the assessment will be presented in terms of hazard quotients (HQs). The HQ is the ratio of the measured or predicted concentration of an ecological COPC to which the receptors are exposed in an environmental medium, and the measured concentration that adversely affects an organism based on a toxicity threshold. If the measured concentration or estimated dose is less than the concentration or dose expected to have the potential to produce an adverse effect (i.e., the ratio of the two is less than 1), the risk is considered acceptable (protective of the ecological receptor). Any quotient greater than or equal to 1 indicates that the ecological COPC warrants further evaluation to determine the actual likelihood of harm. COCs are selected only after an additional weight-of-evidence evaluation of the conservatism of the exposure assumptions, toxicity values, and uncertainties is conducted.

Due to the ephemeral nature of surface water accumulation in the drainage ditches and the limited exposure of valued ecological receptors to surface water or sediment in the ditches, these media are not quantitatively assessed in this ERA.

Measures of Ecosystem and Receptor Characteristics

Section F.6.3.3 discusses the toxicity values associated with the COPCs. Endpoints stated in terms of specific ecological receptors or exposure classes (groups of species exposed by similar pathways) often require data on the processes that increase or decrease the exposure concentration below or above the measured or predicted environmental concentration. Thus, some quotients incorporate exposure factors (e.g., dietary soil fractions and bioaccumulation factors). **Section F.6.3** discusses exposure factors for the site.

F.6.3 Exposure Assessment

The exposure assessment evaluates potential exposure of ecological receptors to site-related constituents through evaluation of the following:

- Description of the spatial distribution of COPCs
- Description of spatial and temporal distribution of ecological receptors
- Quantification of exposure that may result from overlap of these distributions

Each of these components is discussed below.

F.6.3.1 Constituent Distribution

The extent of measured chemical contamination at the site is restricted to the areas sampled within the site. The area of the SEAD-63 is approximately 4 acres, which is less than 1 percent of the 10,000 acre Depot property. Soil located outside this site is presumed to be relatively clean.

The magnitude of constituent exposures that may be experienced by ecological receptors is affected by the degree of their spatial and temporal associations with the site, as discussed in the following sections.

F.6.3.2 Receptor Distribution

A variety of factors may affect the extent and significance of potential exposures. Receptor exposures are affected by the degree of spatial and temporal association with the site. For example, the receptors' mobility may significantly affect their potential exposures to site-related contaminants. Many species may only inhabit the study area during seasonal periods (e.g., breeding season, non-migratory periods). Non-migratory species may remain in the vicinity throughout the year. These species, particularly those with longer life spans (and usually larger home ranges), have the greatest potential duration of exposure. However, species with small home range sizes have the greatest potential frequency of exposure. Other factors affecting exposures include habitat preference, behavior (e.g., burrowing, rooting, foraging), individual home range size (larger home ranges correspond to far less frequent use of study area), and diet. Diet is of particular importance in exposure as related to (1) food source availability (larger amount of preferred food sources equals a greater potential for receptor usage) and (2) bioaccumulative contaminants. Contaminants that bioaccumulate may also tend to biomagnify in the food chain. This discussed in more detail in the following sections. As a result, predatory species at higher trophic levels may receive their most significant exposures through their prey. However, the possibility of a population of an upper trophic-level predator, or even an individual predator, utilizing the site as a primary source of food is considered extremely remote.

The deer mouse and short-tailed shrew each have a typical home range of approximately 0.15 acres (EPA, 1993). The area of the site is approximately 4 acres, which could constitute 100 percent of the home range of a deer mouse or shrew.

The mourning dove has a typical home range of approximately 29 acres (EPA, 1993). The area of the site is 4 acres; thus, SEAD-63 could represent roughly 12 percent of a mourning dove's home range. Comparatively, a robin's home range is roughly 1 to 2 acres (EPA, 1993), which would suggest that SEAD-63 could constitute 100 percent of its exposure.

F.6.3.3 Quantification of Exposure

Evaluation of the degree to which contaminant and receptor distributions (described in the previous two sections) coincide at the site indicated that the two mammals (i.e., deer mouse and short-tailed shrew) and the two birds (i.e., mourning dove and American robin) are the receptors likely to have the greatest potential exposures to COPCs in soil.

To quantify exposures of terrestrial receptors to each COPC, a daily intake of each constituent was calculated. Conversion of the environmental concentration of each COPC to an estimated daily intake for a receptor at the site was necessary prior to evaluation of potentially toxic effects. For terrestrial animal receptors, calculation of exposure intake rates relied upon determination of an organism's exposure to COPCs found in soil. Exposure rates for the deer mouse and shrew receptors were based upon ingestion of contaminants from this medium and also from consumption of other organisms. The ERA did not attempt to measure potential risk from dermal and/or inhalation exposure pathways given the insignificance of these pathways relative to the major exposure pathways (e.g., ingestion) and due to the scarcity of data available for these pathways.

The first step in measuring exposure rates for terrestrial wildlife was the calculation of food ingestion rates for four indicator species (i.e., the deer mouse, short-tailed shrew, mourning dove, and American robin). The EPA's *Wildlife Exposure Factors Handbook* (EPA, 1993) includes a variety of exposure information for a number of avian, herptile, and mammalian species. Data are directly available for body weight, ingestion rate, and dietary composition for the deer mouse, short-tailed shrew, and the American robin. Data provided for the northern bobwhite were used as a surrogate for the mourning dove.

To provide conservative exposure rate calculations for the deer mouse, the mean body weight of 0.02 kg for the female deer mouse and the maximum food ingestion rate of 0.22 g/g-day (0.0044 kg/day) for a non-lactating mouse were used (EPA, 1993).

To provide conservative exposure rate calculations for the short-tailed shrew, the lowest reported mean body weight of 0.015 kg and the maximum food ingestion rate of 0.6 g/g-day (0.009 kg/day) for a short-tailed shrew were used (EPA, 1993).

For exposure rate calculations for the American robin, the average reported body weight of 0.077 kg and the average food ingestion rate of 1.205 g/g-day (0.093 kg/day) for an American robin were used (EPA, 1993).

For exposure rate calculations for the mourning dove, the average reported body weight of the northern bobwhite of 0.174 kg and the average food ingestion rate of 0.0777 g/g-day (0.01347 kg/day) were used (EPA, 1993).

A site foraging factor (SFF) is calculated to account for the reasonably expected use of an exposure group. Because of the small area of their home ranges and their year-round residence, mice and other small mammals living at most of the sites could potentially use contaminated areas 100 percent of the time. Therefore, a SFF of 1 was used for both the shrew and the mouse. The American Robin is a seasonal visitor to the New York area (mid-April to early November or approximately 7 months). Its home range is approximately 1 acre, and as a result a SFF of 0.583 has been applied to it. Conversely, the Mourning Dove is a year round visitor to New York, but its home range encompasses approximately 29 acres. Given these two factors, a SFF of 0.12 has been used in the calculations completed for the dove.

The *Wildlife Exposure Factors Handbook* (EPA, 1993) also presents average values for intake of animal matter and plant matter for the deer mouse as well as incidental soil ingestion. Soil ingestion has been measured at less than 2 percent of diet (Beyer et al., 1994). As might be expected based on the opportunistic habits of mice, the proportion of animal to plant matter in the diet varies from around 65 percent animal : 35 percent plant to 25 percent animal : 75 percent plant depending on season and region of the country. For this ERA, an approximate average of 50 percent animal : 50 percent plant was used, after subtracting the 2 percent for incidental soil ingestion. The dietary intakes calculated for this assessment are as follows:

Total Dietary Intake = 0.0044 kg food/day

Plant Matter Intake	=	0.00216 kg plant matter/day
Animal Matter Intake	=	0.00216 kg animal matter/day
Incidental Soil Intake	=	0.000088 kg soil/day

The short-tailed shrew is primarily carnivorous, with its diet consisting largely of insects and other invertebrates found in the soil. Based on information provided in EPA 1993, 5.3 percent of the shrew's diet is vegetative, with most of the remainder comprised of soil invertebrates. To be conservative in terms of potential bioaccumulation, it was assumed that 94.7 percent of the shrew's intake is animal matter (small insects, etc.) and none of the intake is soil. Accordingly, the shrew's dietary intakes calculated for this assessment are as follows:

Total Dietary Intake	=	0.009 kg food/day
Plant Matter Intake	=	0.00048 kg plant matter/day
Animal Matter Intake	=	0.00852 kg animal matter/day
Incidental Soil Intake	=	0 kg soil/day

The American Robin's diet includes ground dwelling invertebrates, foliage dwelling insects and fruits. The robin's diet varies significantly throughout the year, exhibiting a high insect and invertebrate intake in the spring and a high plant material intake characteristic in the fall. Averaging the dietary characteristics over these three seasons results in an average invertebrate intake of 44 % and an average plant material intake of 56%. Soil ingestion for the American woodcock (surrogate species) has been measured at approximately 10.4 percent of diet (Beyer et al., 1994). For this ERA, an approximate average of 44 percent invertebrate : 56 percent plant was used, after subtracting the 10.4 percent for incidental soil ingestion. The dietary intakes calculated for this assessment are as follows:

Total Dietary Intake	=	0.093 kg food/day
Plant Matter Intake	=	0.0466 kg plant matter/day
Invertebrate Matter Intake	=	0.0366 kg animal matter/day
Incidental Soil Intake	=	0.0096 kg soil/day

The dietary habits of the mourning dove are based on information provided in EPA 1993 for the northern bobwhite. Over the course of the year, the average food ingestion rate for the mourning dove is 0.0778 g/g-day (0.0122 kg/day). Of this material, approximately 85 percent of it is derived from plant matter while the balance is derived from invertebrates. Soil ingestion is estimated at approximately 10.4 percent of diet (Beyer et al., 1994). For this ERA, an approximate average of 15 percent invertebrate : 85 percent plant was used, after subtracting the 1.3 percent for incidental soil ingestion. The dietary intakes calculated for this assessment are as follows:

Total Dietary Intake	=	0.01221 kg food/day
Plant Matter Intake	=	0.00164 kg plant matter/day
Invertebrate Matter Intake	=	0.00931 kg animal matter/day
Incidental Soil Intake	=	0.00125 kg soil/day

A summary of species intake factors used for the subject mammals and birds is provided in **Table F-11**.

A site-specific exposure dose of each COPC was calculated using a food chain uptake model consistent with EPA Region IV guidance (EPA, 1995). This algorithm accounts for exposure via incidental ingestion of contaminated soil, ingestion of plants grown in contaminated soil, and ingestion of lower trophic level animals associated with contamination. The exposure equation for soil is as follows:

$$ED_{soil} = [(C_s \times SP \times CF \times I_p) + (C_s \times BAF \times I_a) + (C_s \times I_s)] \times SFF / BW$$

where:

ED_{soil}	=	Soil exposure dose for terrestrial receptor (mg/kg/day)
C_s	=	RME concentration in soil (mg/kg)
SP	=	Soil-to-plant uptake factor (unitless)
CF	=	Plant wet-weight-to-dry-weight conversion factor (unitless) = 0.2 (used for SP values based on plant dry weight)
I_p	=	Receptor-specific ingestion rate of plant material (kg/day)
BAF	=	Constituent-specific bioaccumulation factor (unitless)
I_a	=	Receptor-specific ingestion rate of animal material (kg/day)
I_s	=	Receptor-specific ingestion rate of soil (kg/day)
SFF	=	Site foraging factor (unitless) = 1 (see explanation below)
BW	=	Body weight (kg)

In evaluating the potential for a contaminant to pose ecological risk, it is important to consider its propensity for bioaccumulation even though its concentration in an environmental medium may be below toxic levels. Therefore, all COPCs were evaluated with regard to their ecological persistence and tendency to bioaccumulate.

Bioaccumulation is the process of absorption and retention of a substance by an organism due to both uptake from water (or other surrounding media) and uptake from ingested residues in food, soil, and/or sediment. It is quantified by the calculation of a bioaccumulation factor (BAF).

TABLE F-11
WILDLIFE INTAKE FACTORS
SEAD-63 EE/CA
Seneca Army Depot Activity

Receptor Seneca Army Depot	Body Weight (kg) (3)	Trophic Level(1)	Foraging Factor(2)	Dietary Intake Breakdown (3)			
				Plant (kg/day) Ip	Animal (kg/day) Ia	Soil (kg/day) Is	Surface Water (L/day) Iw
SEAD-63							
Deer Mouse (3)	0.020	3	1	0.00216	0.00216	0.000088	--
Short-tailed Shrew (3)	0.015	3	1	0.00048	0.00852		0.00330
American Robin (3)	0.077	3	0.583	0.03658	0.04656	0.00965	0.0106
Mourning Dove (3)	0.157	2	0.1204	0.00931	0.00164	0.00125	--

(1) Trophic level: organisms are assigned to trophic levels of 1 (producer), 2 (herbivore), 3 (1st order carnivore), and 4 (top carnivore) within the food web.

(2) Foraging factor: adjustment factor (from 0 to 1) based upon an organism's total time of exposure to unit-based contaminants. Foraging factor includes consideration of foraging range and period of occupancy in an area. If the foraging range is smaller than the identified size of the SEAD (~ 3.44 acres), a factor of 1 is applied. If the species is only present in an area during part of the year a seasonal occupancy factor is applied. Based on information provided in Wildlife Exposure Factors Handbook US EPA 1993 and 1997.
Deer Mouse is a year round resident; Home range = less than 1 acre
Deer Mouse SFF = (3.44 acre / 1 acre home range mouse) or 1 x (12 months/ 12 months/year) = 1.0
Short-tailed shrew is a year round resident; Home range = less than 1 acre
Deer Mouse SFF = (3.44 acre / 1 acre home range mouse) or 1 x (12 months/ 12 months/year) = 1.0
American Robin in New York mid-April through early November (7 months); Home range = 1.1 acres. SFF = 1 x 7/12 = .583
American Robin SFF = (3.44 acre / 1 acre home range robin) or 1 x (7 months/ 12 months/year) = 0.583
Mourning Dove in New York all year (12 months); Home range = 28.6 acres
Mourning Dove SFF = (3.44 acre / 28.6 acre home range dove) X (12 months /12 months) = 0.1204

(3) Deer Mouse body weight and plant matter, animal matter, and surface water ingestion rates from Wildlife Exposure Factors Handbook USEPA 1993 and USEPA 1997; soil intake rate based on Beyer et al. (1994).
Short-tail Shrew body weight and plant matter, animal matter, and surface water ingestion rates from Wildlife Exposure Factors Handbook USEPA 1993 and USEPA 1997.
American Robin body weight and plant matter, animal matter, and surface water ingestion rates from Wildlife Exposure Factors Handbook USEPA 1993 and USEPA 1997; soil intake rate (I.e., 10.4%) based on American woodcock in Beyer et al. (1994).
Mourning Dove body weight and plant matter and animal matter ingestion rates based on northern bobwhite in USEPA (1998); soil intake rate (i.e., 10.4%) based on American woodcock in Beyer et al. (1994).

Bioconcentration is a component of bioaccumulation, accounting only for the process of uptake from the surrounding medium (usually water). It is quantified by the calculation of a bioconcentration factor (BCF). Both BAFs and BCFs are proportionality constants relating the concentration of a contaminant in the tissues of an organism to the concentration in the surrounding environment (Amdur et al., 1991; EPA, 1989).

Bioaccumulation and bioconcentration may be a significant component of exposure to COPCs for the terrestrial receptors. For the species considered in this ERA (i.e., deer mouse, short-tailed shrew, American robin, and mourning dive), bioaccumulation was evaluated by means of contaminant-specific soil-to-plant uptake factors and BAFs. The soil-to-plant uptake factors were obtained from NRC (1992) for metals and for organic compounds by using a regression equation from Travis and Arms (1988). The latter is based on the contaminant-specific octanol/water partition coefficient (log K_{OW}). BAFs were obtained from the scientific literature. Factors reflecting accumulation of COPCs in earthworms were preferentially selected, based on the feeding habits of the deer mouse, shrew and robin. **Table F-12** shows values for soil-to-plant uptake factors and BAFs.

F.6.3.4 Effects Assessment

The effects assessment defines and evaluates the potential ecological response to ecological COPCs in terms of the selected assessment and measurement endpoints. The effects assessment for soil exposure includes the derivation of toxicity reference values (TRVs) that are the basis of the comparison. **Section F.6.4** uses the results of the toxicity assessment to identify ecological COCs and characterize ecological risk.

For soil, the methodology for assessing the potentially toxic effects of COPCs was based on the derivation of a TRV for each COPC. The TRVs were derived to represent reasonable estimates of the constituent concentrations that, if exceeded, may produce toxicity effects in ecological receptors exposed to soil. Ideally, TRV values would be based on site-specific toxicity data. However, in the absence of site-specific data, toxicity data from the literature were used by establishing data selection criteria such that TRVs would be as relevant as possible to assessment endpoints for this site. Furthermore, the conservativeness of the TRVs was reinforced by using the lowest available, appropriate toxicity values and modifying them by uncertainty factors when necessary. The derivation of TRVs for soil is shown in **Table F-13** for mammals and **Table F-14** for birds.

The toxicity benchmarks used as effects thresholds for the evaluation of the assessment endpoint (maintenance of healthy populations of small mammals) are based on NOAELs for test organisms (Sample et al., 1996). The NOAEL (no observed adverse effect level) is the highest

Table F-12

ENVIRONMENTAL FATE AND TRANSPORT PROPERTIES FOR CHEMICALS OF POTENTIAL CONCERN

Action Memorandum/EE/CA - SEAD-63

Seneca Army Depot Activity

Constituent	Soil to Plant Transfer Factors (STP)			Trophic Level 2 BAF (invertebrates)	
	logKow [1]	STP [2]	Source	BAF	Source
Volatile Organics					
Acetone	-0.24	5.33E+01	Travis & Arms 1988	3.90E-01	Sample et al., 1996
Benzene	2.11	2.34E+00	Travis & Arms 1988	2.45E+01	Sample et al., 1996
Methyl ethyl ketone	0.26	2.74E+01	Travis & Arms 1988	9.60E-01	Sample et al., 1996
Toluene	2.5	1.39E+00	Travis & Arms 1988	7.24E+01	Sample et al., 1996
Total Xylenes	3.18	5.62E-01	Travis & Arms 1988	6.00E+00	ATSDR 1990
Semivolatile Organics					
Benzo(a)anthracene	5.9	1.51E-02	Travis & Arms 1988	1.25E-01	Beyer 1990
Benzo(a)pyrene	6.04	1.02E+00	USEPA 1994	4.50E+00	Beyer 1990
Benzo(b)fluoranthene	6.57	6.17E-03	Travis & Arms 1988	3.20E-01	Beyer 1990
Benzo(k)fluoranthene	6.85	4.25E-03	Travis & Arms 1988	2.53E-01	Beyer 1990
Chrysene	5.61	2.22E-02	Travis & Arms 1988	1.75E-01	Beyer 1990
Dibenz(a,h)anthracene	6.36	8.16E-03	Travis & Arms 1988	3.68E-01	Beyer 1990
Fluoranthene	5.22	3.72E-02	Travis & Arms 1988	7.92E-01	Beyer 1990
Fluorene	4.12	1.61E-01	Travis & Arms 1988	3.42E-01	Beyer 1990
Indeno(1,2,3-cd)pyrene	7.7	1.37E-03	Travis & Arms 1988	4.19E-01	Beyer 1990
2-Methylnaphthalene	4.11	1.63E-01	Travis & Arms 1988	3.42E-01	Beyer 1990 (BAP as surrogate)
Naphthalene	3.36	4.43E-01	Travis & Arms 1988	3.42E-01	Beyer 1990 (BAP as surrogate)
Phenanthrene	4.46	1.02E-01	Travis & Arms 1988	1.22E-01	Beyer 1990
Pyrene	5.09	4.43E-02	Travis & Arms 1988	9.20E-02	Beyer 1990
Semi-volatiles					
bis(2-Ethylhexyl)phthalate	4.2	5.10E-03	USEPA 1994	1.20E+01	USEPA 1994
Butylbenzylphthalate	4.78	5.60E-02	Calculated	1.00E+00	Default
Carbazole	1	1.00E+00	Default	1.15E+02	AQUIRE 1997
Dibenzofuran	4.17	1.51E-01	Travis & Arms 1988	1.00E+00	Default
Diethyl phthalate	3	7.14E-01	Travis & Arms 1988	1.17E+00	AQUIRE 1997
Di-n-butylphthalate	4.31	1.25E-01	Travis & Arms 1988	1.25E+00	USEPA 1994 (BEHP as surrogate)
Di-n-octylphthalate	9.2	1.60E-04	USEPA 1994	4.90E+03	USEPA 1994
Phenol	1.48	5.40E+00	Travis & Arms 1988	1.00E+00	Default
Pesticides					
4,4'-DDD	5.99	1.34E-02	Travis & Arms 1988	1.00E-01	USEPA 1994 (DDT as surrogate)
4,4'-DDE	5.766	1.80E-02	Travis & Arms 1988	2.50E-02	Menzie et al., 1992
4,4'-DDT	5.9	1.00E-02	USEPA 1994	1.00E-01	USEPA 1994
Endosulfan I	3.55	3.44E-01	Travis & Arms 1988	2.50E-01	Menzie et al., 1992
Endosulfan sulfate	3.66	2.97E-01	Travis & Arms 1988	2.50E-01	Menzie et al., 1992
Endrin ketone	5.06	2.20E-02	USEPA 1995	1.80E-01	USEPA 1994 (endrin as surrogate)
Metals					
Cadmium	NA	5.50E-01	NRC 1992	2.15E-02	Ash and Lee, 1980
Sodium	NA	1.00E+00	Default	1.00E+00	Default

Notes

(1) Logarithmic value of octonol-water partition coefficient. LogKow source: Montgomery, J.H. and L.M. Welkom. *Groundwater Chemicals Desk Reference*. 1989

(2) Soil to plant uptake factor. For organic chemicals without reported STP values, the STP was estimated from the Kow as follows:

logSTP = 1.588 - 0.578 x logKow (Travis and Arms 1988)

(3) This table includes STP and BAF factor information available from Parsons ES-Tampa current database (8/99).

(4) BAF = Bioaccumulation factor

(5) For chemicals without reported STP or BAF values, surrogate or default values were assigned based on best professional judgement

Table F-13
NOAEL TOXICITY REFERENCE VALUES - MAMMALS
Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

Constituent	Test Organism	Endpoint/Duration/Effect	Source	Effect Dose (mg/kg/day)	Endpoint CF[1]	Study Duration CF[1]	Total CF[1]	TRV[2] (mg/kg/day)
Volatile Organics								
Acetone	rat	NOAEL, gavage, 90-day, liver and kidney damage	Sample et al. 1996	100	1	10	10	10
Benzene	mouse	LOAEL, oral gavage, days 6-12 gestation crit. lifestage, reproduction	Sample et al. 1996	263.6	10	1	10	26.36
Methyl ethyl ketone	rat	NOAEL, water, 2 generations, reproduction	Sample et al 1996	1771	10	1	10	177.1
Toluene	mouse	LOAEL, gavage, day 6-12 gestation crit. lifestage, reproduction	Sample et al. 1996	260	10	1	10	26
Total Xylenes	mouse	NOAEL, gavage, day 6-15 gestation crit. lifestage, reproduction	Sample et al. 1996	2.1	1	1	1	2.1
PAHs								
Benzo(a)anthracene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Benzo(a)pyrene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction	Sample et al. 1996	10	10	1	10	1
Benzo(b)fluoranthene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Benzo(k)fluoranthene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Chrysene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Dibenz(a,h)anthracene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Fluoranthene	mouse	LOAEL, oral gavage, 13 wks., hepatic effects	ATSDR 1995	125	10	10	100	1.25
Fluorene	mouse	LOAEL, oral gavage, 13 wks., hepatic effects	ATSDR 1995	125	10	10	100	1.25
Indeno(1,2,3-cd)pyrene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
2-Methylnaphthalene	mouse	LOAEL, diet, 81 wks., respitory (naphthalene used as surrogate)	ATSDR 1995	71.6	10	1	10	7.16
Naphthalene	mouse	LOAEL, diet, 81 wks., respitory	ATSDR 1995	71.6	10	1	10	7.16
Phenanthrene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1

Table F-13
NOAEL TOXICITY REFERENCE VALUES - MAMMALS
Decision Document - Mini Risk Assessment
Seneca Army Depot Activity

Constituent	Test Organism	Endpoint/Duration/Effect	Source	Effect Dose (mg/kg/day)	Endpoint CF(1)	Study Duration CF(1)	Total CF(1)	TRV(2) (mg/kg/day)
Pyrene	mouse	LOAEL, oral intubation, gestation days 7-16 crit. lifestage, reproduction (benzo(a)pyrene used as surrogate)	Sample et al. 1996	10	10	1	10	1
Semi-volatiles								
bis(2-ethylhexyl)phthalate	mouse	NOAEL, diet, 105 days crit. lifestage, reproduction	Sample et al. 1996	18.33	1	1	1	18.33
Butlybenzylphthalate	rat	NOAEL, diet, 6 months, reproduction, liver weight, blood chemistry	IRIS, 1999	159	1	1	1	159
Carbazole	rat	LD50, oral		500	10	10	100	5
Dibenzofuran	mammal	No data available					--	no data
Diethylphthalate	mouse	NOAEL, diet, 105 day crit. lifestage, reproduction	Sample et al. 1996	4583	1	1	1	4583
Di-n-butylphthalate	mouse	NOAEL, diet, 105 days crit. lifestage, reproduction	Sample et al. 1996	550	1	1	1	550
Di-n-octylphthalate	mouse	NOAEL, diet, 105 days crit. lifestage, reproduction (BEHP as surrogate)	Sample et al. 1996	18.33	1	1	1	18.33
Phenol		No data available					--	no data
Pesticides/PCBs								
4,4'-DDD	rat	NOAEL, diet, 2 year crit. lifestage, reproduction (DDT used as surrogate)	Sample et al. 1996	0.8	1	1	1	0.8
4,4'-DDE	rat	NOAEL, diet, 2 year crit. lifestage, reproduction (DDT used as surrogate)	Sample et al. 1996	0.8	1	1	1	0.8
4,4'-DDT	rat	NOAEL, diet, 2 year crit. lifestage, reproduction	Sample et al. 1996	0.8	1	1	1	0.8
Endosulfan I	mouse	NOAEL, diet, 78-week, renal effects	ATSDR, 1990e	0.5	1	1	1	0.5
Endosulfan sulfate	mouse	Used endosulfan as surrogate		2.5	10	1	10	0.25
Endrin ketone	mouse	LOAEL, diet, 120-day, reproduction (Endrin)		0.92	10	1	10	0.092
Metals								
Cadmium	rat	NOAEL, gavage, 6 weeks mating and gestation crit. lifestage, reproduction	Sample et al. 1996	1	1	1	1	1
Sodium		No data available					--	no data

Notes:
(1) CF = conversion factor. Conversion factors - endpoint (non-NOAEL = 10) and study duration (non-chronic = 10)
(2) The toxicity reference value was derived by dividing the effect dose by the total conversion factor.
(3) This table includes TRV factor information available from Parsons ES-Tampa current database (8/99).
(4) V = Volatile (MW<200, H>1E-05); SV = Semi-Volatile; PAH = Polynuclear Aromatic Hydrocarbon; PES = Pesticide; PCB = Polychlorinated Biphenyl; ING = Inorganic
(5) Mammals: acute = <90days, subchronic = 90days - 1yr, chronic = >1yr. Birds: acute = <18days, subchronic = 18days - 10wks, chronic = >10wks. Source: Sample et al. 1996
If the study is during a critical life stage (gestation or development), the study may be considered a chronic exposure.
(6) The product of the appropriate uncertainty factors from each uncertainty category becomes the total uncertainty factor applied to develop the constituent-specific TRV.

TABLE F-14
NOAEL Toxicity Reference Values - Soil Receptors (Birds)
SEAD 63
Seneca Army Depot Activity

Constituent	Test Organism	Endpoint/Duration/Effect	Source	Effect Dose (mg/kg/day)	Endpoint CF[1]	Study Duration CF[1]	Total CF[1]	TRV[2] (mg/kg/day)
Volatiles								
Acetone	Japanese quail	NOAEL, 14-day old, diet, 5 days, survival	Hill and Camardese 1986	6.10E+03	1	10	10	6.10E+02
Benzene		No data available						
Methyl ethyl ketone		No data available						
Toluene		No data available						
Total Xylenes	Japanese quail	NOAEL, 14-day old chicks, diet, 5 days, survival	Hill and Camardese 1986	3.06E+03	1	10	10	3.06E+02
PAHs								
Benzo(a)anthracene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Benzo(a)pyrene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Benzo(b)fluoranthene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Benzo(k)fluoranthene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Chrysene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Dibenz(a,h)anthracene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Fluoranthene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Fluorene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Indeno(1,2,3-cd)pyrene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
2-Methylnaphthalene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Naphthalene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Phenanthrene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Pyrene	mallard	LOAEL, diet, 7 months, physiological (mixed PAHs used as surrogate)	Eisler 1987	2.85E+02	10	1	10	2.85E+01
Semi-volatiles								
Bis(2-ethylhexyl)phthalate	ringed dove	NOAEL, diet, 4 wks. crit. lifestage, reproduction	Sample et al. 1996	1.10E+00	1	10	10	1.10E-01
Butylbenzylphthalate		No data available						
Carbazole		No data available						
Dibenzofuran	red-winged blackbird	LC50, diet, 18 hours, survival	Schafer et al. 1983.	2.18E+01	10	10	100	2.18E-01
Diethyl phthalate	ringed dove	NOAEL, diet, 4 wks. crit. lifestage, reproduction (di-n-butyl-phthalate used as surrogate)	Sample et al. 1996	1.10E-01	1	10	10	1.10E-02
Di-n-butylphthalate	ringed dove	NOAEL, diet, 4 wks. crit. lifestage, reproduction	Sample et al. 1996	1.10E-01	1	10	10	1.10E-02
Di-n-octylphthalate	ringed dove	NOAEL, diet, 4 wks. crit. lifestage, reproduction (Di-n-butylphthalate as surrogate)	Sample et al. 1996	1.10E-01	1	10	10	1.10E-02
Phenol		No data available						

TABLE F-14
NOAEL Toxicity Reference Values - Soil Receptors (Birds)
SEAD 63
Seneca Army Depot Activity

Constituent	Test Organism	Endpoint/Duration/Effect	Source	Effect Dose (mg/kg/day)	Endpoint CF[1]	Study Duration CF[1]	Total CF[1]	TRV[2] (mg/kg/day)
Pesticides								
4,4'-DDD	Japanese quail	NOAEL, diet, 10 week, reproduction (DDT used as surrogate)	Sample et al. 1996	5.60E-01	1	10	10	5.60E-02
4,4'-DDE	Japanese quail	NOAEL, diet, 12 wks, reproduction, liver effects	Sample et al. 1996	5.60E-01	1	10	10	5.60E-02
4,4'-DDT	Japanese quail	NOAEL, diet, 10 week, reproduction	Sample et al. 1996	5.60E-01	1	10	10	5.60E-02
Endosulfan I	gray partridge	NOAEL, diet, 4 wks crit. lifestage, reproduction (endosulfan as surrogate)	Sample et al. 1996	1.00E+01	1	10	10	1.00E+00
Endosulfan sulfate	gray partridge	NOAEL, diet, 4 wks crit. lifestage, reproduction (endosulfan as surrogate)	Sample et al. 1996	1.00E+01	1	10	10	1.00E+00
Endrin ketone	mallard	NOAEL, diet, >200 days, crit. lifestage, reproduction (endrin as surrogate)	Sample et al. 1996	3.00E-01	1	1	1	3.00E-01
Metals								
Cadmium	mallard	NOAEL, diet, 90 days, reproduction	Sample et al. 1996	1.45E+00	1	1	1	1.45E+00
Sodium		No data available						

1 CF = conversion factor.
2 The toxicity reference value was derived by dividing the effect dose by the total conversion factor.

exposure concentration at which no harmful effects were observed. Use of the NOAEL as the toxicity benchmark is more conservative than use of the LOAEL (lowest observed adverse effect level). Exposure of receptors to the LOAEL has been predicted to translate into less than 20 percent reduction in population size (Suter et al., 1994) or Lowest Observed Effects Concentrations.

For the terrestrial receptor, the order of taxonomic preference when choosing TRVs was data from studies using (1) native small mammal species potentially present at the site, or (2) proxy species, such as commonly studied laboratory species. The preferred toxicity test endpoint was the NOAEL from an appropriate chronic study for non-lethal or reproductive effects. When NOAEL values were not available, LOAELs for were used, as available. Values based on chronic studies were preferred. Studies were considered to provide chronic toxicity data if conducted for a minimum duration of 1 year in mammals. Studies longer than acute but shorter than chronic are considered subchronic. Studies shorter than 90 days in mammals were considered acute. Studies on developmental effects were considered chronic if conducted during a critical gestation period.

The toxicity values selected by this approach were modified through the application of uncertainty factors, as applicable, to derive a TRV for each COPC. The TRVs represent NOAELs with uncertainty factors incorporated for toxicity information derived from studies other than chronic studies and studies on species other than the receptors selected for this risk assessment. Where only a LOAEL was available, an uncertainty factor of 10 was applied, as recommended by EPA Region II, to represent a surrogate NOAEL. In addition, where toxicity information for a surrogate contaminant was used, an uncertainty factor of 10 was applied. Uncertainty factors were applied by dividing the initial toxicity value by the product of the necessary uncertainty factors. Uncertainty factors are listed in **Tables F-13** and **F-14** with the TRVs developed for shallow soil/sediment COPCs.

F.6.4 Risk Characterization

Risk characterization integrates exposure(s) and effect(s) on receptors using hazard quotients (HQs) (ratios of exposure and effect concentrations). The resulting data are used to define the magnitude of risk from ecological COPCs at the site and to assess the risk to ecological receptors. Risk characterization uses the results of the exposure and effects assessments to calculate an HQ for each COPC. The HQs are based on relevant measurement endpoints and are indicative of the COPC's potential to pose ecological risk to receptors. Any COPCs for a given exposure group and medium that were identified as likely to pose significant risk to receptors based on their HQs were classified as ecological chemicals of concern (COCs). Risk assessment related uncertainties are also analyzed and discussed.

Estimation of a COPC's potential to pose significant risk to receptors is based on the magnitude of the HQ value calculated for each constituent. as well as other factors such as the bioaccumulation/biomagnification potential, mechanism of toxicity, physicochemical characteristics, environmental fate, and ecological relevance of each contaminant. The HQ is a ratio of the estimated exposure dose (for terrestrial receptors) of a constituent to the TRV. Generally, a higher ratio or quotient indicates a greater likelihood of an effect. Typically, a quotient of 1 is considered the threshold level at which effects may occur. The TRVs on which the HQs were based were derived to be conservative and representative of chronic exposures, as described previously in **Section F.6.3.3.**

The calculated HQs were used to assess the potential that toxicological effects will occur among the site's receptors. The HQs were compared to HQ guidelines for assessing the risk posed from contaminants (Menzie et al., 1993). These guidelines suggest that HQs less than or equal to 1 present no probable risk; HQs from 1 up to, but less than, 10 present a small potential for environmental effects; HQs from 10 up to, but less than 100 present a significant potential for ecological effects, and HQs greater than 100 present the highest potential for expected effects. The likelihood that a population of deer mice or short-tailed shrews could be significantly impacted by the toxicological effect(s) produced by a given COPC was a major factor in the subsequent determination (in **Section F.6.3.3**) of whether that contaminant should be classified as an ecological COC.

Ecological risk from COPCs was characterized for potential future land use at the site. Risks from constituents found in soil available to terrestrial receptors were assessed quantitatively. Complete exposure calculations for the site are included in **Tables F-15** (mammals) and **F-16** (birds). The hazard quotients calculated for the site are also summarized in **Table F-17** (mammals) and **Table F-18** (birds). Significant findings are summarized in the sections below.

TABLE F-15
CALCULATED SURFACE SOIL/SEDIMENT (0-2' bls) EXPOSURE - MAMMALS
SEAD-63
Seneca Army Depot Activity

Constituent	Max Detected Conc. (mg/kg)	SP[1] (unitless)	BAF[2] (unitless)	Deer Mouse Max Exposure[3] (mg/kg/day)	Shrew Max Exposure[3] (mg/kg/day)
Volatiles					
Acetone	1.50E-01	5.33E+01	3.90E-01	8.70E-01	2.87E-01
Benzene	2.00E-03	2.34E+00	2.45E+01	5.81E-03	2.80E-02
Methyl ethyl ketone	3.50E-02	2.74E+01	9.60E-01	1.07E-01	4.96E-02
Toluene	1.40E-02	1.39E+00	7.24E+01	1.12E-01	5.77E-01
Total Xylenes	1.40E-02	5.62E-01	6.00E+00	9.98E-03	4.80E-02
PAHs					--
Benzo(a)anthracene	2.00E+00	1.51E-02	1.25E-01	3.91E-02	1.43E-01
Benzo(a)pyrene	2.70E+00	1.02E+00	4.50E+00	1.62E+00	6.99E+00
Benzo(b)fluoranthene	3.50E+00	6.17E-03	3.20E-01	1.39E-01	6.37E-01
Benzo(k)fluoranthene	1.90E+00	4.25E-03	2.53E-01	6.11E-02	2.73E-01
Chrysene	2.20E+00	2.22E-02	1.75E-01	5.65E-02	2.20E-01
Dibenz(a,h)anthracene	1.20E+00	8.16E-03	3.68E-01	5.40E-02	2.51E-01
Fluoranthene	4.30E+00	3.72E-02	7.92E-01	4.04E-01	1.94E+00
Fluorene	1.10E-01	1.61E-01	3.42E-01	6.46E-03	2.19E-02
Indeno(1,2,3-cd)pyrene	2.50E+00	1.37E-03	4.19E-01	1.25E-01	5.95E-01
2-Methylnaphthalene	1.40E-02	1.63E-01	3.42E-01	8.25E-04	2.79E-03
Naphthalene	2.30E-02	4.43E-01	3.42E-01	2.05E-03	4.79E-03
Phenanthrene	1.50E+00	1.02E-01	1.22E-01	4.29E-02	1.09E-01
Pyrene	3.20E+00	4.43E-02	9.20E-02	6.12E-02	1.72E-01
Semi-volatiles					--
Bis(2-ethylhexyl)phthalate	1.80E+00	5.10E-03	1.20E+01	2.34E+00	1.23E+01
Butylbenzylphthalate	1.20E-01	5.60E-02	1.00E+00	1.42E-02	6.84E-02
Carbazole	4.30E-01	1.00E+00	1.15E+02	5.39E+00	2.81E+01
Dibenzofuran	3.60E-02	1.51E-01	1.00E+00	4.63E-03	2.06E-02
Diethyl phthalate	9.20E-02	7.14E-01	1.17E+00	1.91E-02	6.33E-02
Di-n-butylphthalate	1.20E-01	1.25E-01	1.25E+00	1.83E-02	8.57E-02
Di-n-octylphthalate	1.90E-02	1.60E-04	4.90E+03	1.01E+01	5.29E+01
Phenol	9.30E-02	5.40E+00	1.00E+00	6.47E-02	6.88E-02
Pesticides					--
4,4'-DDD	3.90E-03	1.34E-02	1.00E-01	6.49E-05	2.23E-04
4,4'-DDE	9.20E-03	1.80E-02	2.50E-02	8.32E-05	1.36E-04
4,4'-DDT	8.30E-03	1.00E-02	1.00E-01	1.35E-04	4.74E-04
Endosulfan I	7.50E-03	3.44E-01	2.50E-01	5.14E-04	1.15E-03
Endosulfan sulfate	5.20E-03	2.97E-01	2.50E-01	3.30E-04	7.88E-04
Endrin ketone	9.40E-03	2.20E-02	1.80E-01	2.46E-04	9.68E-04
Metals					--
Cadmium	8.30E-01	5.50E-01	2.15E-02	1.54E-02	1.30E-02
Sodium	5.78E+02	1.00E+00	1.00E+00	7.75E+01	3.32E+02

1 SP: soil-to-plant uptake factor.
2 BAF: bioaccumulation factor.
3 Exposure calculated as

ED = [(Cs * SP * CF * Ip) + (Cs * BAF * Ia) + (Cs * Is)] * SFF / BW

Where, ED = exposure dose

Cs = maximum or mean concentration in soil (mg/kg)
CF = plant dry-to-wet-weight conversion factor (0.2) for inorganics only
SP = soil-to-plant uptake factor for vegetative matter
Ip = plant-matter intake rate; Mouse = 0.00216 kg/day, Shrew = 0.000477 kg/day.
BAF = invertebrate bioaccumulation factor (unitless)
Ia = animal-matter intake rate; Mouse = 0.00216 kg/day, Shrew = 0.008523 kg/day.
Is = incidental soil intake rate; Mouse = 0 000088 kg/day, Shrew = 0 kg/day.
SFF = site foraging factor = 1
BW = body weight: Mouse = 0.02 kg, Shrew = 0.015 kg

TABLE F-16
CALUCULATED SURFACE SOIL/SEDIMENT (0-2' bls) EXPOSURE - BIRDS
SEAD 63
Seneca Army Depot Activity

Constituent	Max Detected Conc. (mg/kg)	SP[1] (unitless)	BAF[2] (unitless)	Robin Max Exposure[3] (mg/kg/day)	Dove Max Exposure[3] (mg/kg/day)
Volatiles					
Acetone	1.50E-01	5.33E+01	3.90E-01	2.25E+00	5.83E-02
Benzene	2.00E-03	2.34E+00	2.45E+01	1.87E-02	1.10E-04
Methyl ethyl ketone	3.50E-02	2.74E+01	9.60E-01	2.80E-01	7.15E-03
Toluene	1.40E-02	1.39E+00	7.24E+01	3.64E-01	1.52E-03
Total Xylenes	1.40E-02	5.62E-01	6.00E+00	3.28E-02	2.66E-04
PAHs					
Benzo(a)anthracene	2.00E+00	1.51E-02	1.25E-01	2.43E-01	1.53E-02
Benzo(a)pyrene	2.70E+00	1.02E+00	4.50E+00	5.24E+00	5.50E-02
Benzo(b)fluoranthene	3.50E+00	6.17E-03	3.20E-01	6.56E-01	2.75E-02
Benzo(k)fluoranthene	1.90E+00	4.25E-03	2.53E-01	3.10E-01	1.47E-02
Chrysene	2.20E+00	2.22E-02	1.75E-01	3.10E-01	1.71E-02
Dibenz(a,h)anthracene	1.20E+00	8.16E-03	3.68E-01	2.46E-01	9.51E-03
Fluoranthene	4.30E+00	3.72E-02	7.92E-01	1.56E+00	3.73E-02
Fluorene	1.10E-01	1.61E-01	3.42E-01	2.62E-02	9.88E-04
Indeno(1,2,3-cd)pyrene	2.50E+00	1.37E-03	4.19E-01	5.53E-01	1.98E-02
2-Methylnaphthalene	1.40E-02	1.63E-01	3.42E-01	3.34E-03	1.26E-04
Naphthalene	2.30E-02	4.43E-01	3.42E-01	7.27E-03	2.53E-04
Phenanthrene	1.50E+00	1.02E-01	1.22E-01	2.17E-01	1.24E-02
Pyrene	3.20E+00	4.43E-02	9.20E-02	3.77E-01	2.51E-02
Semi-volatiles					
Bis(2-ethylhexyl)phthalate	1.80E+00	5.10E-03	1.20E+01	7.75E+00	4.06E-02
Butylbenzylphthalate	1.20E-01	5.60E-02	1.00E+00	5.29E-02	1.09E-03
Carbazole	4.30E-01	1.00E+00	1.15E+02	1.76E+01	6.86E-02
Dibenzofuran	3.60E-02	1.51E-01	1.00E+00	1.68E-02	3.50E-04
Diethyl phthalate	9.20E-02	7.14E-01	1.17E+02	3.82E+00	1.47E-02
Di-n-butylphthalate	1.20E-01	1.25E-01	1.25E-01	1.82E-02	1.01E-03
Di-n-octylphthalate	1.90E-02	1.60E-04	4.90E+03	3.28E+01	1.17E-01
Phenol	9.30E-02	5.40E+00	1.00E+00	1.79E-01	4.39E-03
Pesticides					
4,4'-DDD	3.90E-03	1.34E-02	1.00E-01	4.37E-04	2.97E-05
4,4'-DDE	9.20E-03	1.80E-02	2.50E-02	7.99E-04	6.96E-05
4,4'-DDT	8.30E-03	1.00E-02	1.00E-01	9.22E-04	6.31E-05
Endosulfan I	7.50E-03	3.44E-01	2.50E-01	1.92E-03	7.63E-05
Endosulfan sulfate	5.20E-03	2.97E-01	2.50E-01	1.27E-03	5.11E-05
Endrin ketone	9.40E-03	2.20E-02	1.80E-01	1.34E-03	7.32E-05
Metals					
Cadmium	8.30E-01	5.50E-01	2.15E-02	9.22E-02	6.82E-03
Sodium	5.78E+02	1.00E+00	1.00E+00	2.78E+02	5.83E+00

1 SP. soil-to-plant uptake factor.
2 BAF. bioaccumulation factor.
3 Exposure calculated as

ED = [(Cs * SP * CF * Ip) + (Cs * BAF * Ia) + (Cs * Is)] * SFF / BW

Where, ED = exposure dose

Cs = maximum or mean concentration in soil (mg/kg)
CF = plant dry-to-wet-weight conversion factor (0.2) for inorganics only
SP = soil-to-plant uptake factor for vegetative matter
Ip = plant-matter intake rate; Robin = 0.0366 kg/day, Dove = 0.00931 kg/day
BAF = invertebrate bioaccumulation factor (unitless)
Ia = animal-matter intake rate; Robin = 0.0466 kg/day, Dove = 0.00164 kg/day
Is = incidental soil intake rate; Robin = 0.00965 kg/day, Dove = 0.00125 kg/day
SFF = Robin = 0.583, Dove = 0.120
BW = body weight; Robin = 0.077 kg, Dove = 0.157 kg

TABLE F-17
CALCULATED SURFACE SOIL/SEDIMENT HAZARD QUOTIENTS - MAMMALS
SEAD-63
Seneca Army Depot Activity

Constituent	Deer Mouse Exposure (mg/kg/day) [1]	Short-tailed Shrew Exposure (mg/kg/day) [1]	Toxicity Reference Value (mg/kg/day) [2]	Deer Mouse Hazard Quotient [3]	Short-tailed Shrew Hazard Quotient [3]
Volatiles					
Acetone	8.70E-01	2.87E-01	1.00E+01	0.09	0.03
Benzene	5.81E-03	2.80E-02	2.64E+01	0.00	0.00
Methyl ethyl ketone	1.07E-01	4.96E-02	1.77E+02	0.00	0.00
Toluene	1.12E-01	5.77E-01	2.60E+01	0.00	0.02
Total Xylenes	9.98E-03	4.80E-02	2.10E+00	0.00	0.02
PAHs					
Benzo(a)anthracene	3.91E-02	1.43E-01	1.00E+00	0.04	0.14
Benzo(a)pyrene	1.62E+00	6.99E+00	1.00E+00	**1.62**	**6.99**
Benzo(b)fluoranthene	1.39E-01	6.37E-01	1.00E+00	0.14	0.64
Benzo(k)fluoranthene	6.11E-02	2.73E-01	1.00E+00	0.06	0.27
Chrysene	5.65E-02	2.20E-01	1.00E+00	0.06	0.22
Dibenz(a,h)anthracene	5.40E-02	2.51E-01	1.00E+00	0.05	0.25
Fluoranthene	4.04E-01	1.94E+00	1.25E+00	0.32	**1.55**
Fluorene	6.46E-03	2.19E-02	1.25E+00	0.01	0.02
Indeno(1,2,3-cd)pyrene	1.25E-01	5.95E-01	1.00E+00	0.12	0.60
2-Methylnaphthalene	8.25E-04	2.79E-03	7.16E+00	0.00	0.00
Naphthalene	2.05E-03	4.79E-03	7.16E+00	0.00	0.00
Phenanthrene	4.29E-02	1.09E-01	1.00E+00	0.04	0.11
Pyrene	6.12E-02	1.72E-01	1.00E+00	0.06	0.17
Semi-volatiles					
Bis(2-ethylhexyl)phthalate	2.34E+00	1.23E+01	1.83E+01	0.13	0.67
Butylbenzylphthalate	1.42E-02	6.84E-02	1.59E+02	0.00	0.00
Carbazole	5.39E+00	2.81E+01	5.00E+00	**1.08**	**5.62**
Dibenzofuran	4.63E-03	2.06E-02	no data	--	--
Diethyl phthalate	1.91E-02	6.33E-02	4.58E+03	0.00	0.00
Di-n-butylphthalate	1.83E-02	8.57E-02	5.50E+02	0.00	0.00
Di-n-octylphthalate	1.01E+01	5.29E+01	1.83E+01	0.55	**2.89**
Phenol	6.47E-02	6.88E-02	no data	--	--
Pesticides					
4,4'-DDD	6.49E-05	2.23E-04	8.00E-01	0.00	0.00
4,4'-DDE	8.32E-05	1.36E-04	8.00E-01	0.00	0.00
4,4'-DDT	1.35E-04	4.74E-04	8.00E-01	0.00	0.00
Endosulfan I	5.14E-04	1.15E-03	5.00E-01	0.00	0.00
Endosulfan sulfate	3.30E-04	7.88E-04	2.50E-01	0.00	0.00
Endrin ketone	2.46E-04	9.68E-04	9.20E-02	0.00	0.01
Metals					
Cadmium	1.54E-02	1.30E-02	1.00E+00	0.02	0.01
Sodium	7.75E+01	3.32E+02	no data	--	--

(1) Receptor exposure from Table I-15
(2) Toxicity reference value from Table A-10
(3) Hazard quotient calculated as HQ = exposure rate / toxicity reference value
with HQ < 1, no effects expected
1 < HQ =< 10, small potential for effects
10 < HQ =< 100, potential for greater exposure to result in effects and
HQ > 100, highest potential for effects

TABLE F-18
CALCULATED SURFACE SOIL/SEDIMENT HAZARD QUOTIENTS - BIRDS
SEAD 63
Seneca Army Depot Activity

Constituent	Robin Max Exposure[1] (mg/kg/day)	Dove Max Exposure[1] (mg/kg/day)	NOAEL Toxicity Reference Value[2] (mg/kg/day)	Robin NOAEL Max Hazard Quotient[3]	Dove NOAEL Max Hazard Quotient[3]
Volatiles					
Acetone	2.25E+00	5.83E-02	6.10E+02	0.00	0.00
Benzene	1.87E-02	1.10E-04	No data	--	--
Methyl ethyl ketone	2.80E-01	7.15E-03	No data	--	--
Toluene	3.64E-01	1.52E-03	No data	--	--
Total Xylenes	3.28E-02	2.66E-04	3.06E+02	0.00	0.00
PAHs					
Benzo(a)anthracene	2.43E-01	1.53E-02	2.85E+01	0.01	0.00
Benzo(a)pyrene	5.24E+00	5.50E-02	2.85E+01	0.18	0.00
Benzo(b)fluoranthene	6.56E-01	2.75E-02	2.85E+01	0.02	0.00
Benzo(k)fluoranthene	3.10E-01	1.47E-02	2.85E+01	0.01	0.00
Chrysene	3.10E-01	1.71E-02	2.85E+01	0.01	0.00
Dibenz(a,h)anthracene	2.46E-01	9.51E-03	2.85E+01	0.01	0.00
Fluoranthene	1.56E+00	3.73E-02	2.85E+01	0.05	0.00
Fluorene	2.62E-02	9.88E-04	2.85E+01	0.00	0.00
Indeno(1,2,3-cd)pyrene	5.53E-01	1.98E-02	2.85E+01	0.02	0.00
2-Methylnaphthalene	3.34E-03	1.26E-04	2.85E+01	0.00	0.00
Naphthalene	7.27E-03	2.53E-04	2.85E+01	0.00	0.00
Phenanthrene	2.17E-01	1.24E-02	2.85E+01	0.01	0.00
Pyrene	3.77E-01	2.51E-02	2.85E+01	0.01	0.00
Semi-volatiles					
Bis(2-ethylhexyl)phthalate	7.75E+00	4.06E-02	1.10E-01	**70**	0.37
Butylbenzylphthalate	5.29E-02	1.09E-03	No data	--	--
Carbazole	1.76E+01	6.86E-02	No data	--	--
Dibenzofuran	1.68E-02	3.50E-04	2.18E-01	0.08	0.00
Diethyl phthalate	3.82E+00	1.47E-02	1.10E-02	**347**	**1.3**
Di-n-butylphthalate	1.82E-02	1.01E-03	1.10E-02	**1.7**	0.09
Di-n-octylphthalate	3.28E+01	1.17E-01	1.10E-02	**2984**	**10.7**
Phenol	1.79E-01	4.39E-03	No data	--	--
Pesticides					
4,4'-DDD	4.37E-04	2.97E-05	5.60E-02	0.01	0.00
4,4'-DDE	7.99E-04	6.96E-05	5.60E-02	0.01	0.00
4,4'-DDT	9.22E-04	6.31E-05	5.60E-02	0.02	0.00
Endosulfan I	1.92E-03	7.63E-05	1.00E+00	0.00	0.00
Endosulfan sulfate	1.27E-03	5.11E-05	1.00E+00	0.00	0.00
Endrin ketone	1.34E-03	7.32E-05	3.00E-01	0.00	0.00
Metals					
Cadmium	9.22E-02	6.82E-03	1.45E+00	0.06	0.00
Sodium	2.78E+02	5.83E+00	No data	--	--

1 Receptor exposure from Table H.30.
2 NOAEL toxicity reference value from Table H.13.
3 Hazard quotient calculated as HQ = exposure rate / toxicity reference value
BOLD : represents receptor HQ > 1.

Mammals

Compound	Deer Mouse Hazard Quotient	Shrew Hazard Quotient
Benzo(a)pyrene	**1.6**	**7.0**
Carbazole	**1.1**	**5.6**
Fluoranthene	0.3	**1.6**
Di-n-octylphthalate	0.6	**2.9**

The hazard quotients calculated for the mammalian species are all ascribed to limited zones of shallow soil/sediment contamination as they generally result due to finding elevated concentrations of the chemicals in one or more related samples. Specifically, the hazard quotients calculated for Benzo(a)pyrene, Carbazole, and Fluoranthene initially result from measuring elevated concentrations of each of these species (i.e., 2,700 ug/Kg, 430 ug/Kg, and 4,300 ug/Kg, respectively) at a single location SW/SD63-19. Of further note is the fact that the second highest concentration measured in any shallow soil/sediment sample for each of these compounds is also collocated in a sample collected from SW/SD63-18. Using the next highest measured concentration for each species and repeating the hazard quotient calculation results in the indication that concentrations measured for one of the problematic chemicals (i.e., Fluoranthene) is potentially acceptable, while a reduced hazard quotient is still represented by the other two chemicals for the shrew.

If the third highest measured concentration is then used for the remaining two species (i.e., 540 ug/Kg for benzo(a)pyrene at SW/SD63-4 and 93 ug/kg for carbazole SW/SD63-13), the computed hazard quotients for the shrew are further reduced to 1.4 and 1.2, respectively for the shrew. Of additional note, is the fact that the continuing high carbazole level is found in the location SW/SD63-4 that is downgradient of both SW/SD 63-18 and 19. The computed hazard quotient for all three chemicals and the deer mouse are all less than 1.

If the maximum concentrations measured for the benzo(a)pyrene and the carbazole are set to the fourth highest concentration measured (i.e., 200 ug/Kg and 34 ug/Kg, respectively), the calculated risk posed to the shrew is also eliminated.

With respect to the hazard quotient recorded for Di-n-octylphthalate, this results due the sole sample in which it was detected at a concentration of 19J ug/Kg. This sample was collected at location SWSD63-3, which is north of SEAD-63.

Birds

The HQs computed for four phthalate species based on the maximum observed concentration in shallow soil/sediment samples indicate that site contaminants represent a potential threat to the American Robin and/or the Mourning Dove. A summary of this data is presented below:

Compound	American Robin Hazard Quotient	Mourning Dove Hazard Quotient
Bis(2-ethylhexyl)phthalate	**70**	0.37
Diethyl phthalate	**347**	**1.3**
Di-n-butylphthalate	**1.7**	0.09
Di-n-octylphthalate	**2984**	**10.7**

Bis(2-ethylhexyl)phthalate was found in 17 of 27 shallow soil/sediment samples collected from SEAD-63. Measured concentrations ranged from a minimum of 8.3 to a maximum of 1,800 ug/Kg. Based on the indices used for the determination for the robin, the maximum concentration that could be measured to ensure that no risk was present for the robin would be 26 ug/Kg. Seven of the 17 samples that contained Bis2-ethylhexyl)phthalate exhibit concentrations that were higher than this level. These samples are all generally located in the vicinity of the former burial area.

Diethyl phthalate was detected in 9 of 22 shallow soil/sediment samples collected from the area of SEAD-63. Measured concentrations ranged from a low of 4.7 to a high of 92 ug/Kg. All of the measured concentrations would represent a potential threat to the American Robin, while any concentration in excess of 70 ug/Kg would suggest a potential threat to the Mourning Dove. The identified Diethyl phthalate is all located in drainage ditches that surrounds the former burial area.

Di-n-butylphthalate was detected in 7 of the 27 shallow soil/sediment samples collected from the area of SEAD-63. Measured concentrations ranged from a low of 6.5 to a high of 120 ug/Kg. The second highest concentration measured in any shallow soil/sediment sample was 19 ug/Kg, and at this concentration the hazard quotient calculated for the robin would drop to 0.28. This suggests that the presumed risk associated with this compound is restricted to a hotspot that is near SWSD63-14..

Di-n-octylphthalate was detected in 1 of the 22 shallow soil/sediment samples collected from the area of SEAD-63. The only measured concentration found for this compound was 19J. This suggests that the apparent risk posed to both the robin and dove is associated with a hot spot that is located at SWSD63-3, as is noted above for the mouse and shrew.

F.6.4.1 Uncertainty

Uncertainty is inherent in each step of the ecological risk assessment process. Major factors contributing to uncertainty in this risk assessment are discussed qualitatively in the following sections.

Chemicals of Potential Concern

The sampling data may not represent the actual overall distribution of contamination at the site, which could result in underestimation or overestimation of potential risk from identified chemicals. However, the use of maximum concentrations provided conservative exposure estimates and it is, therefore, unlikely that the potential for deleterious levels of contaminants has been underestimated.

Exposure Assessment

While the potential receptor species selected for the site are inevitably a limited subset of the total list of species that may utilize the site, the potential exposure of the species evaluated in this assessment is considered likely to be representative of the nature and magnitude of the exposures experienced by those species not discussed.

Risk associated with intake of contaminants through the terrestrial food chain was addressed by modeling food chain transfer of chemical residues through plants and earthworms. The degree of uncertainty in the results of the analysis increases with the increasing distance of the receptor from the base of the food chain. Intakes from dermal contact with and inhalation of contaminants were not quantifiable for ecological receptors. However, this does not significantly increase the uncertainty of the estimated intakes because for most receptors, intakes via these routes are likely to be minimal relative to intakes via ingestion.

Toxicity Assessment

There is uncertainty associated with the TRVs calculated for this risk characterization because the toxicity data were not site-specific. However, the TRVs used were conservative and were modified by uncertainty factors where necessary to increase the applicability of the data to the assessment. The HQs calculated from these conservative TRVs and maximum concentrations provide confidence that the risk assessment yielded reasonably conservative estimates of the potential risk of adverse ecological effects on the assessment endpoint.

Each COPC was assumed to be highly bioavailable. However, for most chemicals in most media, this is an overestimation (Dixon et al., 1993) that may result in an overestimation of the potential for ecological risk. Empirical information on bioavailability of the COPCs was not available. No leachability tests in soil or sediment were conducted. No analysis for acid-volatile sulfide/simultaneously extracted metals was conducted as a measure of bioavailability in sediment. It is possible that some of the contaminants, particularly the metals, may be bound to soil or sediment particles and not available for uptake by receptors. This would tend to overestimate risk.

The soil-to-plant uptake equations and the BAFs include a bioavailability factor; however, these data, taken from the scientific literature, are not specific to this site and may under- or overestimate exposure. For several metals, no quantitative bioavailability data could be found, other than an indication from the literature that the constituent does not significantly bioaccumulate. For these metals, a bioaccumulation factor of 1.0 was used in the exposure equation. This is likely to overestimate the actual value.

The potential for toxic effects to be produced in receptor organisms as a result of exposure to multiple chemicals in a single medium or in multiple media was not evaluated. Therefore, the potential toxic effects in a receptor as a result of exposure to a given medium could be higher or lower than estimated, depending on toxicological interactions. Exposure of a receptor to multiple contaminated media is likely to increase the risk of toxic effects.

Risk Characterization

The methodology, conservative assumptions, and toxicity benchmarks used in the risk estimation portion of the risk characterization are expected to overestimate, rather than underestimate, the potential for COPCs to pose risk to the ecological assessment endpoint. Maximum environmental concentrations were used, concentrations were assumed to remain constant over time, and the toxicity benchmarks used were the NOAEL values (levels where no toxic effects are expected) or conservative surrogates based on LOAEL values for non-lethal or reproductive effects appropriate for extrapolation to effects on the assessment endpoint.

F.6.4.2 Ecological Risk Summary

COPCs in soil were quantitatively assessed for ecological risk for future conditions. These COPCs include contaminants estimated to have the potential to pose adverse effects to the selected assessment endpoints. Exposure to these COPCs by representative terrestrial receptors (deer mouse, American robin, mourning dove, and short-tailed shrew) was further evaluated to determine if any COPCs have a high likelihood of being a risk to the receptor population analyzed for this risk assessment or the ecological community that encompasses the study area.

A hierarchy of assessment endpoints was selected to assess both proximate and ultimate risks that might be associated with site-related chemicals. The proximate assessment endpoint was chosen to provide protection of the population levels of vertebrate species that utilize the sites to a significant extent and that are important as indicators of potential effects on the health of the community. Deer mice and short-tailed shrews represent terrestrial vertebrate populations at the sites. The American robin and mourning dove represent avian populations that usually remain close to or on the surface of the soil and come in contact with it quite frequently. Although toxic effects that reduce this assessment endpoint population or the populations they represent in the immediate vicinity of the site are significant to the populations themselves, they are not necessarily significant to the ultimate, more important, assessment endpoint: the community of species that occupies the area surrounding and including the site.

It is this ultimate assessment endpoint, maintenance of the health and diversity of the natural community in the area, that is the most important ecological component to be protected with regard to this site. Therefore, any COCs estimated to pose a potential for adverse effects to proximate assessment endpoints would subsequently be evaluated with regard to the risk they may pose to the ultimate assessment endpoint.

The ecological setting of the site is not unique or significant, as described in **Section F.6.2.2.** There are no endangered, threatened, or special concern species in the vicinity that are likely to be dependent on or affected by the habitat at the site. The species that inhabit the site are not rare in the region and are not generally considered to be of special societal value. The habitat in the site appears to be relatively low in diversity and productivity.

In soils available to terrestrial receptors (0-2-ft. depth), representative of future conditions at the site, HQs calculated for seven semivolatile organic compounds indicate that potential risks may exist for selected mammalian and avian species. Closer review of these data indicates that the posed threats may be isolated to hot spots that required closer examination during the proposed removal action.

TABLE A-1
CALCULATION OF INTAKE AND RISK FROM INHALATION OF DUST IN AMBIENT AIR
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CA \times IR \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CA = Chemical Concentration in Air, Calculated from Air EPC Data
IR = Inhalation Rate
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Inhalation RfD	Carc. Slope Inhalation	Air EPC* from Surface Soil	Air EPC* from Total Soils	Park Worker				Recreational Visitor (Child)				Construction Worker			
					Intake (mg/kg-day)		Hazard Quotient	Cancer Risk	Intake (mg/kg-day)		Hazard Quotient	Cancer Risk	Intake (mg/kg-day)		Hazard Quotient	Cancer Risk
	(mg/kg-day)	(mg/kg-day)-1	(mg/m3)	(mg/m3)	(Nc)	(Car)			(Nc)	(Car)			(Nc)	(Car)		
Volatile Organics																
Acetone	NA	NA		2.37E-008												
2-Butanone	2.86E-001	NA		6.81E-009									6.93E-010		2E-009	
Benzene	1.71E-003	2.73E-002	3.40E-011	5.92E-010	1.86E-012	6.65E-013	1E-009	2E-014	4.21E-012	3.01E-013	2E-009	8E-015	6.02E-011	8.61E-013	4E-008	2E-014
Toluene	1.14E-001	NA	1.02E-010	3.40E-009	5.59E-012		5E-011		1.26E-011		1E-010		3.46E-010		3E-009	
Total Xylenes	NA	NA	2.38E-010	2.07E-009												
Semivolatile Organics																
Benzo(a)anthracene	NA	NA		4.44E-009												
Benzo(a)pyrene	NA	NA	4.08E-010	6.66E-009												
Benzo(b)fluoranthene	NA	NA	3.57E-010	5.62E-009												
Benzo(ghi)perylene	NA	NA		4.59E-009												
Benzo(k)fluoranthene	NA	NA	3.57E-010	6.36E-009												
bis(2-Ethylhexyl)phthalate	NA	NA	3.06E-008	2.66E-007												
Chrysene	NA	NA	3.91E-010	4.59E-009												
Dibenz(a,h)anthracene	NA	NA		4.14E-009												
Di-n-butylphthalate	NA	NA		1.29E-008												
Fluoranthene	NA	NA	6.46E-010	9.32E-009												
Indeno(1,2,3-cd)pyrene	NA	NA		5.48E-009												
Phenanthrene	NA	NA		4.59E-009												
Pesticides/PCBs																
4,4'-DDD	NA	NA		2.96E-010												
4,4'-DDE	NA	NA		6.51E-010												
4,4'-DDT	NA	3.40E-001		4.88E-010										7.10E-013		2E-013
Metals																
Cadmium	NA	6.30E+000	9.52E-009	3.55E-006		1.86E-010		1E-009		8.43E-011		5E-010		5.16E-009		3E-008
Mercury	8.57E-005	NA	1.02E-009	7.25E-008	5.59E-011		7E-007		1.26E-010		1E-006		7.38E-009		9E-005	
Total Hazard Quotient and Cancer Risk:							**7E-007**	**1E-009**			**1E-006**	**5E-010**			**9E-005**	**3E-008**

Assumptions for Park Worker			Assumptions for Recreational Visitor (Child)			Assumptions for Construction Worker		
CA =	EPC Surface Only		CA =	EPC Surface Only		CA =	EPC Surface and Sub-Surface	
BW =	70	kg	BW =	15	kg	BW =	70	kg
IR =	8	m3/day	IR =	8.7	m3/day	IR =	10.4	m3/day
EF =	175	days/year	EF =	78	days/year	EF =	250	days/year
ED =	25	years	ED =	5	years	ED =	1	year
AT (Nc) =	9,125	days	AT (Nc) =	1,825	days	AT (Nc) =	365	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
* See Table A-3 for calculation of Air EPC.
NA= Information not available.

TABLE-2
CALCULATION OF INTAKE AND RISK FROM INHALATION OF DUST IN AMBIENT AIR
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CA \times IR \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom).
CA = Chemical Concentration in Air, Calculated from Air EPC Data
IR = Inhalation Rate
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Lifetime Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Inhalation RfD (mg/kg-day)	Carc. Slope Inhalation (mg/kg-day)-1	Air EPC* from Surface Soil (mg/m3)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Volatile Organics												
Acetone	NA	NA										
2-Butanone	2.86E-001	NA										
Benzene	1.71E-003	2.73E-002	3.40E-011	9.32E-012	3.19E-012	5E-009	9E-014	1.89E-011	1.62E-012	1E-008	4E-014	1E-013
Toluene	1.14E-001	NA	1.02E-010	2.79E-011		2E-010		5.67E-011		5E-010		
Total Xylenes	NA	NA	2.38E-010									
Semivolatile Organics												
Benzo(a)anthracene	NA	NA										
Benzo(a)pyrene	NA	NA	4.08E-010									
Benzo(b)fluoranthene	NA	NA	3.57E-010									
Benzo(ghi)perylene	NA	NA										
Benzo(k)fluoranthene	NA	NA	3.57E-010									
bis(2-Ethylhexyl)phthalate	NA	NA	3.06E-008									
Chrysene	NA	NA	3.91E-010									
Dibenz(a,h)anthracene	NA	NA										
Di-n-butylphthalate	NA	NA										
Fluoranthene	NA	NA	6.46E-010									
Indeno(1,2,3-cd)pyrene	NA	NA										
Phenanthrene	NA	NA										
Pesticides/PCBs												
4,4'-DDD	NA	NA										
4,4'-DDE	NA	NA										
4,4'-DDT	NA	3.40E-001										
Metals												
Cadmium	NA	6.30E+000	9.52E-009		8.94E-010		6E-009		4.54E-010		3E-009	8E-009
Mercury	8.57E-005	NA	1.02E-009	2.79E-010		3E-006		5.67E-010		7E-006		
Total Hazard Quotient and Cancer Risk:						**3E-006**				**7E-006**		**8E-009**

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
CA =	EPC Surface Only		CA =	EPC Surface Only	
BW =	70	kg	BW =	15	kg
IR =	20	m3/day	IR =	8.7	m3/day
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
* See Table A-3 for calculation of Air EPC.
NA= Information not available.

TABLE A-3
AMBIENT AIR EXPOSURE POINT CONCENTRATIONS - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Air EPC from Surface Soil (mg/m^3) = CS dsurf x PM d10 x CF	Equation for Air EPC from Total Soils (mg/m^3) = CS dtot x PM d10 x CF
Variables:	Variables:
CS dsurf = Chemical Concentration in Surface Soil, from EPC data (mg/kg)	CS dtot = Chemical Concentration in Total Soils, from EPC data (mg/kg)
PM d10 = Average Measured PM d10 Concentration = 17 ug/m^3	PM d10 = PM d10 Concentration Calculated for Construction Worker= 148 ug/m^3
CF = Conversion Factor = 1E-9 kg/ug	CF = Conversion Factor = 1E-9 kg/ug

Analyte	EPC Data for Surface Soil (mg/kg)	EPC Data for Total Soils (mg/kg)	Calculated Air EPC Surface Soil (mg/m^3)	Calculated Air EPC Total Soils (mg/m^3)
Volatile Organics				
Acetone		1.60E-001		2.37E-008
2-Butanone		4.60E-002		6.81E-009
Benzene	2.00E-003	4.00E-003	3.40E-011	5.92E-010
Toluene	6.00E-003	2.30E-002	1.02E-010	3.40E-009
Total Xylenes	1.40E-002	1.40E-002	2.38E-010	2.07E-009
Semivolatile Organics				
Benzo(a)anthracene		3.00E-002		4.44E-009
Benzo(a)pyrene	2.40E-002	4.50E-002	4.08E-010	6.66E-009
Benzo(b)fluoranthene	2.10E-002	3.80E-002	3.57E-010	5.62E-009
Benzo(ghi)perylene		3.10E-002		4.59E-009
Benzo(k)fluoranthene	2.10E-002	4.30E-002	3.57E-010	6.36E-009
bis(2-Ethylhexyl)phthalate	1.80E+000	1.80E+000	3.06E-008	2.66E-007
Chrysene	2.30E-002	3.10E-002	3.91E-010	4.59E-009
Dibenz(a,h)anthracene		2.80E-002		4.14E-009
Di-n-butylphthalate		8.70E-002		1.29E-008
Fluoranthene	3.80E-002	6.30E-002	6.46E-010	9.32E-009
Indeno(1,2,3-cd)pyrene		3.70E-002		5.48E-009
Phenanthrene		3.10E-002		4.59E-009
Pesticides/PCBs				
4,4'-DDD		2.00E-003		2.96E-010
4,4'-DDE		4.40E-003		6.51E-010
4,4'-DDT		3.30E-003		4.88E-010
Metals				
Cadmium	5.60E-001	2.40E+001	9.52E-009	3.55E-006
Mercury	6.00E-002	4.90E-001	1.02E-009	7.25E-008

ND = Compound was not detected.

TABLE A-4
CALCULATION OF INTAKE AND RISK FROM THE INGESTION OF SOIL
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Soil, Calculated from Soil EPC Data
IR = Ingestion Rate
CF = Conversion Factor
FI = Fraction Ingested
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Oral RfD	Carc. Slope Oral	EPC Surface Soil	EPC from Total Soils	Park Worker				Recreational Visitor (Child)				Construction Worker			
					Intake (mg/kg-day)		Hazard Quotient	Cancer Risk	Intake (mg/kg-day)		Hazard Quotient	Cancer Risk	Intake (mg/kg-day)		Hazard Quotient	Cancer Risk
	(mg/kg-day)	(mg/kg-day)-1	(mg/kg)	(mg/kg)	(Nc)	(Car)			(Nc)	(Car)			(Nc)	(Car)		
Volatile Organics																
Acetone	1.00E-001	NA		1.60E-001									7.51E-007		8E-006	
2-Butanone	6.00E-001	NA		4.60E-002									2.16E-007		4E-007	
Benzene	3.00E-003	2.90E-002	2.00E-003	4.00E-003	1.37E-009	4.89E-010	5E-007	1E-011	5.70E-009	4.07E-010	2E-006	1E-011	1.88E-008	2.68E-010	6E-006	8E-012
Toluene	2.00E-001	NA	6.00E-003	2.30E-002	4.11E-009		2E-008		1.71E-008		9E-008		1.08E-007		5E-007	
Total Xylenes	2.00E+000	NA	1.40E-002	1.40E-002	9 59E-009		5E-009		3.99E-008		2E-008		6.58E-008		3E-008	
Semivolatile Organics																
Benzo(a)anthracene	NA	7.30E-001		3.00E-002										2.01E-009		1E-009
Benzo(a)pyrene	NA	7.30E+000	2.40E-002	4.50E-002		5.87E-009		4E-008		4.88E-009		4E-008		3.02E-009		2E-008
Benzo(b)fluoranthene	NA	7.30E-001	2.10E-002	3.80E-002		5.14E-009		4E-009		4.27E-009		3E-009		2.55E-009		2E-009
Benzo(ghi)perylene	NA	NA		3.10E-002												
Benzo(k)fluoranthene	NA	7.30E-002	2.10E-002	4.30E-002		5.14E-009		4E-010		4.27E-009		3E-010		2.89E-009		2E-010
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	1.80E+000	1.80E+000	1.23E-006	4.40E-007	6E-005	6E-009	5.13E-006	3.66E-007	3E-004	5E-009	8.45E-006	1.21E-007	4E-004	2E-009
Chrysene	NA	7.30E-003	2.30E-002	3.10E-002		5.63E-009		4E-011		4.68E-009		3E-011		2.08E-009		2E-011
Dibenz(a,h)anthracene	NA	7.30E+000		2.80E-002										1.88E-009		1E-008
Di-n-butylphthalate	1.00E-001	NA		8.70E-002									4.09E-007		4E-006	
Fluoranthene	4.00E-002	NA	3.80E-002	6.30E-002	2.60E-008		7E-007		1.08E-007		3E-006		2.96E-007		7E-006	
Indeno(1,2,3-cd)pyrene	NA	7.30E-001		3.70E-002										2.48E-009		2E-009
Phenanthrene	NA	NA		3.10E-002												
Pesticides/PCBs																
4,4'-DDD	NA	2.40E-001		2.00E-003										1.34E-010		3E-011
4,4'-DDE	NA	3.40E-001		4.40E-003										2.95E-010		1E-010
4,4'-DDT	5.00E-004	3.40E-001		3.30E-003									1.55E-008	2.21E-010	3E-005	8E-011
Metals																
Cadmium	5.00E-004	NA	5.60E-001	2.40E+001	3.84E-007		8E-004		1.60E-006		3E-003		1.13E-004		2E-001	
Mercury	3.00E-004	NA	6.00E-002	4.90E-001	4.11E-008		1E-004		1.71E-007		6E-004		2.30E-006		8E-003	
Total Hazard Quotient and Cancer Risk:							**1E-003**	**5E-008**			**4E-003**	**4E-008**			**2E-001**	**4E-008**

Assumptions for Park Worker			Assumptions for Recreational Visitor (Child)			Assumptions for Construction Worker		
CF =	1E-006	kg/mg	CF =	1E-006	kg/mg	CF =	1E-006	kg/mg
CS =	EPC Surface Only		CS =	EPC Surface Only		CS =	EPC Surface and Subsurface	
BW =	70	kg	BW =	15	kg	BW =	70	kg
IR =	100	mg soil/day	IR =	200	mg soil/day	IR =	480	mg soil/day
FI =	1	unitless	FI =	1	unitless	FI =	1	unitless
EF =	175	days/year	EF =	78	days/year	EF =	250	days/year
ED =	25	years	ED =	5	years	ED =	1	years
AT (Nc) =	9,125	days	AT (Nc) =	1,825	days	AT (Nc) =	365	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE 5
CALCULATION OF INTAKE AND RISK FROM THE INGESTION OF SOIL
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times IR \times CF \times FI \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Soil, Calculated from Soil EPC Data
IR = Ingestion Rate
CF = Conversion Factor
FI = Fraction Ingested
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Oral RfD (mg/kg-day)	Carc. Slope Oral (mg/kg-day)-1	EPC Surface Soil (mg/kg)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Volatile Organics												
Acetone	1.00E-001	NA										
2-Butanone	6.00E-001	NA										
Benzene	3.00E-003	2.90E-002	2.00E-003	2.74E-009	9.39E-010	9E-007	3E-011	2.56E-008	2.19E-009	9E-006	6E-011	9E-011
Toluene	2.00E-001	NA	6.00E-003	8.22E-009		4E-008		7.67E-008		4E-007		
Total Xylenes	2.00E+000	NA	1.40E-002	1.92E-008		1E-008		1.79E-007		9E-008		
Semivolatile Organics												
Benzo(a)anthracene	NA	7.30E-001										
Benzo(a)pyrene	NA	7.30E+000	2.40E-002		1.13E-008		8E-008		2.63E-008		2E-007	3E-007
Benzo(b)fluoranthene	NA	7.30E-001	2.10E-002		9.86E-009		7E-009		2.30E-008		2E-008	2E-008
Benzo(ghi)perylene	NA	NA										
Benzo(k)fluoranthene	NA	7.30E-002	2.10E-002		9.86E-009		7E-010		2.30E-008		2E-009	2E-009
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	1.80E+000	2.47E-006	8.45E-007	1E-004	1E-008	2.30E-005	1.97E-006	1E-003	3E-008	4E-008
Chrysene	NA	7.30E-003	2.30E-002		1.08E-008		8E-011		2.52E-008		2E-010	3E-010
Dibenz(a,h)anthracene	NA	7.30E+000										
Di-n-butylphthalate	1.00E-001	NA										
Fluoranthene	4.00E-002	NA	3.80E-002	5.21E-008		1E-006		4.86E-007		1E-005		
Indeno(1,2,3-cd)pyrene	NA	7.30E-001										
Phenanthrene	NA	NA										
Pesticides/PCBs												
4,4'-DDD	NA	2.40E-001										
4,4'-DDE	NA	3.40E-001										
4,4'-DDT	5.00E-004	3.40E-001										
Metals												
Cadmium	5.00E-004	NA	5.60E-001	7.67E-007		2E-003		7.16E-006		1E-002		
Mercury	3.00E-004	NA	6.00E-002	8.22E-008		3E-004		7.67E-007		3E-003		
Total Hazard Quotient and Cancer Risk:						**2E-003**				**2E-002**		**3E-007**

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
CF =	1E-006	kg/mg	CF =	1E-006	kg/mg
CS =	EPC Surface Only		CS =	EPC Surface Only	
BW =	70	kg	BW =	15	kg
IR =	100	mg soil/day	IR =	200	mg soil/day
FI =	1	unitless	FI =	1	unitless
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-6
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SOIL
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):

- CS = Chemical Concentration in Soil, from Soil EPC Data
- CF = Conversion Factor
- SA = Surface Area Contact
- AF = Adherence Factor
- ABS = Absorption Factor
- EF = Exposure Frequency
- ED = Exposure Duration
- BW = Bodyweight
- AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Surface Soil (mg/kg)	EPC from Total Soils (mg/kg)	Park Worker Absorbed Dose (mg/kg-day) (Nc)	Park Worker Absorbed Dose (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Nc)	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Absorbed Dose (mg/kg-day) (Nc)	Construction Worker Absorbed Dose (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Volatile Organics																	
Acetone	1.00E-001	NA	NA		1.60E-001												
2-Butanone	6.00E-001	NA	NA		4.60E-002												
Benzene	3.00E-003	2.90E-002	NA	2.00E-003	4.00E-003												
Toluene	2.00E-001	NA	NA	6 00E-003	2.30E-002												
Total Xylenes	2.00E+000	NA	NA	1.40E-002	1.40E-002												
Semivolatile Organics																	
Benzo(a)anthracene	NA	7.3E-001	0.13		3.00E-002										5.40E-010		3.9E-010
Benzo(a)pyrene	NA	7.3E+000	0.13	2.40E-002	4.50E-002		8.70E-009		6.4E-008		1.78E-009		1.3E-008		8.10E-010		5.9E-009
Benzo(b)fluoranthene	NA	7.3E-001	0.13	2.10E-002	3.80E-002		7.61E-009		5.6E-009		1.56E-009		1.1E-009		6.84E-010		5.0E-010
Benzo(ghi)perylene	NA	NA	0.13		3.10E-002												
Benzo(k)fluoranthene	NA	7.3E-002	0.13	2.10E-002	4.30E-002		7.61E-009		5.6E-010		1.56E-009		1.1E-010		7.74E-010		5.6E-011
bis(2-Ethylhexyl)phthalate	2.00E-002	1.4E-002	0.1	1 80E+000	1.80E+000	1.41E-006	5.02E-007	7.0E-005	7.0E-009	1 44E-006	1.03E-007	7.2E-005	1.4E-009	1.74E-006	2.49E-008	8.7E-005	3.5E-010
Chrysene	NA	7.3E-003	0.13	2.30E-002	3.10E-002		8.34E-009		6.1E-011		1.70E-009		1.2E-011		5.58E-010		4.1E-012
Dibenz(a,h)anthracene	NA	7.3E+000	0.13		2.80E-002										5.04E-010		3.7E-009
Di-n-butylphthalate	1 00E-001	NA	0.1		8.70E-002									8.43E-008		8.4E-007	
Fluoranthene	4.00E-002	NA	0.13	3.80E-002	6.30E-002	3.86E-008		9.6E-007		3.94E-008		9.9E-007		7.93E-008		2.0E-006	
Indeno(1,2,3-cd)pyrene	NA	7.3E-001	0.13		3.70E-002										6.66E-010		4.9E-010
Phenanthrene	NA	NA	0.13		3.10E-002												
Pesticides/PCBs																	
4,4'-DDD	NA	2.40E-001	0.03		2.00E-003										8.30E-012		2.0E-012
4,4'-DDE	NA	3.40E-001	0.03		4.40E-003										1.83E-011		6.2E-012
4,4'-DDT	5.00E-004	3.40E-001	0.03		3.30E-003									9.59E-010	1.37E-011	1.9E-006	4.7E-012
Metals																	
Cadmium	1.25E-005	NA	0.001	5.60E-001	2.40E+001	4.37E-009		3.5E-004		4.47E-009		3.6E-004		2.32E-007		1.9E-002	
Mercury	2.10E-005	NA	NA	6.00E-002	4.90E-001												
Total Hazard Quotient and Cancer Risk:								**4E-004**	**8E-008**			**4E-004**	**2E-008**			**2E-002**	**1E-008**

Assumptions for Park Worker			Assumptions for Recreational Visitor (Child)			Assumptions for Construction Worker		
CS =	EPC Surface Only		CS =	EPC Surface Only		CS =	EPC Surface and Subsurface	
CF =	1.00E-006	kg/mg	CF =	1.00E-006	kg/mg	CF =	1.00E-006	kg/mg
SA =	5,700	cm2	SA =	2,800	cm2	SA =	3,300	cm2
AF =	0.2	mg/cm2	AF =	0.2	mg/cm2	AF =	0.3	mg/cm2
EF =	175	days/year	EF =	78	days/year	EF =	250	days/year
ED =	25	years	ED =	5	years	ED =	1	years
BW =	70	kg	BW =	15	kg	BW =	70	kg
AT (Nc) =	9,125	days	AT (Nc) =	1,825	days	AT (Nc) =	365	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.
* Recommended dermal absorption factor by EPA Dermal Risk Assessment Guidance (1999).

TABLE A-7
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SOIL
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):

- CS = Chemical Concentration in Soil, from Soil EPC Data
- CF = Conversion Factor
- SA = Surface Area Contact
- AF = Adherence Factor
- ABS = Absorption Factor
- EF = Exposure Frequency
- ED = Exposure Duration
- BW = Bodyweight
- AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Lifetime Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD	Carc. Slope Dermal	Absorption Factor*	EPC Surface Soil	Resident (Adult)				Resident (Child)				Resident
					Intake (mg/kg-day)		Hazard Quotient	Contribution to Lifetime Cancer Risk	Intake (mg/kg-day)		Hazard Quotient	Contribution to Lifetime Cancer Risk	Total Lifetime Cancer Risk
	(mg/kg-day)	(mg/kg-day)-1	(unitless)	(mg/kg)	(Nc)	(Car)			(Nc)	(Car)			
Volatile Organics													
Acetone	1.00E-001	NA	NA										
2-Butanone	6.00E-001	NA	NA										
Benzene	3.00E-003	2.90E-002	NA	2.00E-003									
Toluene	2.00E-001	NA	NA	6.00E-003									
Total Xylenes	2.00E+000	NA	NA	1.40E-002									
Semivolatile Organics													
Benzo(a)anthracene	NA	7.30E-001	0.13										
Benzo(a)pyrene	NA	7.30E+000	0.13	2.40E-002		5.85E-009		4 27E-008		9.57E-009		6.99E-008	1E-007
Benzo(b)fluoranthene	NA	7.30E-001	0.13	2.10E-002		5.12E-009		3.73E-009		8.38E-009		6.12E-009	1E-008
Benzo(ghi)perylene	NA	NA	0.13										
Benzo(k)fluoranthene	NA	7.30E-002	0.13	2.10E-002		5.12E-009		3.73E-010		8.38E-009		6.12E-010	1E-009
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	0.10	1.80E+000	9.84E-007	3.37E-007	4.92E-005	4.72E-009	6.44E-006	5.52E-007	3.22E-004	7.73E-009	1E-008
Chrysene	NA	7.30E-003	0.13	2.30E-002		5.60E-009		4.09E-011		9.17E-009		6.70E-011	1E-010
Dibenz(a,h)anthracene	NA	7.30E+000	0.13										
Di-n-butylphthalate	1.00E-001	NA	0.10										
Fluoranthene	4.00E-002	NA	0.13	3.80E-002	2.70E-008		6.75E-007		1.77E-007		4.42E-006		
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	0.13										
Phenanthrene	NA	NA	0.13										
Pesticides/PCBs													
4,4'-DDD	NA	2.40E-001	0.03										
4,4'-DDE	NA	3.40E-001	0.03										
4,4'-DDT	5.00E-004	3.40E-001	0.03										
Metals													
Cadmium	1.25E-005	NA	0.00	5.60E-001	3.06E-009		2.45E-004		2.00E-008		1.60E-003		
Mercury	2.10E-005	NA	NA	6.00E-002									
Total Hazard Quotient and Cancer Risk:							**3E-004**	**5E-009**			**2E-003**	**8E-009**	**1E-008**

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
CS =	EPC Surface Only		CS =	EPC Surface Only	
CF =	1E-006	kg/mg	CF =	1E-006	kg/mg
SA =	5,700	cm2	SA =	2,800	cm2
AF =	0.07	mg/cm2	AF =	0.2	mg/cm2
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
BW =	70	kg	BW =	15	kg
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.

NA= Information not available.

* Recommended dermal absorption factor by EPA Dermal Risk Assessment Guidance (1999).

TABLE A-8

CALCULATION OF INTAKE AND RISK FROM INHALATION OF GROUNDWATER (WHILE SHOWERING)

REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63

Decision Document - Mini Risk Assessment

Seneca Army Depot Activity

Based on a lack of toxicity data (i.e. inhalation RfDs and carcinogenic slope factors for the analytes detected) risks from this pathway were not quantified.

TABLE A-9
CALCULATION OF INTAKE AND RISK FROM THE INGESTION OF GROUNDWATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CW \times IR \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CW = Chemical Concentration in Groundwater, from Groundwater EPC Data
IR = Ingestion Rate
EF = Exposure Frequency
ED=Exposure Duration
BW=Bodyweight
AT=Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Oral RfD (mg/kg-day)	Carc. Slope Oral (mg/kg-day)-1	EPC Groundwater (mg/liter)	Park Worker Intake (mg/kg-day) (Nc)	Park Worker Intake (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Intake (mg/kg-day) (Nc)	Recreational Visitor (Child) Intake (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Intake (mg/kg-day) (Nc)	Construction Worker Intake (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Semivolatile Organics															
Phenol	6.00E-001	NA	2.00E-003	1.37E-005		2E-005		2.85E-005		5E-005		**Ingestion of Groundwater Not Applicable for Construction Worker**			
Metals															
Manganese	5.00E-002	NA	1.07E+000	7.33E-003		1E-001		1.52E-002		3E-001					
Sodium	NA	NA	1.46E+002												
Total Hazard Quotient and Cancer Risk:						**1E-001**				**3E-001**					

Assumptions for Park Worker		
BW =	70	kg
IR =	1	liter/day
EF =	175	days/year
ED =	25	years
AT (Nc) =	9,125	days
AT (Car) =	25,550	days

Assumptions for Recreational Visitor (Child)		
BW =	15	kg
IR =	1	liter/day
EF =	78	days/year
ED =	5	years
AT (Nc) =	1,825	days
AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-10
CALCULATION OF INTAKE AND RISK FROM THE INGESTION OF GROUNDWATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CW \times IR \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CW = Chemical Concentration in Groundwater, from Groundwater EPC Data — ED=Exposure Duration
IR = Ingestion Rate — BW=Bodyweight
EF = Exposure Frequency — AT=Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Oral RfD (mg/kg-day)	Carc. Slope Oral (mg/kg-day)-1	EPC Groundwater (mg/liter)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Semivolatile Organics												
Phenol	6.00E-001	NA	2.00E-003	5.48E-005		9E-005		1.28E-004		2E-004		
Metals												
Manganese	5.00E-002	NA	1.07E+000	2.93E-002		6E-001		6.84E-002		1E+000		
Sodium	NA	NA	1.46E+002									
Total Hazard Quotient and Cancer Risk:						**6E-001**				**1E+000**		

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
BW =	70	kg	BW =	15	kg
IR =	2	liters/day	IR =	1	liters/day
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-11
CALCULATION OF INTAKE AND RISK FROM DERMAL CONTACT TO GROUNDWATER (WHILE SHOWERING)
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
DA = Absorbed Dose per Event
SA = Surface Area Contact
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics: $DA = 2Kp \times CW \sqrt{\frac{6 \times \tau \times ET}{\pi}} \times CF$

For inorganics: $DA = Kp \times CW \times ET \times CF$

Kp = Permeability Coefficient
CW = EPC Cderm
ET = Exposure Time
τ = Lag Time
CF = Conversion Factor

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient *Kp* (cm/hr)	Tau (hours)	EPC Groundwater (mg/liter)	Absorbed Dose/Event (mg-cm³/event)	Park Worker: Intake (mg/kg-day) (Nc)	Park Worker: Intake (mg/kg-day) (Car)	Park Worker: Hazard Quotient	Park Worker: Cancer Risk	Recreational Visitor (Child): Intake (mg/kg-day) (Nc)	Recreational Visitor (Child): Intake (mg/kg-day) (Car)	Recreational Visitor (Child): Hazard Quotient	Recreational Visitor (Child): Cancer Risk	Construction Worker: Intake (mg/kg-day) (Nc)	Construction Worker: Intake (mg/kg-day) (Car)	Construction Worker: Hazard Quotient	Construction Worker: Cancer Risk
Semivolatile Organics																		
Phenol	6.00E-001	NA	4.3E-003	3.80E-001	2.00E-003	6.26E-007	**Dermal Contact to Groundwater**				5.89E-005		1E-004		**Dermal Contact to Groundwater**			
Metals							**Not Applicable**								**Not Applicable**			
Manganese	2.00E-003	NA	1.00E-003	NA	1.07E+000	1.07E-006	**for Park Worker**				1.01E-004		5E-002		**for Construction Worker**			
Sodium	NA	NA	1.00E-003	NA	1.46E+002	1.71E+002												
Total Hazard Quotient and Cancer Risk:													**5E-002**					

Assumptions for Recreational Visitor (Child)

CF =	0.001	l/cm3
BW =	15	kg
SA =	6,600	cm2
ET =	1.00	hours/day
EF =	78	days/year
ED =	5	years
AT (Nc) =	1,825	days
AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-12

CALCULATION OF INTAKE AND RISK FROM DERMAL CONTACT TO GROUNDWATER (WHILE SHOWERING)

REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63

EE/CA - Mini Risk Assessment

Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):

DA = Absorbed Dose per Event
SA = Surface Area Contact
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics: $DA = 2Kp \times CW \sqrt{\frac{6 \times \tau \times ET}{\pi}} \times CF$

For inorganics: DA = Kp x CW x ET x CF

Kp = Permeability Coefficient
CW = EPC Cderm
ET = Exposure Time
τ = Lag Time
CF = Conversion Factor

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient Kp (cm/hr)	Tau (hours)	EPC Groundwater (mg/liter)	Absorbed Dose/Event (mg-cm²/event)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Semivolatile Organics															
Phenol	6.00E-001	NA	4.30E-003	3.80E-001	2.00E-003	6.26E-007	1.54E-004		3E-004		2.64E-004		4E-004		
Metals															
Manganese	2.00E-003	NA	1.00E-003	NA	1.07E+000	1.07E-006	2.64E-004		1E-001		4.51E-004		2E-001		
Sodium	NA	NA	1.00E-003	NA	1.46E+002	1.71E+002									
Total Hazard Quotient and Cancer Risk:									**1E-001**				**2E-001**		

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
CF =	0.001	l/cm3	CF =	0.001	l/cm3
BW =	70	kg	BW =	15	kg
SA =	18,000	cm2	SA =	6,600	cm2
ET =	0.58	hours/day	ET =	1.00	hours/day
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.

TABLE A-13
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SURFACE WATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
DA = Absorbed Dose per Event; ED = Exposure Duration
SA = Surface Area Contact; BW = Bodyweight
EF = Exposure Frequency; AT = Averaging Time

Equation for Absorbed Dose per Event (DA):
For organics with ET < t*: $DA = 2 Kp \; CW \sqrt{\frac{6 \cdot \tau \cdot ET}{\pi}} \; CF$
For organics with ET > t*: DA = Kp x CW x [ET/(1+B) + 2Tau(1+3B)/(1+B)] x CF
For inorganics: DA = Kp x CW x ET x CF
Kp = Permeability Coefficient; Tau = Lag Time
CW = EPC Surface Water; CF = Conversion Factor
ET = Exposure Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose
Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient Kp (cm/hr)	Tau (hours)	B (unitless)	EPC Surface Water (mg/L)	Absorbed Dose/Event (mg-cm²/event)	Park Worker Intake (mg/kg-day) (Nc)	Park Worker Intake (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Intake (mg/kg-day) (Nc)	Recreational Visitor (Child) Intake (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Intake (mg/kg-day) (Nc)	Construction Worker Intake (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Volatile Organics																			
Chloroform	1.00E-002	6.10E-003	6.9E-003	0.53	0.0	8.00E-004	1.11E-008	1.55E-008	5 53E-009	2E-006	3E-011	1.34E-007	9.56E-009	1E-005	6E-011	**Dermal Contact to Surface Water Not Applicable For Construction Worker**			
Toluene	2.00E-001	NA	3.2E-002	0.37	0.1	1.00E-003	5.51E-008	7.69E-008		4E-007		6.64E-007		3E-006					
Semivolatile Organics																			
4-Methylphenol	NA	NA	7.7E-003	0.45	0.0	2 20E-004	3.14E-009												
Benzo(a)pyrene	NA	7.30E+000	8.3E-001	2.83	5.0	1.00E-003	3.86E-006		1.92E-006		1E-005		3.32E-006		2E-005				
Benzo(b)fluoranthene	NA	7.30E-001	8.3E-001	2.92	5 1	9.00E-004	3.53E-006		1.76E-006		1E-006		3.04E-006		2E-006				
Benzo(ghi)perylene	NA	NA	1.2E+000	4.24		8.00E-004	5.66E-006												
Benzo(k)fluoranthene	NA	7.30E-002	7.6E-001	3.03		1 00E-003	3.65E-006		1.82E-006		1E-007		3.15E-006		2E-007				
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	2.9E-002	17.44	0.2	6.80E-002	2.28E-005	3.18E-005	1.13E-005	2E-003	2E-007	2.74E-004	1.96E-005	1E-002	3E-007				
Butylbenzylphthalate	2.00E-001	NA	4.2E-002	7.04		2.30E-004	7.03E-008	9.80E-008		5E-007		8.47E-007		4E-006					
Di-n-butylphthalate	1.00E-001	NA	2.6E-002	4.06	0.2	1.50E-004	2.17E-008	3.03E-008		3E-007		2.62E-007		3E-006					
Dibenz(a,h)anthracene	NA	7.30E+000	1.8E+000	4.08	11.7	8.00E-004	8.04E-006		4.01E-006		3E-005		6.92E-006		5E-005				
Diethyl phthalate	8.00E-001	NA	4.00E-003	1.97	0.0	2.90E-004	4.50E-009	6.28E-009		8E-009		5.42E-008		7E-008					
Fluoranthene	4.00E-002	NA	2.5E-001	1.53	1.4	7.00E-004	5.98E-007	8.35E-007		2E-005		7.21E-006		2E-004					
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	1.3E+000	3.97	8.0	9.00E-004	6.44E-006		3.21E-006		2E-006		5.55E-006		4E-006				
Pentachlorophenol	3.00E-002	1.20E-001	4.6E-001	3.50	2.9	1.00E-003	2.38E-006	3.32E-006	1.18E-006	1E-004	1E-007	2.87E-005	2.05E-006	1E-003	2E-007				
Phenanthrene	NA	NA	1.6E-001	1.12	0.8	5.70E-005	2.67E-008												
Phenol	6.00E-001	NA	4.3E-003	0.38	0.0	8.00E-004	6.05E-009	8.44E-009		1E-008		7.30E-008		1E-007					
Pyrene	3.00E-002	NA	2.2E-001	1.50		5.00E-004	3.68E-007	5.13E-007		2E-005		4.43E-006		1E-004					
Pesticides/PCBs																			
4,4'-DDD	NA	2.40E-001	2.1E-001	6.98	1.4	2 60E-005	3.99E-008		1.99E-008		5E-009		3.43E-008		8E-009				
4,4'-DDE	NA	3.40E-001	1.8E-001	6.80	1.2	5.10E-006	6.62E-009		3.30E-009		1E-009		5.70E-009		2E-009				
4,4'-DDT	5.00E-004	3.40E-001	3.2E-001	10.96	2.3	4.60E-005	1.35E-007	1.88E-007	6.71E-008	4E-004	2E-008	1.62E-006	1.16E-007	3E-003	4E-008				
Endosulfan sulfate	6.00E-003	NA	1.9E-003	26.55		1.40E-005	3.83E-010	5.35E-010		9E-008		4 62E-009		8E-007					
Endrin	3.00E-004	NA	1.4E-002	15.33	0.1	5.20E-005	7.88E-009	1.10E-008		4E-005		9 50E-008		3E-004					
Endrin aldehyde	NA	NA	1.4E-002	15.33	0.1	6.20E-005	9.39E-009												
Endrin ketone	NA	NA	1.4E-002	15.33	0.1	4.60E-005	6.97E-009												
gamma-Chlordane	5.00E-004	3.50E-001	1.2E-002	4.80	0.1	4.00E-006	2.91E-010	4.05E-010	1.45E-010	8E-007	5E-011	3.50E-009	2.50E-010	7E-006	9E-011				
Heptachlor	5.00E-004	4.50E+000	9.6E-003	13.91	0.1	3.60E-006	3.56E-010	4.97E-010	1.77E-010	1E-006	8E-010	4.29E-009	3.07E-010	9E-006	1E-009				
Heptachlor epoxide	1.30E-005	9.10E+000	2.3E-002	20.73		3.00E-006	8.58E-010	1.20E-009	4.27E-010	9E-005	4E-009	1.03E-008	7.39E-010	8E-004	7E-009				
Metals																			
Aluminum	1.00E+000	NA	1.00E-003	NA	NA	3.63E+000	3.63E-006	5.06E-006		5E-006		4.38E-005		4E-005					
Arsenic	3.00E-004	1.50E+000	1.00E-003	NA	NA	3.80E-003	3.80E-009	5.30E-009	1.89E-009	2E-005	3E-009	4.58E-008	3.27E-009	2E-004	5E-009				
Barium	4.90E-003	NA	1.00E-003	NA	NA	9.14E-002	9.14E-008	1.27E-007		3E-005		1.10E-006		2E-004					
Beryllium	1.40E-005	NA	1.00E-003	NA	NA	1.90E-004	1.90E-010	2.65E-010		2E-005		2.29E-009		2E-004					
Cadmium	1.25E-005	NA	1.00E-003	NA	NA	7.80E-004	7.80E-010	1.09E-009		9E-005		9.40E-009		8E-004					
Calcium	NA	NA	1.00E-003	NA	NA	2.20E+002	2.20E-004												
Chromium	7.50E-005	NA	2.00E-003	NA	NA	5.60E-003	1.12E-008	1.56E-008		2E-004		1.35E-007		2E-003					
Cobalt	2.00E-002	5.00E-006	4.00E-004	NA	NA	7.20E-003	2.88E-009	4.02E-009	1.43E-009	2E-007	7E-015	3.47E-008	2.48E-009	2E-006	1E-014				
Copper	4.00E-002	NA	1.00E-003	NA	NA	7.90E-003	7.90E-009	1.10E-008		3E-007		9.52E-008		2E-006					
Iron	3.00E-001	NA	1.00E-003	NA	NA	9.05E+000	9.05E-006	1.26E-005		4E-005		1.09E-004		4E-004					
Lead	NA	NA	1.00E-004	NA	NA	2.00E-002	2.00E-009												
Magnesium	NA	NA	1.00E-003	NA	NA	3.37E+001	3.37E-005												
Manganese	2.00E-003	NA	1.00E-003	NA	NA	2.30E+000	2.30E-006	3.21E-006		2E-003		2.77E-005		1E-002					
Mercury	2.10E-005	NA	1.00E-003	NA	NA	1.00E-004	1.00E-010	1.39E-010		7E-006		1.21E-009		6E-005					
Nickel	8.00E-004	NA	2.00E-004	NA	NA	1.88E-002	3.76E-009	5.24E-009		7E-006		4.53E-008		6E-005					
Potassium	NA	NA	2.00E-003	NA	NA	1.16E+001	2.32E-005												
Silver	2.00E-004	NA	6.00E-004	NA	NA	8.90E-004	5.34E-010	7.45E-010		4E-006		6.44E-009		3E-005					
Sodium	NA	NA	1.00E-003	NA	NA	5.93E+001	5.93E-005												
Thallium	8.00E-005	NA	1.00E-003	NA	NA	1.90E-003	1.90E-009	2.65E-009		3E-005		2.29E-008		3E-004					
Vanadium	1.82E-004	NA	1.00E-003	NA	NA	8.90E-003	8.90E-009	1.24E-008		7E-005		1.07E-007		6E-004					
Zinc	3.00E-001	NA	6.00E-004	NA	NA	9.90E-002	5.94E-008	8.29E-008		3E-007		7.16E-007		2E-006					
Total Hazard Quotient and Cancer Risk:										4E-003	5E-005			4E-002	8E-005				

TABLE A-13
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SURFACE WATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
DA = Absorbed Dose per Event   ED = Exposure Duration
SA = Surface Area Contact   BW = Bodyweight
EF = Exposure Frequency   AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics with ET < t*: $DA = 2Kp \; CW \sqrt{\frac{6 \cdot \tau \cdot ET}{\pi}} \; CF$

For organics with ET > t*: DA = Kp x CW x [ET/(1+B) + 2Tau(1+3B)/(1+B)] x CF
For inorganics: DA = Kp x CW x ET x CF
Kp = Permeability Coefficient   Tau = Lag Time
CW = EPC Surface Water   CF = Conversion Factor
ET = Exposure Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient Kp (cm/hr)	Tau (hours)	B (unitless)	EPC Surface Water (mg/L)	Absorbed Dose/Event (mg-cm²/event)	Park Worker Intake (mg/kg-day) (Nc)	Park Worker Intake (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Intake (mg/kg-day) (Nc)	Recreational Visitor (Child) Intake (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Intake (mg/kg-day) (Nc)	Construction Worker Intake (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk

Assumptions for Park Worker		
CF =	1E-003	liter/cm3
BW =	70	kg
SA =	1,980	cm2
ET =	1	hour/day
EF =	18	days/year
ED =	25	years
AT (Nc) =	9,125	days
AT (Car) =	25,550	days

Assumptions for Recreational Visitor (Child)		
CF =	1E-003	liter/cm3
BW =	15	kg
SA =	3,300	cm2
ET =	1	hour/day
EF =	20	days/year
ED =	5	years
AT (Nc) =	1,825	days
AT (Car) =	25,550	days

Notes:
1. Cells in this table were intentionally left blank due to a lack of toxicity data.
2. Kp, B, and Tou were taken from EPA Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment Interim Guidance, 1999.
Where Kp and B were not availabe, they were calculated according to the guidance. Kow values from SRC PhysProp Database were used to estimate Kp (http://esc.syrres.com/interkow/physdemo.htm).

TABLE A

CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SURFACE WATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):

DA = Absorbed Dose per Event; ED = Exposure Duration
SA = Surface Area Contact; BW = Bodyweight
EF = Exposure Frequency; AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics with ET < t*: $DA = 2K_p \cdot CW \cdot \sqrt{\frac{6 \tau \cdot ET}{\pi}} \cdot CF$

For organics with ET > t: DA = Kp x CW x [ET/(1+B) + 2Tau(1+3B)/(1+B)] x CF

For inorganics: DA = Kp x CW x ET x CF

Kp = Permeability Coefficient; Tau = Lag Time
CW = EPC Surface Water; CF = Conversion Factor
ET = Exposure Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose
Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Permeability Coefficient Kp (cm/hr)	Tau (hours)	B (unitless)	EPC Surface Water (mg/L)	Absorbed Dose/Event (mg-cm²/event)	Resident (Adult) Intake (mg/kg-day) (Nc)	Resident (Adult) Intake (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day) (Nc)	Resident (Child) Intake (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Volatile Organics																
Chloroform	1.00E-002	6.10E-003	6.9E-003	0.53	0.0	8.00E-004	1.11E-008	1.61E-008	5.53E-009	2E-006	3E-011	1.34E-007	9.56E-009	1E-005	6E-011	9E-011
Toluene	2.00E-001	NA	3.2E-002	0.37	0.1	1.00E-003	5 51E-008	8.01E-008		4E-007		6.64E-007		3E-006		
Semivolatile Organics																
4-Methylphenol	NA	NA	7.7E-003	0.45	0.0	2.20E-004	3.14E-009									
Benzo(a)pyrene	NA	7.30E+000	8.3E-001	2.83	5.0	1.00E-003	3.86E-006		1.92E-006		1E-005		3.32E-006		2E-005	4E-005
Benzo(b)fluoranthene	NA	7.30E-001	8.3E-001	2.92	5.1	9.00E-004	3.53E-006		1.76E-006		1E-006		3.04E-006		2E-006	4E-006
Benzo(ghi)perylene	NA	NA	1.2E+000	4.24		8.00E-004	5.66E-006									
Benzo(k)fluoranthene	NA	7.30E-002	7.6E-001	3.03		1.00E-003	3.65E-006		1.82E-006		1E-007		3 15E-006		2E-007	4E-007
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	2.9E-002	17.44	0.2	6.80E-002	2.28E-005	3.31E-005	1 13E-005	2E-003	2E-007	2.74E-004	1.96E-005	1E-002	3E-007	4E-007
Butylbenzylphthalate	2.00E-001	NA	4.2E-002	7.04		2.30E-004	7.03E-008	1.02E-007		5E-007		8.47E-007		4E-006		
Di-n-butylphthalate	1.00E-001	NA	2.6E-002	4.06	0.2	1.50E-004	2.17E-008	3.16E-008		3E-007		2 62E-007		3E-006		
Dibenz(a,h)anthracene	NA	7.30E+000	1.8E+000	4.08	11.7	8.00E-004	8.04E-006		4 01E-006		3E-005		6 92E-006		5E-005	8E-005
Diethyl phthalate	8.00E-001	NA	4.00E-003	1.97	0.0	2.90E-004	4.50E-009	6.54E-009		8E-009		5.42E-008		7E-008		
Fluoranthene	4.00E-002	NA	2.5E-001	1.53	1.4	7.00E-004	5.98E-007	8.69E-007		2E-005		7 21E-006		2E-004		
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	1.3E+000	3.97	8.0	9.00E-004	6.44E-006		3.21E-006		2E-006		5.55E-006		4E-006	6E-006
Pentachlorophenol	3.00E-002	1.20E-001	4.6E-001	3.50	2.9	1.00E-003	2.38E-006	3.46E-006	1.18E-006	1E-004	1E-007	2.87E-005	2.05E-006	1E-003	2E-007	4E-007
Phenanthrene	NA	NA	1.6E-001	1.12	0.8	5.70E-005	2.67E-008									
Phenol	6.00E-001	NA	4.3E-003	0.38	0.0	8.00E-004	6.05E-009	8.79E-009		1E-008		7.30E-008		1E-007		
Pyrene	3.00E-002	NA	2.2E-001	1.50		5.00E-004	3.68E-007	5.34E-007		2E-005		4.43E-006		1E-004		
Pesticides/PCBs																
4,4'-DDD	NA	2.40E-001	2.1E-001	6.98	1.4	2.60E-005	3.99E-008		1.99E-008		5E-009		3 43E-008		8E-009	1E-008
4,4'-DDE	NA	3.40E-001	1.8E-001	6.80	1.2	5.10E-006	6.62E-009		3.30E-009		1E-009		5.70E-009		2E-009	3E-009
4,4'-DDT	5.00E-004	3.40E-001	3.2E-001	10.96	2.3	4.60E-005	1.35E-007	1.96E-007	6.71E-008	4E-004	2E-008	1.62E-006	1.16E-007	3E-003	4E-008	6E-008
Endosulfan sulfate	6.00E-003	NA	1.9E-003	26.55		1.40E-005	3.83E-010	5.57E-010		9E-008		4.62E-009		8E-007		0E+000
Endrin	3.00E-004	NA	1.4E-002	15.33	0.1	5.20E-005	7.88E-009	1.14E-008		4E-005		9.50E-008		3E-004		0E+000
Endrin aldehyde	NA	NA	1.4E-002	15.33	0.1	6.20E-005	9.39E-009									
Endrin ketone	NA	NA	1.4E-002	15.33	0.1	4.60E-005	6.97E-009									
gamma-Chlordane	5.00E-004	3.50E-001	1.2E-002	4.80	0.1	4.00E-006	2.91E-010	4.22E-010	1.45E-010	8E-007	5E-011	3.50E-009	2.50E-010	7E-006	9E-011	1E-010
Heptachlor	5.00E-004	4.50E+000	9.6E-003	13.91	0.1	3.60E-006	3.56E-010	5.18E-010	1.77E-010	1E-006	8E-010	4.29E-009	3.07E-010	9E-006	1E-009	2E-009
Heptachlor epoxide	1.30E-005	9.10E+000	2.3E-002	20.73		3.00E-006	8.58E-010	1.25E-009	4.27E-010	1E-004	4E-009	1.03E-008	7.39E-010	8E-004	7E-009	1E-008
Metals																
Aluminum	1.00E+000	NA	1.00E-003	NA	NA	3.63E+000	3.63E-006	5.27E-006		5E-006		4.38E-005		4E-005		
Arsenic	3.00E-004	1.50E+000	1.00E-003	NA	NA	3.80E-003	3.80E-009	5.52E-009	1.89E-009	2E-005	3E-009	4.58E-008	3.27E-009	2E-004	5E-009	8E-009
Barium	4.90E-003	NA	1.00E-003	NA	NA	9.14E-002	9.14E-008	1.33E-007		3E-005		1.10E-006		2E-004		
Beryllium	1.40E-005	NA	1.00E-003	NA	NA	1.90E-004	1.90E-010	2.76E-010		2E-005		2.29E-009		2E-004		
Cadmium	1.25E-005	NA	1.00E-003	NA	NA	7.80E-004	7.80E-010	1.13E-009		9E-005		9.40E-009		8E-004		
Calcium	NA	NA	1.00E-003	NA	NA	2.20E+002	2.20E-004									
Chromium	7.50E-005	NA	2.00E-003	NA	NA	5.60E-003	1.12E-008	1.63E-008		2E-004		1.35E-007		2E-003		
Cobalt	2.00E-002	5.00E-006	4.00E-004	NA	NA	7.20E-003	2.88E-009	4.18E-009	1.43E-009	2E-007	7E-015	3.47E-008	2.48E-009	2E-006	1E-014	2E-014
Copper	4.00E-002	NA	1.00E-003	NA	NA	7.90E-003	7.90E-009	1.15E-008		3E-007		9.52E-008		2E-006		
Iron	3.00E-001	NA	1.00E-003	NA	NA	9.05E+000	9.05E-006	1.31E-005		4E-005		1.09E-004		4E-004		
Lead	NA	NA	1.00E-004	NA	NA	2.00E-002	2.00E-009									
Magnesium	NA	NA	1.00E-003	NA	NA	3.37E+001	3.37E-005									
Manganese	2.00E-003	NA	1.00E-003	NA	NA	2.30E+000	2.30E-006	3.34E-006		2E-003		2.77E-005		1E-002		
Mercury	2.10E-005	NA	1.00E-003	NA	NA	1.00E-004	1.00E-010	1.45E-010		7E-006		1.21E-009		6E-005		
Nickel	8.00E-004	NA	2.00E-004	NA	NA	1.88E-002	3.76E-009	5.46E-009		7E-006		4.53E-008		6E-005		
Potassium	NA	NA	2.00E-003	NA	NA	1.16E+001	2.32E-005									
Silver	2.00E-004	NA	6.00E-004	NA	NA	8.90E-004	5.34E-010	7.76E-010		4E-006		6.44E-009		3E-005		
Sodium	NA	NA	1.00E-003	NA	NA	5.93E+001	5.93E-005									
Thallium	8.00E-005	NA	1.00E-003	NA	NA	1.90E-003	1.90E-009	2.76E-009		3E-005		2.29E-008		3E-004		
Vanadium	1.82E-004	NA	1.00E-003	NA	NA	8.90E-003	8.90E-009	1.29E-008		7E-005		1.07E-007		6E-004		
Zinc	3.00E-001	NA	6.00E-004	NA	NA	9.90E-002	5.94E-008	8.63E-008		3E-007		7.16E-007		2E-006		
Total Hazard Quotient and Cancer Risk:										**5E-003**	**5E-005**			**4E-002**	**8E-005**	**1E-004**

TABLE A-[illegible]
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SURFACE WATER
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{DA \times SA \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):

DA = Absorbed Dose per Event	ED = Exposure Duration
SA = Surface Area Contact	BW = Bodyweight
EF = Exposure Frequency	AT = Averaging Time

Equation for Absorbed Dose per Event (DA):

For organics with ET < t*: $DA = 2Kp \; CW \sqrt{\frac{6 \; \tau \cdot ET}{\pi}} \; CF$

For organics with ET > t DA = Kp x CW x { ET/(1+B) + 2Tau(1+3B)/(1+B) } x CF

For inorganics: DA = Kp x CW x ET x CF

Kp = Permeability Coefficient	Tau = Lag Time
CW = EPC Surface Water	CF = Conversion Factor
ET = Exposure Time	

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose
Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD	Carc. Slope Dermal	Permeability Coefficient *Kp*	Tau	B	EPC Surface Water	Absorbed Dose/Event	Resident (Adult) Intake (mg/kg-day)		Hazard Quotient	Contribution to Lifetime Cancer Risk	Resident (Child) Intake (mg/kg-day)		Hazard Quotient	Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
	(mg/kg-day)	(mg/kg-day)-1	(cm/hr)	(hours)	(unitless)	(mg/L)	(mg-cm²/event)	(Nc)	(Car)			(Nc)	(Car)			
								Assumptions for Resident (Adult)				Assumptions for Resident (Child)				
								CF =	1E-003	liter/cm3		CF =	1E-003	liter/cm3		
								BW =	70	kg		BW =	15	kg		
								SA =	4,500	cm2		SA =	3,300	cm2		
								ET =	0.5	hour/day		ET =	1	hour/day		
								EF =	35	days/year		EF =	35	days/year		
								ED =	24	years		ED =	6	years		
								AT (Nc) =	8,760	days		AT (Nc) =	2,190	days		
								AT (Car) =	25,550	days		AT (Car) =	25,550	days		

Notes:
1. Cells in this table were intentionally left blank due to a lack of toxicity data.
2. Kp, B, and Tou were taken from EPA Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment Interim Guidance, 1999
Where Kp and B were not availabe, they were calculated according to the guidance. Kow values from SRC PhysProp Database were used to estimate Kp (http://esc.syrres.com/interkow/physdemo.htm).

TABLE A-15
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SEDIMENT
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Sediment, from Sediment EPC Data
CF = Conversion Factor
SA = Surface Area Contact
AF = Adherence Factor
ABS = Absorption Factor
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Sediment (mg/kg)	Park Worker: Absorbed Dose (mg/kg-day) (Nc)	Park Worker: Absorbed Dose (mg/kg-day) (Car)	Park Worker: Hazard Quotient	Park Worker: Cancer Risk	Recreational Visitor (Child): Absorbed Dose (mg/kg-day) (Nc)	Recreational Visitor (Child): Absorbed Dose (mg/kg-day) (Car)	Recreational Visitor (Child): Hazard Quotient	Recreational Visitor (Child): Cancer Risk	Construction Worker: Absorbed Dose (mg/kg-day) (Nc)	Construction Worker: Absorbed Dose (mg/kg-day) (Car)	Construction Worker: Hazard Quotient	Construction Worker: Cancer Risk
Volatile Organics																
Acetone	1.00E-001	NA	NA	1.50E-001									Dermal Contact to Sediment Not Applicaple for for Construction Worker			
Methyl ethyl ketone	6.00E-001	NA	NA	3.50E-002												
Toluene	2.00E-001	NA	NA	1.40E-002												
Semivolatile Organics																
2-Methylnaphthalene	4.00E-002	NA	0.10	1.40E-002	1 12E-009		3E-008		1.12E-008		3E-007					
Benzo(a)anthracene	NA	7.30E-001	0.13	2.00E+000		7.46E-008		5E-008		1.48E-007		1E-007				
Benzo(a)pyrene	NA	7.30E+000	0.13	2.70E+000		1.01E-007		7E-007		2.00E-007		1E-006				
Benzo(b)fluoranthene	NA	7.30E-001	0.13	3.50E+000		1 31E-007		1E-007		2.59E-007		2E-007				
Benzo(k)fluoranthene	NA	7.30E-002	0.13	1.90E+000		7 08E-008		5E-009		1.41E-007		1E-008				
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	0.10	1.10E-001	8.83E-009	3.16E-009	4E-007	4E-011	8.78E-008	6.27E-009	4E-006	9E-011				
Butylbenzylphthalate	2.00E-001	NA	0.10	2.20E-002	1.77E-009		9E-009		1 76E-008		9E-008					
Carbazole	NA	2.00E-002	0.10	4.30E-001		1.23E-008		2E-010		2.45E-008		5E-010				
Chrysene	NA	7.30E-003	0.10	2.20E+000		6.31E-008		5E-010		1.25E-007		9E-010				
Di-n-butylphthalate	1.00E-001	NA	0.10	1.90E-002	1.53E-009		2E-008		1.52E-008		2E-007					
Di-n-octylphthalate	NA	NA	0.10	1.90E-002												
Dibenz(a,h)anthracene	NA	7.30E+000	0.13	1.20E+000		4.47E-008		3E-007		8.89E-008		6E-007				
Dibenzofuran	NA	NA	0.10	3.60E-002												
Diethyl phthalate	8.00E-001	NA	0.10	9.20E-002	7.39E-009		9E-009		7.34E-008		9E-008					
Fluoranthene	4.00E-002	NA	0.13	4.30E+000	4.49E-007		1E-005		4.46E-006		1E-004					
Fluorene	4.00E-002	NA	0.13	1 10E-001	1.15E-008		3E-007		1.14E-007		3E-006					
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	0.13	2.50E+000		9.32E-008		7E-008		1.85E-007		1E-007				
Naphthalene	2.00E-002	NA	0.13	2.30E-002	2.40E-009		1E-007		2.39E-008		1E-006					
Phenanthrene	NA	NA	0.13	1.50E+000												
Phenol	6.00E-001	NA	0.10	1.10E-002	8.83E-010		1E-009		8.78E-009		1E-008					
Pyrene	3.00E-002	NA	0.13	3.20E+000	3.34E-007		1E-005		3.32E-006		1E-004					
Pesticides/PCBs																
4,4'-DDD	NA	2.40E-001	0.03	3.90E-003		3.36E-011		8E-012		6.67E-011		2E-011				
4,4'-DDE	NA	3.40E-001	0.03	9.20E-003		7.92E-011		3E-011		1.57E-010		5E-011				
4,4'-DDT	5.00E-004	3.40E-001	0.03	8.30E-003	2.00E-010	7.14E-011	4E-007	2E-011	1.99E-009	1.42E-010	4E-006	5E-011				
alpha-Chlordane	5.00E-004	3.50E-001	0.04	3.20E-003	1.03E-010	3.67E-011	2E-007	1E-011	1.02E-009	7.29E-011	2E-006	3E-011				
Aroclor-1260	2.00E-005	2.00E+000	0.14	1.10E-001	1.24E-008	4.42E-009	6E-004	9E-009	1.23E-007	8.78E-009	6E-003	2E-008				
Endosulfan I	6.00E-003	NA	0.10	7.50E-003	6.02E-010		1E-007		5.98E-009		1E-006					
Endosulfan sulfate	6.00E-003	NA	0.10	1.20E-002	9.64E-010		2E-007		9.57E-009		2E-006					
Endrin aldehyde	NA	NA	0.10	8.60E-003												
Endrin ketone	NA	NA	0.10	9.40E-003												
Metals																
Aluminum	1.00E+000	NA	NA	1.67E+004												
Arsenic	3.00E-004	1.50E+000	3.00E-002	6.80E+000	1.64E-007	5.85E-008	5E-004	9E-008	1.63E-006	1.16E-007	5E-003	2E-007				
Barium	4.90E-003	NA	NA	1.07E+002												
Beryllium	1.40E-005	NA	NA	8.00E-001												
Cadmium	1.25E-005	NA	1.00E-003	8.30E-001	6.67E-010		5E-005		6 62E-009		5E-004					
Calcium	NA	NA	NA	2.11E+005												
Chromium	7.50E-005	NA	NA	2.44E+001												
Cobalt	2.00E-002	5.00E-006	NA	1.44E+001												
Copper	4.00E-002	NA	NA	4.26E+001												
Cyanide	2.00E-002	NA	NA	2.10E+000												
Iron	3.00E-001	NA	NA	2.97E+004												
Lead	NA	NA	NA	4.62E+001												
Magnesium	NA	NA	NA	1.61E+004												
Manganese	2.00E-003	NA	NA	9.95E+002												
Mercury	2.10E-005	NA	NA	1.30E-001												
Nickel	8.00E-004	NA	NA	4.42E+001												

TABLE A-15
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SEDIMENT
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = (CS x CF x SA x AF x ABS x EF x ED) / (BW x AT)

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Sediment, from Sediment EPC Data
CF = Conversion Factor
SA = Surface Area Contact
AF = Adherence Factor
ABS = Absorption Factor
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose

Equation for Cancer Risk = Chronic Daily Intake (Car) x Slope Factor

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Sediment (mg/kg)	Park Worker Absorbed Dose (mg/kg-day) (Nc)	Park Worker Absorbed Dose (mg/kg-day) (Car)	Park Worker Hazard Quotient	Park Worker Cancer Risk	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Nc)	Recreational Visitor (Child) Absorbed Dose (mg/kg-day) (Car)	Recreational Visitor (Child) Hazard Quotient	Recreational Visitor (Child) Cancer Risk	Construction Worker Absorbed Dose (mg/kg-day) (Nc)	Construction Worker Absorbed Dose (mg/kg-day) (Car)	Construction Worker Hazard Quotient	Construction Worker Cancer Risk
Potassium	NA	NA	NA	2.57E+003												
Selenium	5.00E-003	NA	NA	2.10E+000												
Sodium	NA	NA	NA	5.78E+002												
Thallium	8.00E-005	NA	NA	2.30E+000												
Vanadium	1.82E-004	NA	NA	2.80E+001												
Zinc	3.00E-001	NA	NA	5.34E+002												
Total Hazard Quotient and Cancer Risk:							**1E-003**	**1E-006**			**1E-002**	**3E-006**				

Assumptions for Park Worker			Assumptions for Recreational Visitor (Child)		
CF =	1E-006	kg/mg	CF =	1E-006	kg/mg
BW =	70	kg	BW =	15	kg
SA =	5,700	cm2	SA =	2,800	cm2
AF =	0.2	mg/cm2	AF =	0.2	mg/cm2
EF =	18	days/year	EF =	78	days/year
ED =	25	years	ED =	5	years
AT (Nc) =	9,125	days	AT (Nc) =	1,825	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.
Absorption factors are from EPA Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment, 1999.

TABLE A-16
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SEDIMENT
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = $\frac{CS \times CF \times SA \times AF \times ABS \times EF \times ED}{BW \times AT}$

Variables (Assumptions for Each Receptor are Listed at the Bottom):
CS = Chemical Concentration in Sediment, from Sediment EPC Data
CF = Conversion Factor
SA = Surface Area Contact
AF = Adherence Factor
ABS = Absorption Factor
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose
Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Sediment (mg/kg)	Resident (Adult) Absorbed Dose (mg/kg-day) (Nc)	Resident (Adult) Absorbed Dose (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Absorbed Dose (mg/kg-day) (Nc)	Resident (Child) Absorbed Dose (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Volatile Organics													
Acetone	1.00E-001	NA	NA	1.50E-001									
Methyl ethyl ketone	6.00E-001	NA	NA	3.50E-002									
Toluene	2.00E-001	NA	NA	1.40E-002									
Semivolatile Organics													
2-Methylnaphthalene	4.00E-002	NA	0.10	1.40E-002	1.12E-009		3E-008		1.12E-008		3E-007		
Benzo(a)anthracene	NA	7.30E-001	0.13	2.00E+000		7.46E-008		5E-008		1.48E-007		1E-007	1.63E-007
Benzo(a)pyrene	NA	7.30E+000	0.13	2.70E+000		1.01E-007		7E-007		2.00E-007		1E-006	2.20E-006
Benzo(b)fluoranthene	NA	7.30E-001	0.13	3.50E+000		1.31E-007		1E-007		2.59E-007		2E-007	2.85E-007
Benzo(k)fluoranthene	NA	7.30E-002	0.13	1.90E+000		7.08E-008		5E-009		1.41E-007		1E-008	1.54E-008
bis(2-Ethylhexyl)phthalate	2.00E-002	1.40E-002	0.10	1.10E-001	8.83E-009	3.16E-009	4E-007	4E-011	8.78E-008	6 27E-009	4E-006	9E-011	1.32E-010
Butylbenzylphthalate	2.00E-001	NA	0.10	2.20E-002	1.77E-009		9E-009		1.76E-008		9E-008		
Carbazole	NA	2.00E-002	0.10	4.30E-001		1 23E-008		2E-010		2.45E-008		5E-010	7.37E-010
Chrysene	NA	7 30E-003	0.10	2.20E+000		6.31E-008		5E-010		1.25E-007		9E-010	1.38E-009
Di-n-butylphthalate	1.00E-001	NA	0.10	1.90E-002	1.53E-009		2E-008		1.52E-008		2E-007		
Di-n-octylphthalate	NA	NA	0.10	1.90E-002									
Dibenz(a,h)anthracene	NA	7.30E+000	0.13	1.20E+000		4.47E-008		3E-007		8.89E-008		6E-007	9.76E-007
Dibenzofuran	NA	NA	0.10	3.60E-002									
Diethyl phthalate	8.00E-001	NA	0.10	9.20E-002	7.39E-009		9E-009		7.34E-008		9E-008		
Fluoranthene	4.00E-002	NA	0.13	4.30E+000	4.49E-007		1E-005		4.46E-006		1E-004		
Fluorene	4.00E-002	NA	0.13	1.10E-001	1.15E-008		3E-007		1.14E-007		3E-006		
Indeno(1,2,3-cd)pyrene	NA	7.30E-001	0.13	2.50E+000		9.32E-008		7E-008		1.85E-007		1E-007	2.03E-007
Naphthalene	2.00E-002	NA	0.13	2.30E-002	2.40E-009		1E-007		2.39E-008		1E-006		
Phenanthrene	NA	NA	0.13	1.50E+000									
Phenol	6.00E-001	NA	0.10	1.10E-002	8.83E-010		1E-009		8.78E-009		1E-008		
Pyrene	3.00E-002	NA	0.13	3.20E+000	3.34E-007		1E-005		3.32E-006		1E-004		
Pesticides/PCBs													
4,4'-DDD	NA	2.40E-001	0.03	3.90E-003		3.36E-011		8E-012		6.67E-011		2E-011	2.41E-011
4,4'-DDE	NA	3 40E-001	0.03	9.20E-003		7.92E-011		3E-011		1.57E-010		5E-011	8.04E-011
4,4'-DDT	5.00E-004	3.40E-001	0.03	8.30E-003	2.00E-010	7.14E-011	4E-007	2E-011	1.99E-009	1.42E-010	4E-006	5E-011	7.25E-011
alpha-Chlordane	5.00E-004	3.50E-001	0.04	3.20E-003	1.03E-010	3.67E-011	2E-007	1E-011	1.02E-009	7.29E-011	2E-006	3E-011	3.84E-011
Aroclor-1260	2.00E-005	2.00E+000	0.14	1.10E-001	1.24E-008	4.42E-009	6E-004	9E-009	1.23E-007	8.78E-009	6E-003	2E-008	2.64E-008
Endosulfan I	6.00E-003	NA	0.10	7.50E-003	6.02E-010		1E-007		5.98E-009		1E-006		
Endosulfan sulfate	6.00E-003	NA	0.10	1.20E-002	9.64E-010		2E-007		9.57E-009		2E-006		
Endrin aldehyde	NA	NA	0.10	8.60E-003									
Endrin ketone	NA	NA	0.10	9.40E-003									
Metals													
Aluminum	1.00E+000	NA	NA	1.67E+004									
Arsenic	3.00E-004	1.50E+000	3.00E-002	6.80E+000	1.64E-007	5 85E-008	5E-004	9E-008	1.63E-006	1.16E-007	5E-003	2E-007	2.62E-007
Barium	4.90E-003	NA	NA	1.07E+002									
Beryllium	1.40E-005	NA	NA	8.00E-001									
Cadmium	1.25E-005	NA	1 00E-003	8.30E-001	6.67E-010		5E-005		6.62E-009		5E-004		
Calcium	NA	NA	NA	2.11E+005									
Chromium	7.50E-005	NA	NA	2.44E+001									
Cobalt	2.00E-002	5.00E-006	NA	1.44E+001									
Copper	4.00E-002	NA	NA	4.26E+001									
Cyanide	2.00E-002	NA	NA	2.10E+000									
Iron	3.00E-001	NA	NA	2.97E+004									
Lead	NA	NA	NA	4.62E+001									
Magnesium	NA	NA	NA	1.61E+004									
Manganese	2.00E-003	NA	NA	9.95E+002									
Mercury	2.10E-005	NA	NA	1.30E-001									
Nickel	8.00E-004	NA	NA	4.42E+001									

TABLE A-16
CALCULATION OF ABSORBED DOSE AND RISK FROM DERMAL CONTACT TO SEDIMENT
REASONABLE MAXIMUM EXPOSURE (RME) - SEAD-63
EE/CA - Mini Risk Assessment
Seneca Army Depot Activity

Equation for Intake (mg/kg-day) = CS x CF x SA x AF x ABS x EF x ED / BW x AT

Variables (Assumptions for Each Receptor are Listed at the Bottom).
CS = Chemical Concentration in Sediment, from Sediment EPC Data
CF = Conversion Factor
SA = Surface Area Contact
AF = Adherence Factor
ABS = Absorption Factor
EF = Exposure Frequency
ED = Exposure Duration
BW = Bodyweight
AT = Averaging Time

Equation for Hazard Quotient = Chronic Daily Intake (Nc)/Reference Dose
Equation for Contribution to Cancer Risk = Chronic Daily Intake (Car) x Slope Factor
Equation for Total Lifetime Cancer Risk = Adult Contribution + Child Contribution

Analyte	Dermal RfD (mg/kg-day)	Carc. Slope Dermal (mg/kg-day)-1	Absorption Factor* (unitless)	EPC Sediment (mg/kg)	Resident (Adult) Absorbed Dose (mg/kg-day) (Nc)	Resident (Adult) Absorbed Dose (mg/kg-day) (Car)	Resident (Adult) Hazard Quotient	Resident (Adult) Contribution to Lifetime Cancer Risk	Resident (Child) Absorbed Dose (mg/kg-day) (Nc)	Resident (Child) Absorbed Dose (mg/kg-day) (Car)	Resident (Child) Hazard Quotient	Resident (Child) Contribution to Lifetime Cancer Risk	Resident Total Lifetime Cancer Risk
Potassium	NA	NA	NA	2.57E+003									
Selenium	5.00E-003	NA	NA	2.10E+000									
Sodium	NA	NA	NA	5.78E+002									
Thallium	8.00E-005	NA	NA	2.30E+000									
Vanadium	1.82E-004	NA	NA	2.80E+001									
Zinc	3.00E-001	NA	NA	5.34E+002									
Total Hazard Quotient and Cancer Risk:							1E-003	1E-006			1E-002	3E-006	4.13E-006

Assumptions for Resident (Adult)			Assumptions for Resident (Child)		
CF =	1E-006	kg/mg	CF =	1E-006	kg/mg
BW =	70	kg	BW =	15	kg
SA =	5,700	cm2	SA =	2,800	cm2
AF =	0.07	mg/cm2	AF =	0.2	mg/cm2
EF =	350	days/year	EF =	350	days/year
ED =	24	years	ED =	6	years
AT (Nc) =	8,760	days	AT (Nc) =	2,190	days
AT (Car) =	25,550	days	AT (Car) =	25,550	days

Note: Cells in this table were intentionally left blank due to a lack of toxicity data.
NA= Information not available.
Absorption factors are from EPA Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual, Supplement Guidance: Dermal Risk Assessment, 1999.

Response to the Comments From the U.S. Environmental Protection Agency, Region II

Subject: Action Memorandum for the Miscellaneous Components Burial Site (SEAD-63) Seneca Army Depot, Romulus, New York, dated July, 2001

Comments Dated: August 23, 2001

Date of Comment Response: October 31, 2001

USEPA REGION II:

1. Comment: Section 2.1, 2nd ¶, 2nd to last Sentence: This statement seems outdated.

   Response: We believe the comment refers to the sentence "The depot formerly employed approximately 1,000 civilian and military personnel." This sentence is valid. No change has been made to the text

2. Comment: Section 5.1.9, 1st Sentence: Replace the word remedial with removal.

   Response: The word remedial has been replaced with removal.

3. Comment: An exposure frequency of 14 days for SEAD-63 is not protective of public health. EPA proposed an exposure frequency based on 3 days/week during 13 summer weeks, and 1 day/week for the remaining 39 weeks of the year for a total exposure frequency of 78 days/year.

   Response: EPA's recommended exposure frequency as stated above has been considered for a recreational visitor (child). The recommended exposure frequency was directly used for exposure to soil, groundwater, and sediment. For exposure to surface water, we assumed wading events take place every time during 13 spring visits (when water is most likely to accumulate in the ditches) and 10% of other visits. Therefore, an exposure frequency of 20 days/yr was used for exposure to ditch water and sediment. This is a very conservative assumption because the ditch is usually dry except during storm periods. In addition, we used other conservative assumptions such as half of the total body surface being exposed during the wading event. The comparison of the human health risks presented in this report with the previously calculated risks are summarized in the attached table.

   All the risks calculated for the recreational child, park worker, and construction worker are within EPA's target risk ranges (i.e., 10^{-4} to 10^{-6} for lifetime cancer risk and 1 for non-cancer hazard risk) and therefore, are acceptable. The recreational child resulted in a hazard index of 0.4 and a cancer risk of 8E-5. The park worker resulted in a hazard index of 0.2 and a cancer risk of 5E-5. The primary constituents driving the cancer risk are dibenz(a,h)anthracene and benzo(a)pyrene in surface water. These two constituents were detected in only one sample out of 22 samples. Therefore, risk driven by these two constituents is most likely lower than indicated by the mini-risk assessment. In addition, the sediment of the ditch where dibenz(a,h)anthracene and benzo(a)pyrene were detected in the surface water is proposed to be excavated. Therefore, risks associated with the surface water due to the compounds will be addressed by the removal action.

In addition to addressing EPA's comments, we have updated our risk assessment of the dermal exposure route according to the USEPA's Dermal Risk Assessment Interim Guidance (1999), which represents the current knowledge of dermal risk assessment. The following major changes were included:

(1) We have updated soil dermal absorption factor according to the USEPA 1999 guidance. Risks associated with semivolatile organic compounds have been added to the risk evaluation by using a default value of 0.1 as the dermal absorption factor.

(2) The dermal RfD or cancer slope factor has been updated according to the USEPA's recommendations (1999).

(3) The permeability coefficient for compounds in water (Kp) and lag time per event (τ) have been updated.

(4) The RME values for soil and water dermal contact (e.g.. skin surface area, soil adherence factor) have been updated according to the 1999 guidance.

We have also added residential risk evaluation backup calculations in Appendix F and updated table references in Table 2-15. The residential risk scenario was performed for comparison purposes only and was presented in the text of the earlier versions of this document.

Table 1. attached. compares the risk values in the July 2001 report and the updated risk values provided in this final version.

TABLE 1
Summary of Total Noncarcinogenic and Carcinogenic Risks
SEAD-63
Seneca Army Depot Activity

RECEPTOR	EXPOSURE ROUTE	Total Noncarcinogenic and Carcinogenic Risks			
		July, 2001 Report		October, 2001 Report	
		HAZARD INDEX	CANCER RISK	HAZARD INDEX	CANCER RISK
PARK WORKER	Inhalation of Dust in Ambient Air	7E-07	1E-09	7E-07	1E-09
	Ingestion of Soil	1E-03	5E-08	1E-03	5E-08
	Dermal Contact to Soil	4E-03	NQ	4E-04	8E-08
	Ingestion of Groundwater	1E-01	NQ	1E-01	NQ
	Dermal Contact to Surface Water	7E-03	9E-05	4E-03	5E-05
	Dermal Contact to Sediment	8E-04	1E-08	1E-03	1E-06
	TOTAL RECEPTOR RISK (Nc & Car)	**2E-01**	**9E-05**	**2E-01**	**5E-05**
RECREATIONAL VISITOR (CHILD)	Inhalation of Dust Ambient Air	3E-07	1E-10	1E-06	5E-10
	Ingestion of Soil	7E-04	8E-09	4E-03	4E-08
	Dermal Contact to Soil	7E-04	NQ	4E-04	2E-08
	Ingestion of Groundwater	5E-02	NQ	3E-01	NQ
	Dermal Contact to Groundwater	4E-03	NQ	5E-02	NQ
	Dermal Contact to Surface Water	3E-02	8E-05	4E-02	8E-05
	Dermal Contact to Sediment	3E-03	1E-08	1E-02	3E-06
	TOTAL RECEPTOR RISK (Nc & Car)	**9E-02**	**8E-05**	**4E-01**	**8E-05**
CONSTRUCTION WORKER	Inhalation of Dust in Ambient Air	9E-05	3E-08	9E-05	3E-08
	Ingestion of Soil	2E-01	4E-08	2E-01	4E-08
	Dermal Contact to Soil	3E-01	NQ	2E-02	1E-08
	TOTAL RECEPTOR RISK (Nc & Car)	**5E-01**	**8E-08**	**3E-01**	**9E-08**

NQ = Not Quantified due to lack of toxicity data

PARSONS ENGINEERING SCIENCE, INC.

30 Dan Road • Canton, Massachusetts 02021-2809 • (781) 401-3200 • Fax: (781) 401-2575

file - SEAD 12 comments

August 18, 1999

Ms. Carla Struble
USEPA Region II
Emergency & Remedial Response Division
290 Broadway, 18th Floor, E-3
New York, NY 10007-1866

Mr. James Quinn
New York State Department of Environmental Conservation
Bureau of Eastern Remedial Action
Division of Hazardous Waste Remediation
50 Wolf Road
Albany, NY 12233-7010

SUBJECT: Responses to Comments from USEPA dated November 14, 1997 and April 15, 1998 on the Draft-Final SEAD-12 and SEAD-63 Project Scoping Plan for Performing a CERCLA Remedial Investigation/Feasibility Study at Building 804 and the Associated Radioactive Waste Burial Sites and the Miscellaneous Components Burial Site for the Seneca Army Depot Activity

Dear Ms. Struble and Mr. Quinn:

Responses to USEPA's comments dated November 14, 1997 and April 15, 1998 on the Draft-Final SEAD-12 and SEAD-63 Project Scoping Plan were recently sent to you on August 13, 1999. The additional required copies of these responses are enclosed with this correspondence. Please insert these responses into Appendix K of the Project Scoping Plan for SEAD-12.

Should you have any questions, please do not hesitate to call me at (781) 401-2492.

Sincerely,

PARSONS ENGINEERING SCIENCE, INC.

Jacqueline Travers / for
Michael Duchesneau, P.E.
Project Manager

cc: Mr. Randall Battaglia, CENAN-PP-HE
Mr. Stephen Absolom, SEDA
Mr. Dorothy Richards CEHND-ED-CS
Mr. Keith Hoddinott, USACHPPM (Prov.)
Mr. John Buck, USAEC
Mr. Tom Enroth, USCOE

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 2
290 BROADWAY
NEW YORK, NY 10007-1866

CF
Tom E
Mike D
Kevin
Mary F

file: SEAD-12 Comments

NOV 26 1999

EXPRESS MAIL

Stephen M. Absolom
BRAC Environmental Coordinator
Directorate of Engineering and Housing
Seneca Army Depot Activity (SEDA)
Romulus, New York 14541-5001

Re: Comments on the Seneca Army Depot Activity, Ecological Risk Assessment Insert for the Workplan for SEAD-12, Final prepared by Parsons dated August 13, 1998

Dear Mr. Absolom:

Please find below our comments regarding the above referenced document in accordance with Article 17.7 of the Federal Facility Agreement.

GENERAL COMMENTS

In the Screening Level Ecological Risk Assessment(SLERA), contaminants of concern (COCs) should not be selected based on a comparison to background concentrations. This is because there is a potential for even 'naturally' occurring levels of analytes to affect the cumulative risk that is present in the system by increasing the stress on receptors utilizing that habitat. For this reason, when screening contaminants for ecological consideration, comparison should be to ecologically relevant criteria, guidance, recommended benchmarks, or literature effects values. The Ontario guidelines (D. Persaud, et al. August 1993. "Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario." Ontario Ministry of Environment and Energy), or the NYSDEC Sediment Quality Criteria, are recommended for the screening of wetland sediment. Surface water should be screened against the USEPA's Ambient Water Quality Criteria (AWQC) (Federal Register/Vol. 57, No. 246/Tuesday, Dec. 22, 1992/Rules and Regulations, p. 60911; and as revised for specific metals by Federal Register/Vol. 60, No. 86/Thursday, May 4, 1995/Rules and Regulations, p. 22228), or the NYSDEC Ambient Water Quality Standards and Guidance Values (AWQS). Compilations of soil values are not as readily available, but literature values such as those found in the Eisler series are recommended (A...Hazards to Fish, Wildlife, and Invertebrates: A Synoptic Review,@ Ronald Eisler, Biological Report..., Contaminant Hazard Reviews..., U.S. Fish and Wildlife Service). There are also many 'on-line' computer databases that can be accessed to acquire information, but it is recommended that the original study referenced in these databases be obtained when possible rather than strictly relying on what is reported in the database. This is to ensure that the methods and results of the study have produced data that are applicable to the ecological risk assessment process.

SPECIFIC COMMENTS

1. Page 1, Section 4.2.7, 3rd ¶ - To clarify, a Superfund Ecological Risk Assessment is conducted in an eight step manner according to the 1997 ERAGS guidance. The first two steps are considered a screening level ecological risk assessment and the other six steps constitute a baseline ecological risk assessment.

2. Page 3, Ecological Characterization section, 4th ¶, 2nd sentence - Federally-designated wetlands are also an aquatic resource of concern and should be included in the topographic map as well as the report text.

3. Page 4, 4th complete ¶ - Identification of criteria for potential remediation of resources should not be included as part of the ecological risk assessment.

4. Page 8, Soil Exposure Pathway, 2nd ¶, 3rd sentence - BTAG recommends evaluating a soil depth of zero to 2 feet for potential terrestrial exposure to site soils.

5. Page 9, Preliminary Screening and Identification of Chemical Stressors section, 1st ¶ - A SLERA uses the maximum media concentrations to select contaminants of concern.

6. Page 10,
   a. 1st bullet - Contaminants for the ecological risk assessment should not be screened against background concentrations to select contaminants of concern.
   b. 2nd bullet - Maximum concentrations of surface water and sediment contaminants should be screened against relevant criteria and guidelines to select COCs. See the General Comments section above for more information.

7. Page 11, last ¶ - As stated above, a SLERA uses the maximum media concentrations to select contaminants of concern.

8. Page 13,
   a. 1st ¶, last sentence - This sentence needs to indicate why the screening benchmarks for the terrestrial and aquatic receptors are an order of magnitude lower than the chronic doses listed in the previous sentence.
   b. The terms in the equation and the explanations below need to agree.

9. Page 14, explanation of equation terms for "C" should read "Daily ingested concentration per gram body weight (pCi/g)"

10. Page 16, 1st ¶, 1st sentence - Since a reference section is not provided, please give the full name of the reference "Blaylock et al (1993)."

11. Page 21, Exposure Assessment section,

a. 1st ¶, last two sentences - If after the SLERA (Steps 1 and 2) indicates potential risk, further evaluation of the chemicals using the information provided is performed in Step 3 after a Scientific Management Decision Point is agreed upon.

b. For a SLERA, the maximum media concentrations are used to calculate exposure doses to the receptors of concern. All the references to RME concentrations must be removed from this section on calculating doses for the Phase I (SLERA).

c. For the SLERA, the minimum body weight and maximum ingestion rate from the literature must be used to calculate exposure doses for all receptors.

12. Page 26, 2nd complete ¶ - ERAGS states that the most conservative (highest) bioaccumulation factors from the literature should be used in the SLERA.

13. Page 30, 1st ¶ - A hazard quotient greater than or equal to one in the SLERA indicates the potential for ecological risk. All of the other information presented here is part of Step 3 of the ERAGS process and comes after a Scientific Management Decision Point is agreed upon.

A facsimile of this letter will be sent to you today. If you have any questions, please call me at (212) 637-4323.

Sincerely yours,

Julio F. Vazquez

Julio F. Vazquez, RPM
Federal Facilities Section

cc: J. Quinn, NYSDEC
D. Geraghty, NYSDOH
R. Scott, NYSDEC-Avon
T. Enroth, USACE-NY
K. Healy, USACE-HD
M. Duchesneau, Parsons ES

file in SEAD-12 comments - this has been addressed in revised WP

NOV 1 4 1997

EXPRESS MAIL

Stephen M. Absolom
BRAC Environmental Coordinator
Directorate of Engineering and Housing
Seneca Army Depot Activity (SEDA)
Romulus, New York 14541-5001

Re: Draft-Final SEAD-12 and SEAD-63 Project Scoping Plan For Performing a CERCLA Remedial Investigation/Feasibility Study At Building 804 And The Associated Radioactive Waste Burial Sites And The Miscellaneous Components Burial Site for the Seneca Army Depot Activity

Dear Mr. Absolom:

This is regarding the revised pages to the above referenced document prepared by Parsons Engineering-Science (Parsons ES) for the U.S. Army Corps of Engineers New York District and Huntsville Division. EPA received this submittal September 19, 1997 in response to our comments dated July 2, 1996, August 19, 1996, October 4, 1996, April 9, 1997, April 22, 1997, July 25, 1997 and August 7, 1997. Comments which have not been addressed are summarized below.

GENERAL COMMENTS

It is our understanding that the Army has proceeded with the collection of surface water and sediment samples at SEADs 12 and 63. This work has been conducted prior to the approval of the Work Plan. Considering the number of revisions the Army chose to make to the Work Plan for these SEADs, the Army is proceeding at its own risk with this sampling. This work was also conducted without providing 30 days notice as discussed in our Federal Facility Agreement in order to schedule EPA and NYSDEC collection of split samples. On November 3, 1997, EPA requested a field sampling schedule but it has not been provided. In addition, this work was conducted without providing EPA with documentation of renewed certification for radiological analyses. SEDA's contracted laboratory's certifications for radiological analyses expired April 1, 1997. EPA reminded you of this in our April 9, 1997 letter regarding the Project Scoping Plan for SEADs 12 & 63 and subsequently during our telephone conversations in August and October. For these reasons, if the adequacy of the data is uncertain, re-sampling would be required.

At the Albany, New York meeting between SEDA, EPA and the NYSDEC on June 26, 1997, the Army advocated the use of a phased approach to implement the Remedial Investigations for SEADs 12 and 63. A phased approach has been incorporated in the revised Work Plan by initially identifying survey classifications in accordance with MARSSIM. The revised Work Plan should discuss details on how decisions will be reached to change a survey classification or implement additional phases of investigation. It should also be clarified if the implementation of any portion of the scope of work described in the revised Work Plans is intended to be optional or dependent upon the results of earlier phases of the revised Work Plan scope.

Throughout the plan, the authors state that MARSSIM will be followed, along with NUREG/CR-5849 and other NUREG documents. However, as the following specific comments point out, there are several activities and procedures included in this plan which are inconsistent with MARSSIM methodology. MARSSIM is not intended to be adopted selectively. Either it is followed, or it should be not cited as the basis for this project.

SPECIFIC COMMENTS

Comment/Response # 3:
The response to this comment acknowledges that the NYSDEC will use the RESRAD code to determine guideline values for the radiological data at these SEADs. The response further states, however, that "the project scoping plan has been revised and all references to performing a radiological risk assessment as part of the baseline risk assessment have been removed". This implies that a baseline risk assessment will be conducted only for non-radiological chemicals of concern. The output from the NYSDEC's application of RESRAD will not result in a baseline risk assessment for radiological compounds. The USEPA's Risk Assessment Guidance for Superfund, Chapter 10, Radiation Risk Assessment Guidance, discusses summing the estimates of lifetime risk of cancer resulting from radiological and chemical risk assessments in order to determine the overall potential human health hazard associated with a site. The scoping document should be revised to indicate that a radiological baseline risk assessment will also be prepared.

Comment/Response #11:
As referenced in previous comment letters on the draft Remedial Investigation Reports for SEADs 16 & 17 and SEADs 25 & 26, the USEPA's Supplemental Guidance to RAGS: Calculating the Concentration Term (USEPA, 1992; Publication 9285.7-08I) should be used as a reference in calculating the 95 percent upper confidence limit. If Parsons is aware of more recent USEPA guidance on this subject, it should be submitted for review. In the absence of such guidance, the document cited above should be used.

Comment/Response #14:
Due to the future intended use of these areas as a wildlife conservation / recreation area, the future use will also require the preparation of an ecological risk assessment. The Army should review the applicability of the RESRAD-Ecorisk model in the preparation of such an assessment.

Page 3-24: A Ludlum M-19 is called a micro-R beta and gamma rate meter. It is a sodium iodide gamma scintillation detector (it does not respond to beta particles). A Ludlum 2221 is called an alpha scintillation meter. It is a rate meter/scaler (it is not a scintillation detector).

Page 3-56: The text states "Gamma radiation from radium-226 and two of its associated radionuclides were found at levels ranging from 56 pCi/L to 109 pCi/L." Gamma radiation is not expressed as a concentration. The text should be revised.

Page 3-78: See the previous comment on the use of radiation detection equipment.

Page 3-97, Section 3.1.2.3: The language in the introduction to this section contrasts with the discussion in the "Groundwater" subsection. The introduction indicates the groundwater has been affected, whereas the subsection indicates it may have been affected. The elevated gross alpha and gross beta concentrations in some samples may be a reflection of natural levels of radioactivity in the suspended solids, measured in NTUs. The text should consistently indicate this.

Page 3-135, ARARs: 40 CFR 192, the Uranium Mill Tailings Radiation Control Act (UMTRCA), should be deleted in lieu of USEPA's recent OSWER Directive No. 9200.4-18 (Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination), which, in an attachment, indicates that UMTRCA does <u>not</u> apply to CERCLA sites.

Page 3-142: The text states that "The Null Hypothesis for the radiological survey units at SEADs-12 and -63 is that any residual radiation at a survey unit is below a release criterion." In MARSSIM, the Null Hypothesis used for testing a survey unit is exactly the opposite, i.e., that the residual radioactivity in a survey unit exceeds the release criterion. A survey unit may be released when the Null is rejected. It is recommended that the text be revised to be consistent with MARSSIM.

Page 4-2, p1: The text states that the "investigations are designed to demonstrate <u>that</u> the levels of exposure to radiation . . . is below the acceptable limits." The word "that" should be changed to "if." The actual conditions are not known, pending an evaluation of the RI data.

Page 4-2: The text states that the radiation survey methodologies of NUREG/CR-5849 and MARSSIM will be followed. The two documents describe methodologies which are similar, but they do have real differences. The SEDA investigations can not be compliant with both. If both are referenced, it should be clear what is included/excluded from NUREG/CR-5849 and MARSSIM.

Page 4-6, p1: The last sentence states that monitoring wells MW12-10, -11, -12, and -13 will be located in areas where the borehole geophysics survey indicates that radium-226 <u>is being transported</u> downgradient of the disposal pit. The scientific literature shows that radium is extremely slow to migrate from soil to groundwater and this sentence, as written, makes the *a priori* assumption that migration has occurred. It is possible, or even likely, that radium migration to groundwater has not occurred. The text should be clarified.

Page 4-9: The text states that the site is divided into survey units and then classified as Class 1, 2, or 3 areas. This sequence is inconsistent with MARSSIM, which calls for classification of areas to precede survey unit designations. Survey unit size is class dependent. The approach should be changed accordingly.

Figures 4-4 and 4-5, p. 4-10: The strategy to upgrade area classification is inconsistent with MARSSIM. As written, the area 3 and 2 survey units will be upgraded to area 2 and 1 survey units, respectively, when residual radioactivity exceeding 50% of the site specific guideline value, but less than the site specific guideline value, is found. MARSSIM classifies survey units as follows:

Class 1 - Residual activity exceeds guideline value at one or more locations.

Class 2 - Residual activity exists, but does not exceed guideline value.

Class 3 - Greater than background residual activity does not exist anywhere in survey unit.

As currently presented in the document, there will be survey units with relatively equivalent levels of residual radioactivity given different classifications (some Class 1 and some Class 2) simply as a result of the preliminary classification prior to data collection. Furthermore, problems also exist with the strategy proposed to downgrade classification of survey units. The text states that Class 3 survey units in Buildings 806, 810, 812, 800, 802, and 825 will be downgraded to unaffected if Class 1 and Class 2 survey units in Buildings 803, 804, 805, 806, 810, or 812 are found not to have residual radioactivity above 50% of the guideline. To release Class 3 survey units, data must be collected from those survey units and meet the release criterion as specified in MARSSIM.

The classification protocols should be changed to be consistent with MARSSIM methodology.

Table 4-3, p. 4-16 and 4-17: Regarding guideline values for building surfaces; Section 8.5.3 of MARSSIM clearly indicates that removable activity data (from wipe or smear samples) are not to be used for comparison to guideline values due to the relatively high degree of error associated with that type of data. Rather, they are a diagnostic tool to determine if further investigation is necessary and should only be used for that purpose. They should not be used to evaluate if a survey unit meets release criteria.

Table 4-4, p. 4-19 and 4-20: Regarding the MDCs; the field investigations include surface scanning for alpha emitters with ZnS and/or gas proportional counters. Page 4-5 of MARSSIM (December 1996) and a recent article by Abelquist and Vitkus in the July/August 1997 issue of Radiation Protection Management which describes the errors which result when one assumes that the alpha detection efficiency determined with a smooth, massless alpha source is achieved in the field. This is because there is a large and variable reduction in alpha efficiency due to the self-attenuation of alpha particles emitted from irregular surfaces. Therefore the scanning data determined in the field often significantly underestimates the true alpha activity levels. Whenever possible, therefore, beta particle measurements should be used as a surrogate for alpha activity; this can be done for radionuclides which are members of the uranium, thorium, and actinium series.

Page 4-24: MARSSIM states that 100% of Class 1 survey units must be scanned. The text states that this will be done for lower walls, but upper wall scans will be done over only 10% of the surface. This approach is reasonable, but then the upper walls should be classified as Class 2 survey units rather than Class 1.

Page 4-24 and Page 4-25: See previous comment on MDCs. Alpha surveys for radionuclides of concern which include uranium, thorium, and radium would be better served by beta surveys due to the problems with alpha detection efficiency over an irregularly shaped source.

Page 4-27, Daily Flag Values: See the previous comments on MDCs. The detection efficiency for surface alpha measurements will differ significantly from location to location due to self-attenuation.

Section 4.2.3.3 Exposure Rate Surveys: Exposure rate measurements may be useful to characterize contamination, which is of course an objective of a remedial investigation. However, for indoor surveys, exposure rate measurements should not be compared to a guideline level for statistical testing designed to test the survey unit against a reference background area to evaluate if it has met the release criterion. It is possible that alpha and/or beta surface contamination could be present at levels exceeding the release criteria, yet the exposure rates at one meter above the surface will not differ from background. The determination of surface activity in survey units and reference areas, which are a part of this project, are sufficient for the buildings investigations.

Section 4.2.3.4: See previous comment regarding Tables 4-3, page 4-16 and 4-17.

Page 4-33, Surface Soil Sampling Program: A total of 318 surface soil samples will be collected from SEAD-12, of which 250 will be collected from Class 1 and Class 2 areas where, the text states, no residual radiation is expected except in the subsurface of Disposal Pit A. If no residual radiation is expected in most of the area, then, by MARSSIM definition, most of the area should be classified as Class 2. Furthermore, the sampling density of one sample per 10 by 10 meter grid is said to be planned as a means of documenting the surface scanning and exposure rate measurement surveys. If the instruments used to conduct those surveys are operating properly and the appropriate QC checks are performed, then the data which result from those surveys would not require "documentation" by another means. Soil samples should be collected to (1) help delineate contaminated areas, and (2) enable statistical testing of the survey unit.

Section 4.2.4.4 Soil Sampling Summary: See previous comment concerning the surface soil sampling program.

Page 4-46: The text states that "groundwater samples from the ESI contained two principal radionuclides, U-235 and Ra-226, gross alpha, and gross beta radiations at concentrations exceeding state or federal drinking water criteria." It goes on to state that the vertical and lateral extent of potential contaminant migration . . . has not been fully characterized and that up to 41 monitoring wells will be installed to determine the extent of groundwater contamination. At the Albany, New York meeting between SEDA, EPA and the DEC in June 26, 1997, the Army advocated the use of a phased approach to implement the Remedial Investigations for SEADs 12 and 63. The text should discuss how that will effect the installation of 41 monitoring wells. See general comment above.

Section 4.3.2, Radiological Investigations at SEAD-63: All of the comments above regarding radiation characterization activities at SEAD-12 are applicable to the SEAD-63 investigation. These include the comments about instruments, types of measurements and the use of specific types of data.

Section 4.4 Data Reduction, Assessment and Interpretation: MARSSIM is cited and the statistical tests included in MARSSIM are mentioned. As noted in earlier comments, MARSSIM testing should not be done on parameters which MARSSIM indicates are not quantitative (such as removable surface activity data and indoor exposure rate measurements).

HAZARDOUS WASTE SUPPORT SECTION

1. Modification of Existing methods to Achieve MCLs

The SEDA response indicates that this issue is addressed under separate cover in a letter to EPA dated 9/9/97 and that the requested information will be incorporated into the generic workplan. However, recent discussions with SEDA have indicated that subsequent revision of the Generic RI/FS Workplan is not currently possible due to contractual difficulties. This is contradictory to the original intent of the Generic RI/FS Workplan as stated in Section 1.1, page 1-1. "As required , this generic workplan will be updated and/or revised to incorporate specific field sampling procedures and/or analytical methodologies or test procedures used for environmental investigation/construction developments at the SEDA." Therefore, if revision of the generic workplan is not possible, each individual Scoping Plan must contain all relevant and appropriate information to the AOCs and be amended as such.

Review of SEDAs 9/9/97 submittal regarding the analytical method modifications as they apply to SEADs 12 and 63 warrant the following comments.

a. Regarding the validation SOPs to be used on data acquired with the modified NYSDEC ASP methods, the EPA Region II SOPs for Evaluating Organic Data stated in the Generic Workplan, Appendix C, Chemical Data Acquisition Plan, Section 9.2.4, page C-49 remain applicable and must be used.

b. SEDA has not fully addressed item 6 in EPA's letter of 11/15/96. That is, SEDA must provide the scenario which is to exist on order to implement the modified methods. For example, will first round sampling be performed by routine NYSDEC ASP semi-volatile and pesticide/PCB methods? If non-detect results are obtained for those compounds which have an ARAR lower than the achieved quantitation limit, will the modified method then be enacted on subsequent sampling rounds? Or, will the modified semi-volatile and PST/PCB methods be used initially? Please discuss.

c. The PCB reporting limits listed in Attachment C of the SEDA 9/9/97 letter do not agree with those listed in the Pesticide/PCB Analysis SOP, Section 11, pages 23 and 24, as provided by Inchcape Testing Services. This information is also inconsistent with the Ar 1260 reporting limit listed in the laboratory's MDL study using the modified NYSDEC ASP methods (Inchcape letter dated 3/25/97). Please clarify.

2. Data Validation

As per the approved Generic Workplan and item 1a above, the Region 2 SOPs for Evaluating Organic Data are to be used in lieu of the National Functional Guidelines which the Army is currently proposing in the Project Scoping Plan. For the data acquired using Method 524.2, the regional organic SOP should be used as a guideline for the topics to assess and the subsequent qualification actions to perform. The specific QC criteria and acceptance limits are found within M. 524.2 and must be used by the validation personnel.

3. TCLP data

The response provided is acceptable.

4. Radiological data

The response provided is acceptable.

5. Laboratory Certification

See general comment above.

A facsimile of this letter will be sent to you today. If you have any questions, please call me at (212) 637-4322.

Sincerely yours,

Carla M. Struble, P.E.
Federal Facilities Section

cc: M. Chen, NYSDEC
D. Geraghty, NYSDOH
R. Scott, NYSDEC
R. Battaglia, USACE-NY
K. Healy, USACE-HD
M. Duchesneau, Parsons ES

bcc: R. Wing, SPB
A. Jackson, DESA-HWSB
B. Nelson, MPI
E. Simpson, DEPP-RIAB

SENECA ARMY DEPOT ACTIVITY

BLDG 123
ROMULUS, N.Y.
14541

ENGINEERING/ENVIRONMENTAL DIVISION

DATE: 5/5/98 **TIME:** 0835 **# of PAGES W/ COVER SHT:** 8

TO: Mike Duchesneau

OFFICE/CO. Parsons

FAX#

FROM: S.M. Absolom

SENECA ARMY DEPOT ACTIVITY
FAX# (607) 869-1362
PHONE# (607) 869-1532

non-applicable here TMO

COMMENTS: Mike - This should help resolve the issue on the applicability of UMTRAC STD.

Please pass to Becky & confirm what she has to say so we can address it in the future.

S M Absolom

C.F. Kevin Healy
Tom Enroth.

To: Steve Absolom
(607) 869-1362

From: Michael Bassily

Steve,

This may become important to the uranium mill tailing site at Seneca, if covered under CERCLA. Please pass to Cleary & the Parsons Health Physicist.

Thanks
Mike
(301) 394-6310
DSN 290-6310

EPA United States Environmental Protection Agency **Superfund**

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

Signed 2/12/98

Directive no. 9200.4-25

MEMORANDUM

SUBJECT: Use of Soil Cleanup Criteria in 40 CFR Part 192 as Remediation Goals for CERCLA sites

FROM: Stephen D. Luftig, Director
Office of Emergency and Remedial Response

Larry Weinstock, Acting Director
Office of Radiation and Indoor Air

TO: Addressees

PURPOSE

This memorandum addresses the use of the soil cleanup criteria in 40 CFR Part 192 when setting remediation goals at CERCLA sites with radioactive contamination. In particular, it clarifies the intent of 40 CFR Part 192 in setting remediation levels for subsurface soil. It does not address the applicability or intent of other standards contained in 40 CFR Part 192, nor does it address setting remediation goals for contaminated media other than soil. This document provides guidance to EPA staff. It also provides guidance to the public and to the regulated community on how EPA intends that the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) be implemented. The guidance is designed to describe EPA's national policy on these issues. The document does not, however, substitute for EPA's statutes or regulations, nor is it a regulation itself. Thus, it cannot impose legally-binding requirements on EPA, States, or the regulated community, and may not apply to a particular situation based upon the circumstances. EPA may change this guidance in the future, as appropriate.

BACKGROUND

All remedial actions at CERCLA sites must be protective of human health and the environment and comply with applicable or relevant and appropriate requirements (ARARs) unless a waiver is justified. Cleanup levels for response actions under CERCLA are developed based on site-specific risk assessments, ARARs, and/or to-be-considered materiall (TBCs). The determination of whether a requirement is applicable, or relevant and appropriate, must be made on a site-specific basis (see 40 CFR Part 300.400(g)).

On January 5, 1983, EPA promulgated in Subpart B of 40 CFR Part 192 (48 FR 590 to 606) *Standards for Cleanup of Land and Buildings Contaminated with Residual Radioactive Materials from Inactive Uranium Processing Sites.* These standards were developed pursuant to Section 275 of the Atomic Energy Act (42 U.S.C. 2022), as amended by Section 206 of the Uranium Mill Tailings Radiation Control Act of 1978 (42 U.S.C. 7918).

These standards were developed specifically for the cleanup of uranium mill tailings at 24 sites designated under Section 102(a)(1) of UMTRCA (Title I sites). The purpose of these standards was to limit the risk from inhalation of radon decay products in houses built on land contaminated with tailings, and to limit gamma radiation exposure of people using contaminated land (see 48 FR 600). The list of 24 Title I sites is a closed set chosen in 1979 that cannot be added to. It includes the so-called "vicinity" sites at which cleanup of specified off-site properties for unrestricted use is authorized.

Subpart B of 40 CFR Part 192 contains two different soil standards. The concentration criterion for surface soil (5 pCi/g of radium-226) is a health-based standard. The relevant source of health risk for surface soil is exposure to gamma radiation, which is the basis for this standard. This basis is noted in the preamble to the final rule (see 48 FR 600) and is discussed in greater detail in the Final Environmental Impact Statement (FEIS) which was conducted as part of the rulemaking process (see the FEIS at pp. 57, 111-112, and 134-137). This standard for a single radioisotope (radium-226) was developed to control the hazard from gamma radiation.

The concentration criterion for subsurface soil in Subpart B (15 pCi/g of radium-226) is not a health-based standard, but rather was developed for use in limited circumstances, explained below, to allow the use of field measurements rather than laboratory analyses to determine when buried tailings had been detected. The basis for this criterion is documented in the materials accompanying the promulgation of Subpart B (see 48 FR 600, the FEIS at pp. 134-137 and D-51 to D-52, and *Findings of an Ad Hoc Technical Group on Cleanup of Open Land Contaminated with Uranium Mill Tailings. EPA, 1981, Docket A-79-25*).

The criterion for subsurface soil was derived as a tool for use in locating and remediating discrete deposits of high activity tailings (typically 300-1,000 pCi/g) in subsurface locations at mill sites or at vicinity properties. The criterion for subsurface soil in Subpart B was originally proposed as 5 pCi/g (46 FR 2562). The criterion in the final rule was changed, not because of a reassessment of the level of contamination that would present a threat to health, but rather in order to reduce the cost to DOE of locating buried tailings; EPA's analysis found that by cleaning up this highly active waste, located using the 15 pCi/g finding tool, DOE would achieve essentially the same degree of cleanup that would result at the Title I sites as originally proposed under the 5 pCi/g criterion (see 48 FR 600 and FEIS p. D-51).

When examining the costs and benefits of alternative standards ranging from 5 to 30 pCi/g, the analysis for the final rulemaking found that the amount of buried tailings to be removed varies only slightly with the limit selected (see 48 FR 600). This indicates that there was expected to be little subsurface contamination ranging from 5 to 30 pCi/g at the Title I sites regulated under this rule. The rule was not developed for situations where significant quantities of contamination exist between 5 and 30 pCi/g. EPA considered significant residual contamination of up to 15 pCi/g of radium-226 to generally be hazardous to build on, but concluded that there would be very little contamination in this range at Title I sites. A concentration of 15 pCi/g was considered likely to occur only in thin layers at the edges of more concentrated deposits that would be cleaned up under a 15 pCi/g criterion (see FEIS p. 136-137). EPA's analysis for the rule determined that a 5 pCi/g, rather than 15 pCi/g, criterion for subsurface soil "would require more skill and training of personnel, and greater use of expensive measuring techniques, but cleanup would only be marginally more complete" (see FEIS p. 136). The 15 pCi/g criterion is therefore only suitable for use, as a cost effective tool to locate and remediate radioactive waste, when most or all subsurface contamination is at a level greater than 30 pCi/g and is not expected to be significantly admixed with clean soil. In this situation, removing all subsurface contamination detected at 15 pCi/g or above will reduce residual contamination to nearly zero.

The 5 pCi/g and 15 pCi/g standards were initially developed for a single radioisotope (radium-226) to control the hazard from radiation. In Subpart E of 40 CFR Part 192 (48 FR 45947) *Standards for Management of Thorium Byproduct Materials Pursuant to Section 84 of the Atomic Energy Act of 1954, as Amended*, EPA determined that these standards were suitable for remediation of radium-228 at Title II sites (see 48 FR 45944 and the FEIS for *Standards for the Control of Byproduct Materials from Uranium or Processing (40 CFR 192) Volume I, Appendix G: Thorium Mill Tailings)*.

Attainment of the 5 pCi/g and 15 pCi/g UMTRCA standards was intended to signify that a Title I site had been cleaned up to a level suitable for unrestricted use. However, in Subpart C of 40 CFR Part 192, alternative site-specific standards may be established under some special circumstances that allow the selection and performance of remedial actions that come as close as reasonably achievable to meeting the UMTRCA standards. In general, these "supplemental standards" were not expected to be used often. They were designed for situations in which worker safety would be adversely impacted or clearly greater environmental harm would result from the remedial action necessary to attain the standards, for situations in which the materials do not pose a clear present or future hazard and improvements could be achieved only at unreasonably high cost, or where concentrations of other radionuclides are sufficiently high to constitute a significant radiation hazard.

OBJECTIVE

The objective of this memorandum is to provide guidance regarding the circumstances under which the soil cleanup criteria in 40 CFR Part 192 should be considered an ARAR in developing a response action under CERCLA.

IMPLEMENTATION

The following subsections will clarify the use of 40 CFR Part 192 in setting remediation levels for subsurface soil.

UMTRCA AS AN APPLICABLE REQUIREMENT

The standards contained within Subpart B of 40 CFR Part 192 are potentially applicable requirements only for the Title I sites designated under Section 102(a)(1) of UMTRCA. The standards contained within Subparts D and E of 40 CFR Part 192 are potentially applicable requirements only for the Title II sites designated under Section 206 of UMTRCA.

UMTRCA AS A RELEVANT AND APPROPRIATE REQUIREMENT

If the contaminants at a site are the same (i.e., radium-226, radium-228, and/or thorium) and the distribution of contamination is similar to that existing at Title I sites as described in 40 CFR Part 192 (i.e., little subsurface contamination from 5 to 30 pCi/g), then the 15 pCi/g standard is a potentially relevant and appropriate requirement for the site. As explained above, under these circumstances the 15 pCi/g standard would be expected to achieve an actual subsurface cleanup level of below 5 pCi/g in practice.

If it is determined, either in the course of further study, or even during remedial action, that subsurface contamination exists at a level between 5 pCi/g to 15 pCi/g averaged over areas of 100 square meters (the averaging areas provided for in the Part 192 rules), this indicates that conditions at the site are probably not sufficiently similar to an UMTRCA site to consider the subsurface contamination standard under 40 CFR Part 192 a relevant and appropriate requirement. If such a finding had been made, the ARAR determination should be reconsidered and a cleanup level for the subsurface contamination may have to be established based on a site-specific risk assessment.

For the same reasons, the 15 pCi/g standard should not generally be considered relevant and appropriate as a standard for backfill material. Since EPA's expectation in promulgating Part 192 was that cleanups of subsurface soil contamination would, in practice, achieve a protective level of 5 pCi/g under the circumstances presented at UMTRCA sites, it would not generally be appropriate to allow backfilling with material with concentrations higher than 5 pCi/g.

WHERE UMTRCA IS NOT AN ARAR

If the radioactive contamination at the site is unlike that at the uranium mill tailings sites regulated under 40 CFR 192, in that significant subsurface contamination exists at a level between 5 pCi/g to 30 pCi/g, the use of the 15 pCi/g standard is not generally appropriate.

In this situation, we recommend 5 pCi/g as a suitable cleanup level for subsurface contamination, if a site-specific risk assessment demonstrates that 5 pCi/g is protective 2, on the basis that the preamble to 40 CFR 192 indicates that even with a standard of 15 pCi/g, almost all contamination was expected to be remediated to a level of 5 pCi/g. The level of 5 pCi/g was the actual health-based level that was expected to be achieved when implementing 40 CFR 192.

WHERE RADIUM-226, RADIUM-228, AND/OR THORIUM ARE COMMINGLED

Because the risk from uranium and thorium byproducts is additive, and because the 5 pCi/g and 15 pCi/g standards are based on total acceptable risk, whenever the 5 pCi/g and/or 15 pCi/g standards are used as relevant and appropriate requirements (or TBC's) at CERCLA sites with some combination of radium-226 and radium-228, these soil standards should apply to the combined level of contamination of radium-226 and radium-228.

It should be noted that to meet a permanent clean-up objective for radium -226 and radium-228 of 5 pCi/g, there needs to be reasonable assurance that the preceding radionuclides in the series will not be left behind at levels that will permit the combined radium activity to build-up to levels exceeding 5 pCi/g after completion of the response action. At a minimum, this would generally mean that thorium-230 (the parent of radium-226) and thorium-232 (the parent of radium-228) should be cleaned up to the same concentrations as their radium progeny. Therefore, whenever the 5 pCi/g and/or 15 pCi/g standards are used as relevant and appropriate requirements (or TBC's) at CERCLA sites with some combination of thorium-230 and thorium-232, these soil standards should apply to the combined level of contamination of thorium-230 and thorium-232.

SUPPLEMENTAL STANDARDS

If supplemental standards in 40 CFR Part 192, Subpart C, are used in conjunction with the above standards for the remediation of soil, institutional controls should generally be included as a component of cleanup alternatives in order to ensure the response will be protective over time.3 The requirement for 5-year reviews (see 40 CFR 300.430(f)(4)(ii)) would apply if the use of supplemental standards were to result in waste being left on-site at levels that would require limited use and restricted exposure to ensure protectiveness.

FURTHER INFORMATION

The subject matter specialists for this directive are Stuart Walker of OERR (703-603-8748) and John Karhnak of ORIA (202-564-9280). General questions about this directive, should be directed to 1-800-424-9346.

Addressees
National Superfund Policy Managers

Superfund Branch Chiefs (Regions I-X)
Superfund Branch Chiefs, Office of Regional Counsel (Regions I-X)
Radiation Program Managers (Regions I, IV, V, VI, VII, X)
Radiation Branch Chief (Region II)
Residential Domain Section Chief (Region III)
Radiation and Indoor Air Program Branch Chief (Region VIII)
Radiation and Indoor Office Director (Region IX)
Federal Facilities Leadership Council
OERR Center Directors

CC:
Jim Woolford, FFRRO
Elizabeth Cotsworth, OSW
Craig Hooks, FFEO
Barry Breen, OSRE
Joanna Gibson, HOSC/OERR
Earl Salo, OGC

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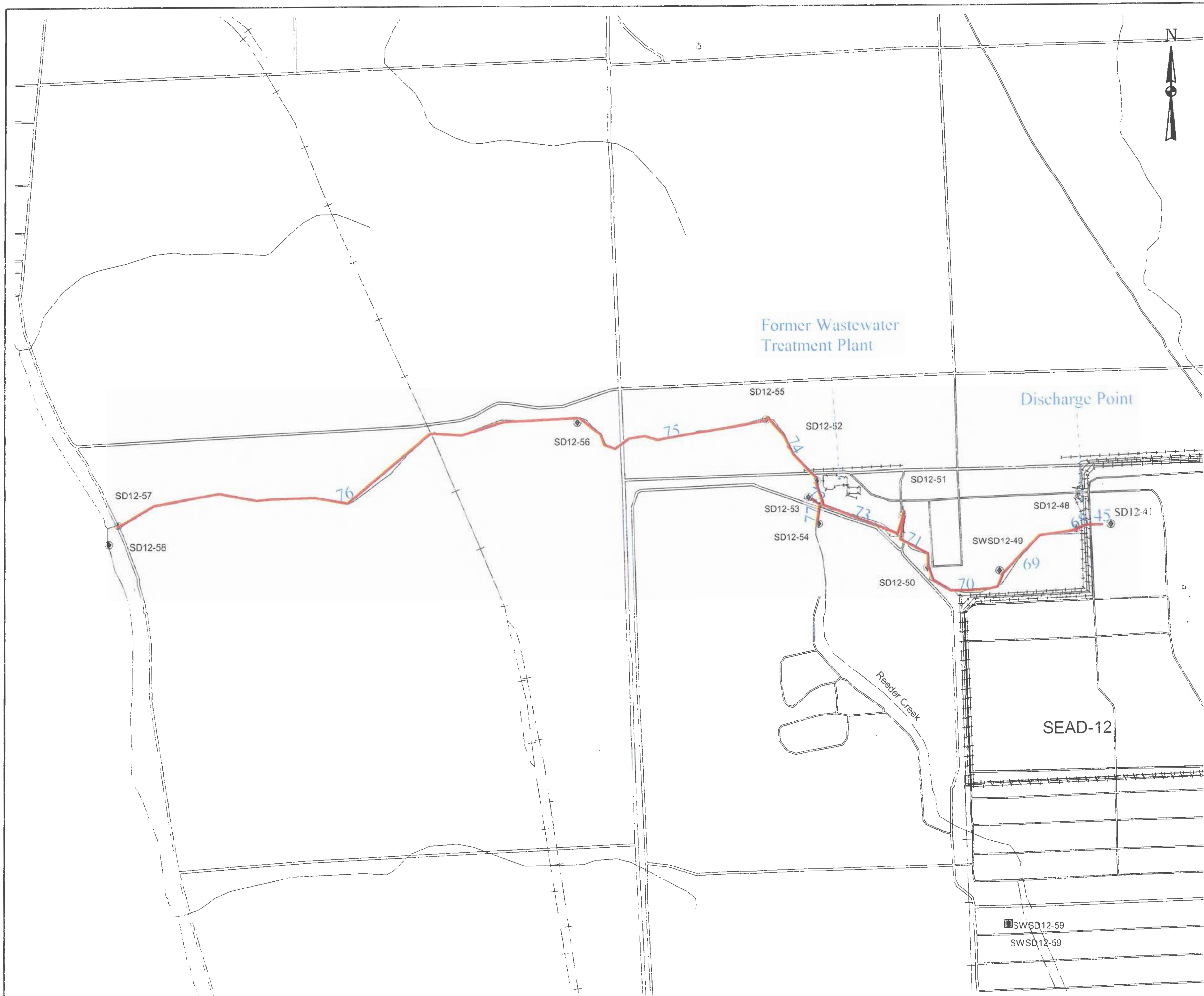
1 To-be-considered material (TBCs) are non-promulgated advisories or guidance issued by Federal or State governments that are not legally binding and do not have the status of potential ARARs. However, TBCs will be considered along with ARARs as part of the site risk assessment and may be used in determining the necessary level of cleanup for protection of health and the environment.

2 For further information regarding protective cleanups at CERCLA sites, see the memo from Stephen D. Luftig and Larry Weinstock to the Regions; "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination" (OSWER Directive 9200.4-18), August 22, 1997.

3 For further information regarding protective cleanups at CERCLA sites, see the memo from Stephen D. Luftig and Larry Weinstock to the Regions; "Establishment of Cleanup Levels for CERCLA Sites with Radioactive Contamination" (OSWER Directive 9200.4-18), August 22, 1997.

ATTACHMENT B
QUALITY ASSURANCE PROJECT PLAN ELEMENTS
(TO BE PROVIDED)



LEGEND

SD SAMPLE LOCATION

Location of Ditches that are Assumed to be About 20 Feet Wide. These Ditches Contain Water Year Round.

NOTE: According to NYS AWQS Class C (aquatic) there are no Metal Exceedances in the surface water samples downgradient of the site.

1000 0 1000 2000 Feet

PARSONS

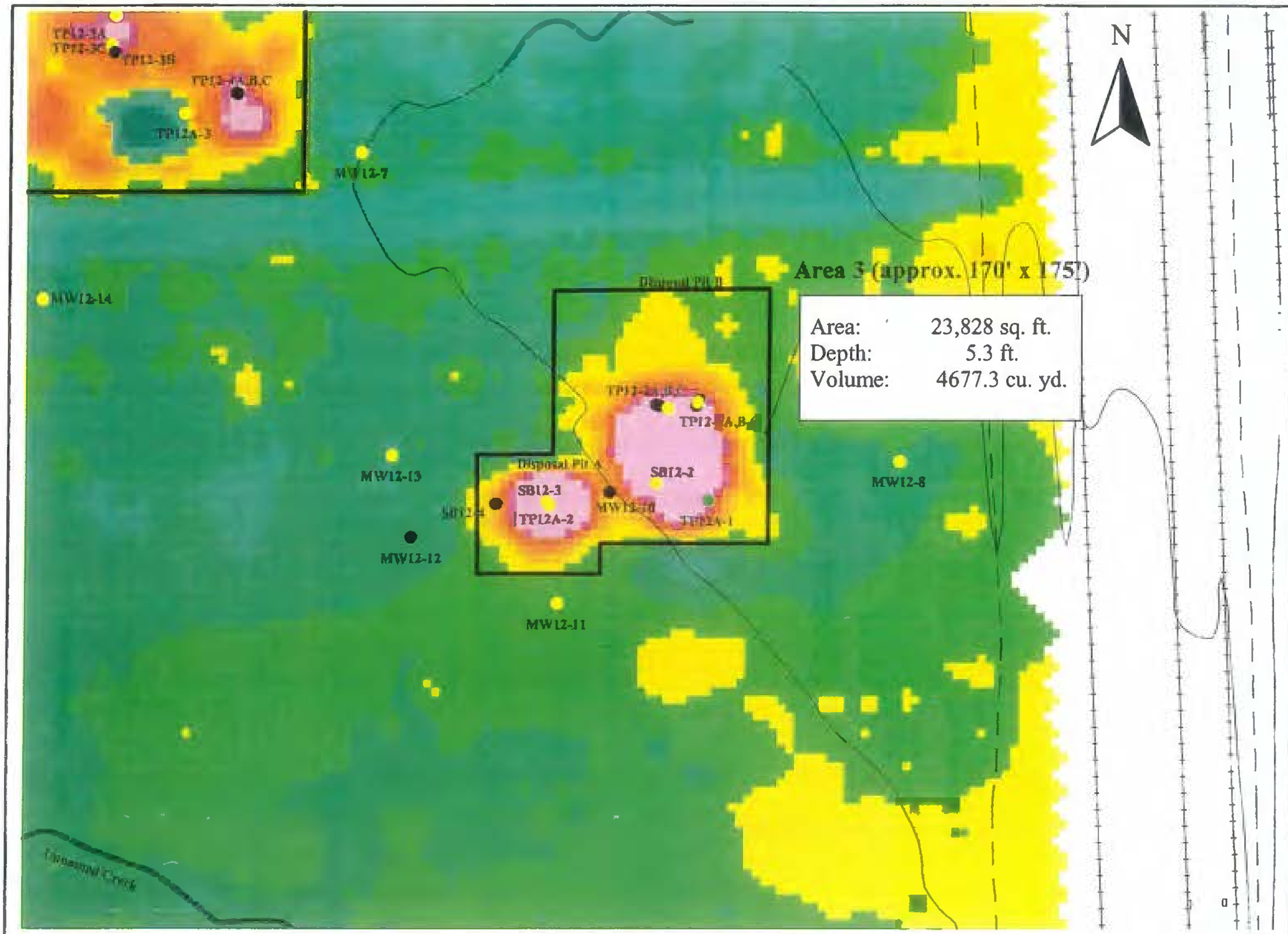
PARSONS ENGINEERING SCIENCE, INC.

SENECA ARMY DEPOT ACTIVITY
RI/FS
SEAD-12

FIGURE 2
LOCATION OF DITCHES TO BE EXCAVATED FOR CASES SED-2 AND SED-4

SCALE	DATE	REV	
1:1500	JULY 2001		Sheet 1 of 1

O:\AV GIS30\SENECA\SEAD12\GKEXCD.APR



100 0 100
(feet)

LEGEND

MW12-15 ● Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. No exceedences present

MW12-15 ● Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Metal exceedences present

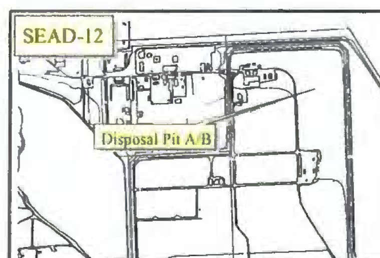
MW12-15 ● Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Semi Volatile Organic exceedences present.

MW12-15 ● Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Metal and Semi Volatile Organic exceedences present

MW12-15 ▲ Background Sub-surfacerface Soil with Loc_ID analysed for chemical parameters.

Potential Release Area

Area to be Excavated



PARSONS

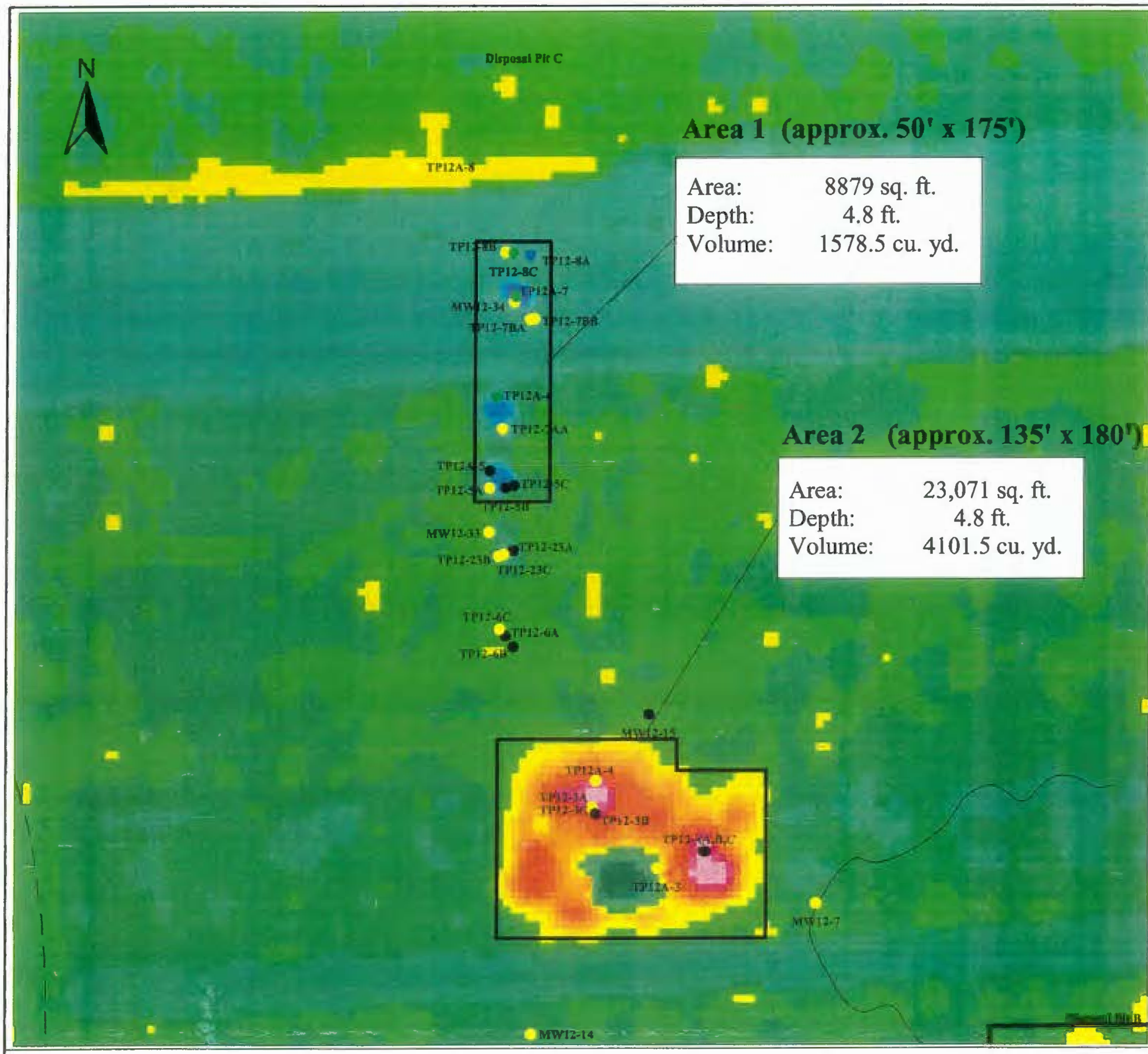
PARSONS ENGINEERING SCIENCE, INC.

SENECA ARMY DEPOT ACTIVITY
RI/FS
SEAD-12

FIGURE 2-9
ELECTROMAGNETIC DATA AND REMEDIAL VOLUME ESTIMATE FOR SOIL AT DISPOSAL PIT A/B

SCALE 1:100	DATE AUG 200	REV	Sheet 1 of 1

O:\SENECA\SEAD-12\SUB_SOIL.APR

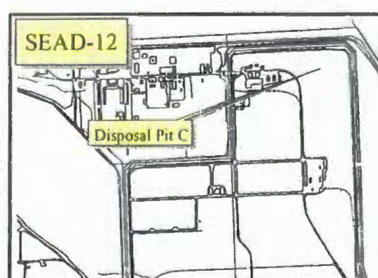


100 0 100

(feet)

LEGEND

- MW12-15 — Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. No exceedences present
- MW12-15 — Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Metal exceedences present
- MW12-15 — Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Semi Volatile Organic exceedences present.
- MW12-15 — Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Metal and Semi Volatile Organic exceedences present
- MW12-15 — Background Sub-surfacerface Soil with Loc_ID analysed for chemical parameters.
- Potential Release Area
- Area to be Excavated



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SENECA ARMY DEPOT ACTIVITY
RI/FS
SEAD-12

FIGURE 2-11
ELECTROMAGNETIC DATA AND REMEDIATION VOLUME ESTIMATE FOR SOIL AT DISPOSAL PIT C

SCALE	DATE	REV	
1:100	AUG 200		Sheet 1 of 1

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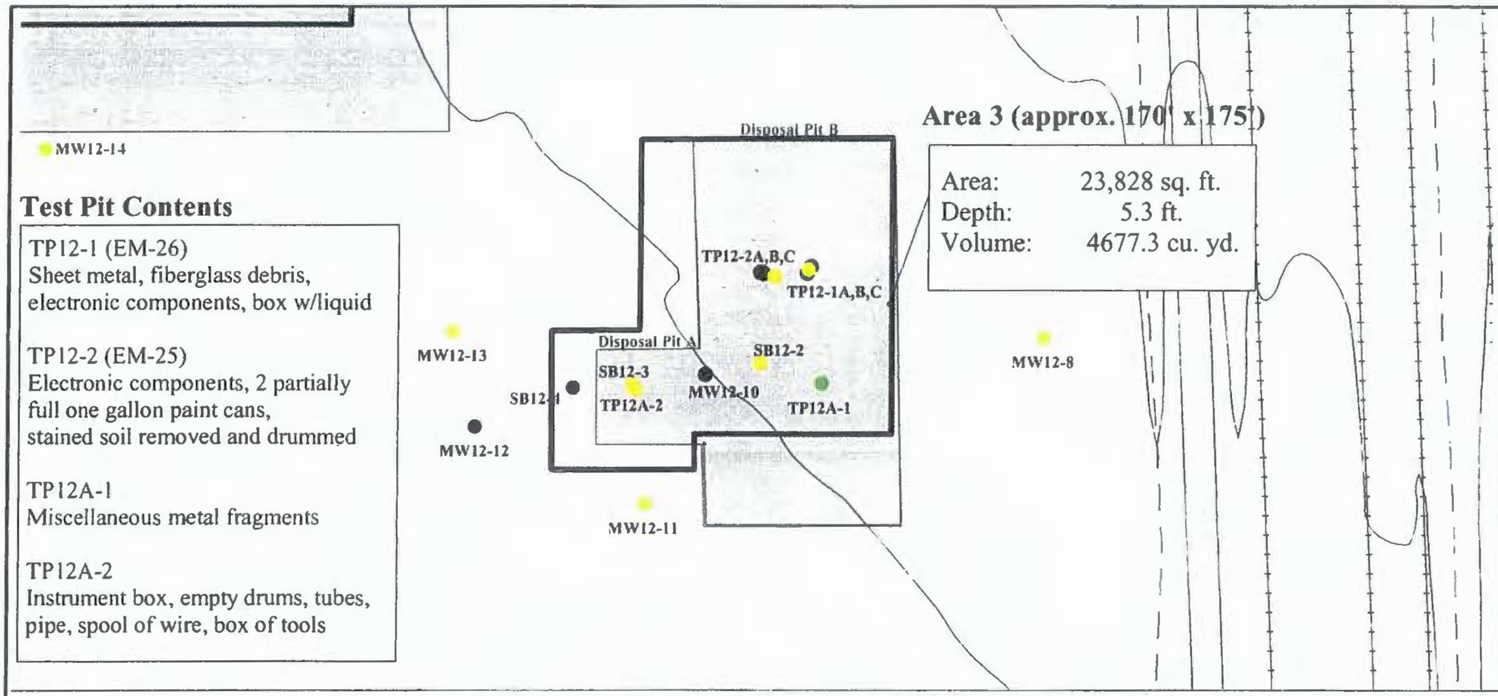
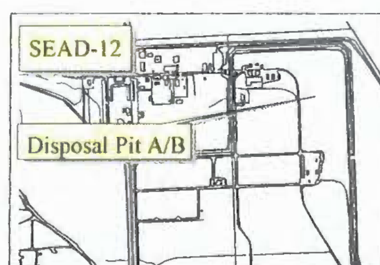


Loc_id	Parameter	Depth Range (feet)	Value	Criteria Level	Units
SB12-3	Heptachlor epoxide*	1-4	22	20	UG/KG
SB12-3	Cadmium Chromium Copper Lead Nickel Silver Zinc	10-11.9	6.0 30.2 63.2 63.9 76.4 1.6 160	2.46 30 33 24.4 50 0.8 115	MG/KG MG/KG MG/KG MG/KG MG/KG MG/KG MG/KG
SB12-2	Cadmium Chromium Lead	0.2-2.0	3.9 53.5 27.2	2.46 30 24.4	MG/KG MG/KG MG/KG
MW12-11	Copper	4-5.6	33.7	33	MG/KG
MW12-13	Magnesium	4-6	34,300	21,700	MG/KG
SB12-2	Thallium	10-12	1.1	0.855	MG/KG
TP12-1C	Thallium	6-8	0.94	0.855	MG/KG
TP12-2C	Calcium	6-6	142,000	125,300	MG/KG
MW12-8	Cyanide Thallium	4-6	1.5 1.7	0.35 0.855	MG/KG MG/KG
MW12-8	Cyanide Thallium	8-10	0.72 1.5	0.35 0.855	MG/KG MG/KG
TP12A-1	Phenol Cadmium	2.5-2.5	300 7.8	30 2.46	UG/KG MG/KG
TP12A-1	Benzo(a)pyrene Dibenz(a,h)pyrene Phenol Cadmium Chromium Copper Lead Silver Zinc	3-3	200 57 48 94.3 83.3 215 366 11.9 285	61 14 30 2.46 30 33 24.4 0.8 115	UG/KG UG/KG UG/KG MG/KG MG/KG MG/KG MG/KG MG/KG MG/KG
TP12A-2	Antimony Cadmium Copper Thallium	6-6	7.2 27.3 43.6 0.98	6 2.46 33 0.855	MG/KG MG/KG MG/KG MG/KG
TP12A-2	Cadmium Chromium Copper Nickel Zinc	5-5	37.3 32.4 128 201 424	2.46 30 33 50 115	MG/KG MG/KG MG/KG MG/KG MG/KG

Note. The highest value between a sample and a duplicate sample was taken

* Indicates a Pesticide/PCB parameter.
** Indicates a Volitale Organic parameter.



LEGEND

- MW12-15 Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. No exceedences present
- MW12-15 Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Metal exceedences present
- MW12-15 Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Semi Volatile Organic exceedences present
- MW12-15 Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Metal and Semi Volatile Organic exceedences present
- MW12-15 Background Sub-surfacerface Soil with Loc ID analysed for chemical parameters
- Potential Release Area
- Area to be Excavated

N

100 0 100
(feet)

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RI/FS
SEAD-12

FIGURE 2-8
REMEDIATION VOLUME ESTIMATE FOR SOIL AT DISPOSAL PIT A/B

SCALE 1:100 | DATE AUG 2001 | REV | Sheet 1 of 1

O:\SENECA\SEAD-12\SUB_SOIL.APR

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION AND MISSILE COMMAND
REDSTONE ARSENAL, ALABAMA 35898-5000

REPLY TO
ATTENTION OF

AMSAM-TMD-SR(C) 17 September 2001

MEMORANDUM FOR Commander, Seneca Army Depot Activity, ATTN: SIOSE-S, 5786 State Rte. 96, Romulus, NY 14541-5001

SUBJECT: Wipe Tests Results

1. The result of the wipe tests made for buildings 802, 806, 810, 812, 813, 816, 827, and HS at your facility, which this laboratory received on 5 September 2001, are indicated on the enclosed sheets.

2. Traceability to NIST is provided by an Am-241 source, SN: SS-804, last calibrated date: 15 June 2000, a Sr-90 source, SN: SS 809, last calibrated date: 1 June 2000, and a Cs-137 source, SN: SS-798, last calibrated date: 1 May 2000. These sources were calibrated at NIST and were used to calibrate the counters used to evaluate your wipe tests. The NIST calibration documents are maintained on file at this facility. ***This laboratory is ISO-9002 registered.***

3. The POC is Mr. David Walsh, COM 256-876-0613/3340 or DSN 746-0613/3340.

Encls

STEPHEN V. HOWARD
Lead Health Physicist, Nuclear Counting
and Special Projects

Seneca Army Depot
Wipe Test for Bldg 802
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 22 (Page 1 of 24) Test Date: 7 June & 9 August 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	1.4	0.0	0.0
8	1.4	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 7 dpm for Beta, and 94 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 802
Room 22

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

COC #7

Sample_ID			Dry smear date	Dry Smear
802	-22-	1	8/9/2001	X
802	-22-	2	6/7/2001	X
802	-22-	3	6/7/2001	X
802	-22-	4	6/7/2001	X
802	-22-	5	6/7/2001	X
802	-22-	6	6/7/2001	X
802	-22-	7	6/7/2001	X
802	-22-	8	6/7/2001	X
802	-22-	9	6/7/2001	X
802	-22-	10	6/7/2001	X
802	-22-	11	6/7/2001	X
802	-22-	12	6/7/2001	X
802	-22-	13	6/7/2001	X
802	-22-	14	6/7/2001	X
802	-22-	15	8/9/2001	X
total smears				15

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Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1016

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Sign:
Print:
Firm:
Date: Time:

Seneca Army Depot
Wipe Test for Bldg 806
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 10 (Page 2 of 24) Test Date: 26 August 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 7 dpm for Beta, and 94 dpm for Gamma.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 806
Room 10

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
806	-10-	1	8/26/2001	X
806	-10-	2	8/26/2001	X
806	-10-	3	8/26/2001	X
806	-10-	4	8/26/2001	X
806	-10-	5	8/26/2001	X
806	-10-	6	8/26/2001	X
806	-10-	7	8/26/2001	X
806	-10-	8	8/26/2001	X
806	-10-	9	8/26/2001	X
806	-10-	10	8/26/2001	X
806	-10-	11	8/26/2001	X
806	-10-	12	8/26/2001	X
806	-10-	13	8/26/2001	X
806	-10-	14	8/26/2001	X
806	-10-	15	8/26/2001	X
total smears				15

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Date: Time:

Seneca Army Depot
Wipe Test for Bldg 810
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 24 (Page 3 of 24)							
Test Date: 12 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0	16	0.0	0.0	0.0

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 7 dpm for Beta, and 94 dpm for Gamma.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 810
Room 24

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
810	-24-	1	7/12/2001	X
810	-24-	2	7/12/2001	X
810	-24-	3	7/12/2001	X
810	-24-	4	7/12/2001	X
810	-24-	5	7/12/2001	X
810	-24-	6	7/12/2001	X
810	-24-	7	7/12/2001	X
810	-24-	8	7/12/2001	X
810	-24-	9	7/12/2001	X
810	-24-	10	7/12/2001	X
810	-24-	11	7/12/2001	X
810	-24-	12	7/12/2001	X
810	-24-	13	7/12/2001	X
810	-24-	14	7/12/2001	X
810	-24-	15	7/12/2001	X
810	-24-	16	7/12/2001	X
total smears				16

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Firm:
Date: Time:

Seneca Army Depot
Wipe Test for Bldg 812
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 1 (Page 4 of 24) Test Date: 29 July & 8 August 2001							
1	0.0	0.0	0.0	10	0.0	0.0	0.0
2	0.0	0.0	0.0	11	0.0	0.0	0.0
3	0.0	0.0	0.0	12	0.0	0.0	0.0
4	0.0	0.0	0.0	13	0.0	0.0	0.0
5	0.0	0.0	0.0	14	0.0	0.0	0.0
6	0.0	0.0	0.0	15	0.0	0.0	0.0
7	0.0	0.0	0.0	16	0.0	0.0	0.0
8	0.0	0.0	0.0	17	0.0	0.0	0.0
9	0.0	0.0	0.0	18	1.4	0.0	0.0
Room 2 (Page 5 of 24) Test Date: 29 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				
Room 3 (Page 6 of 24) Test Date: 29 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	1.0	0.0	0.0	15	4.0	9.9	0.0
8	0.0	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 7 dpm for Beta, and 94 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 1

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID	Dry smear date	Dry Smear
812 -1- 1	7/29/2001	X
812 -1- 2	7/29/2001	X
812 -1- 3	7/29/2001	X
812 -1- 4	7/29/2001	X
812 -1- 5	7/29/2001	X
812 -1- 6	7/29/2001	X
812 -1- 7	7/29/2001	X
812 -1- 8	7/29/2001	X
812 -1- 9	7/29/2001	X
812 -1- 10	7/29/2001	X
812 -1- 11	7/29/2001	X
812 -1- 12	7/29/2001	X
812 -1- 13	7/29/2001	X
812 -1- 14	7/29/2001	X
812 -1- 15	7/29/2001	X
812 -1- 16	8/8/2001	X
812 -1- 17	8/8/2001	X
812 -1- 18	8/8/2001	X
total smears		18

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Date: Time:

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 2

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
812	-2-	1	7/29/2001	X
812	-2-	2	7/29/2001	X
812	-2-	3	7/29/2001	X
812	-2-	4	7/29/2001	X
812	-2-	5	7/29/2001	X
812	-2-	6	7/29/2001	X
812	-2-	7	7/29/2001	X
812	-2-	8	7/29/2001	X
812	-2-	9	7/29/2001	X
812	-2-	10	7/29/2001	X
812	-2-	11	7/29/2001	X
812	-2-	12	7/29/2001	X
812	-2-	13	7/29/2001	X
812	-2-	14	7/29/2001	X
812	-2-	15	7/29/2001	X
total smears				15

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Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 3

Bldg. 5417
Redstone Arsenal, AL 35898-5400
Mr. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
812	-3-	1	7/29/2001	X
812	-3-	2	7/29/2001	X
812	-3-	3	7/29/2001	X
812	-3-	4	7/29/2001	X
812	-3-	5	7/29/2001	X
812	-3-	6	7/29/2001	X
812	-3-	7	7/29/2001	X
812	-3-	8	7/29/2001	X
812	-3-	9	7/29/2001	X
812	-3-	10	7/29/2001	X
812	-3-	11	7/29/2001	X
812	-3-	12	7/29/2001	X
812	-3-	13	7/29/2001	X
812	-3-	14	7/29/2001	X
812	-3-	15	7/29/2001	X
total smears				15

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Seneca Army Depot
Wipe Test for Bldg 812
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 4 (Page 7 of 24) Test Date: 28 July 2001							
1	1.5	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	46.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				
Room 5 (Page 8 of 24) Test Date: 28 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				
Room 6 (Page 9 of 24) Test Date: 28 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	45.0				
Room 7 (Page 10 of 24) Test Date: 28 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	1.5	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 6 dpm for Beta, and 88 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 4

Bldg. 5417
Redstone Arsenal, AL 35898-5400
Mr. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
812	-4-	1	7/28/2001	X
812	-4-	2	7/28/2001	X
812	-4-	3	7/28/2001	X
812	-4-	4	7/28/2001	X
812	-4-	5	7/28/2001	X
812	-4-	6	7/28/2001	X
812	-4-	7	7/28/2001	X
812	-4-	8	7/28/2001	X
812	-4-	9	7/28/2001	X
812	-4-	10	7/28/2001	X
812	-4-	11	7/28/2001	X
812	-4-	12	7/28/2001	X
812	-4-	13	7/28/2001	X
812	-4-	14	7/28/2001	X
812	-4-	15	7/28/2001	X
total smears				15

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Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 5

Bldg. 5417
Redstone Arsenal, AL 35898-5400
Mr. Steve Howard/David Walsh

Sample_ID	Dry smear date	Dry Smear
812 -5- 1	7/28/2001	X
812 -5- 2	7/28/2001	X
812 -5- 3	7/28/2001	X
812 -5- 4	7/28/2001	X
812 -5- 5	7/28/2001	X
812 -5- 6	7/28/2001	X
812 -5- 7	7/28/2001	X
812 -5- 8	7/28/2001	X
812 -5- 9	7/28/2001	X
812 -5- 10	7/28/2001	X
812 -5- 11	7/28/2001	X
812 -5- 12	7/28/2001	X
812 -5- 13	7/28/2001	X
812 -5- 14	7/28/2001	X
812 -5- 15	7/28/2001	X
total smears		15

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125309

Sampled and relinquished by
sign: K. Kadlubak
Print: R. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1019

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Sign:
Print:
Firm:
Date: Time:

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 6

Bldg. 5417
Redstone Arsenal, AL 35898-5400
Mr. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
812	-6-	1	7/28/2001	X
812	-6-	2	7/28/2001	X
812	-6-	3	7/28/2001	X
812	-6-	4	7/28/2001	X
812	-6-	5	7/28/2001	X
812	-6-	6	7/28/2001	X
812	-6-	7	7/28/2001	X
812	-6-	8	7/28/2001	X
812	-6-	9	7/28/2001	X
812	-6-	10	7/28/2001	X
812	-6-	11	7/28/2001	X
812	-6-	12	7/28/2001	X
812	-6-	13	7/28/2001	X
812	-6-	14	7/28/2001	X
812	-6-	15	7/28/2001	X
total smears				15

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125310

Sampled and relinquished by
sign: K. Radlubak
Print: K. Radlubak
Firm: Parsons
Date: 8-29-01 Time: 1020

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Sign:
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Firm:
Date: Time:

Page 9 of 12

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 7

Bldg. 5417
Redstone Arsenal, AL 35898-5400
Mr. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
812	-7-	1	7/28/2001	X
812	-7-	2	7/28/2001	X
812	-7-	3	7/28/2001	X
812	-7-	4	7/28/2001	X
812	-7-	5	7/28/2001	X
812	-7-	6	7/28/2001	X
812	-7-	7	7/28/2001	X
812	-7-	8	7/28/2001	X
812	-7-	9	7/28/2001	X
812	-7-	10	7/28/2001	X
812	-7-	11	7/28/2001	X
812	-7-	12	7/28/2001	X
812	-7-	13	7/28/2001	X
812	-7-	14	7/28/2001	X
812	-7-	15	7/28/2001	X
total smears				15

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125311

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1020

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Sign:
Print:
Firm:
Date: Time:

Seneca Army Depot
Wipe Test for Bldg 812
17-Sep-01

ID	DPM Alpha	DPM Beta	DPM Gamma	ID	DPM Alpha	DPM Beta	DPM Gamma
Room 8 (Page 11 of 24) Test Date: 28 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				
Room 9 (Page 12 of 24) Test Date: 28 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	46.5	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0	16	0.0	0.0	0.0

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 6 dpm for Beta, and 88 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

ID	DPM Alpha	DPM Beta	DPM Gamma	ID	DPM Alpha	DPM Beta	DPM Gamma
Room 10 (Page 13 of 24) Test Date: 29 July 2001							
1	0.0	0.0	61.8	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 6 dpm for Beta, and 90 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 8

Bldg. 5417
Redstone Arsenal, AL 35898-5400
Mr. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
812	-8-	1	7/28/2001	X
812	-8-	2	7/28/2001	X
812	-8-	3	7/28/2001	X
812	-8-	4	7/28/2001	X
812	-8-	5	7/28/2001	X
812	-8-	6	7/28/2001	X
812	-8-	7	7/28/2001	X
812	-8-	8	7/28/2001	X
812	-8-	9	7/28/2001	X
812	-8-	10	7/28/2001	X
812	-8-	11	7/28/2001	X
812	-8-	12	7/28/2001	X
812	-8-	13	7/28/2001	X
812	-8-	14	7/28/2001	X
812	-8-	15	7/28/2001	X
total smears				15

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1020

Received By
Sign:
Print:
Firm:
Date: Time:

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 9

Bldg. 5417
Redstone Arsenal, AL 35898-5400
Mr. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
812	-9-	1	7/28/2001	X
812	-9-	2	7/28/2001	X
812	-9-	3	7/28/2001	X
812	-9-	4	7/28/2001	X
812	-9-	5	7/28/2001	X
812	-9-	6	7/28/2001	X
812	-9-	7	7/28/2001	X
812	-9-	8	7/28/2001	X
812	-9-	9	7/28/2001	X
812	-9-	10	7/28/2001	X
812	-9-	11	7/28/2001	X
812	-9-	12	7/28/2001	X
812	-9-	13	7/28/2001	X
812	-9-	14	7/28/2001	X
812	-9-	15	7/28/2001	X
812	-9-	16	7/29/2001	X
total smears				16

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125313

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.28.01 Time: 1022

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Sign:
Print:
Firm:
Date: Time:

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 10

Bldg. 5417
Redstone Arsenal, AL 35898-5400
Mr. Steve Howard/David Walsh

Sample_ID	Dry smear date	Dry Smear
812 -10- 1	7/29/2001	X
812 -10- 2	7/29/2001	X
812 -10- 3	7/29/2001	X
812 -10- 4	7/29/2001	X
812 -10- 5	7/29/2001	X
812 -10- 6	7/29/2001	X
812 -10- 7	7/29/2001	X
812 -10- 8	7/29/2001	X
812 -10- 9	7/29/2001	X
812 -10- 10	7/29/2001	X
812 -10- 11	7/29/2001	X
812 -10- 12	7/29/2001	X
812 -10- 13	7/29/2001	X
812 -10- 14	7/29/2001	X
812 -10- 15	7/29/2001	X
total smears		15

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125314

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8-29-01 Time: 1023

Received By
Sign:
Print:
Firm:
Date: Time:

Seneca Army Depot
Wipe Test for Bldg 812
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 11 (Page 14 of 24) Test Date: 8 August 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	1.2	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				
Room 15 (Page 15 of 24) Test Date: 10 August 2001							
1	0.0	0.0	45.4	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	44.3				
Room 33 (Page 16 of 24) Test Date: 27 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 6 dpm for Beta, and 90 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 11

Bldg. 5417
Redstone Arsenal, AL 35898-5400
Mr. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
812	-11-	1	8/8/2001	X
812	-11-	2	8/8/2001	X
812	-11-	3	8/8/2001	X
812	-11-	4	8/8/2001	X
812	-11-	5	8/8/2001	X
812	-11-	6	8/8/2001	X
812	-11-	7	8/8/2001	X
812	-11-	8	8/8/2001	X
812	-11-	9	8/8/2001	X
812	-11-	10	8/8/2001	X
812	-11-	11	8/8/2001	X
812	-11-	12	8/8/2001	X
812	-11-	13	8/8/2001	X
812	-11-	14	8/8/2001	X
812	-11-	15	8/8/2001	X
total smears				15

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125315

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sign: K. Kadlubak
Print: K. Kadlubak K.
Firm: Parsons
Date: 8.29.01 Time: 1022

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Sign:
Print:
Firm:
Date: Time:

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 15

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID	Dry smear date	Dry Smear
812 -15- 1	8/10/2001	X
812 -15- 2	8/10/2001	X
812 -15- 3	8/10/2001	X
812 -15- 4	8/10/2001	X
812 -15- 5	8/10/2001	X
812 -15- 6	8/10/2001	X
812 -15- 7	8/10/2001	X
812 -15- 8	8/10/2001	X
812 -15- 9	8/10/2001	X
812 -15- 10	8/10/2001	X
812 -15- 11	8/10/2001	X
812 -15- 12	8/10/2001	X
812 -15- 13	8/10/2001	X
812 -15- 14	8/10/2001	X
812 -15- 15	8/10/2001	X
total smears		15

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125316

Sampled and relinquished by
sign: K Kadlubak
Print: K. Kadlubak
Firm: Parsons
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Print:
Firm:
Date: Time:

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 812
Room 33

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
812	-33-	1	7/27/2001	X
812	-33-	2	7/27/2001	X
812	-33-	3	7/27/2001	X
812	-33-	4	7/27/2001	X
812	-33-	5	7/27/2001	X
812	-33-	6	7/27/2001	X
812	-33-	7	7/27/2001	X
812	-33-	8	7/27/2001	X
812	-33-	9	7/27/2001	X
812	-33-	10	7/27/2001	X
812	-33-	11	7/27/2001	X
812	-33-	12	7/27/2001	X
812	-33-	13	7/27/2001	X
812	-33-	14	7/27/2001	X
812	-33-	15	7/27/2001	X
total smears				15

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125317

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1023

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Print:
Firm:
Date: Time:

Seneca Army Depot
Wipe Test for Bldg 813
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 1 (Page 17 of 24) Test Date: 25 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	3.3	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				
Room 4 (Page 18 of 24) Test Date: 27 July 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 6 dpm for Beta, and 90 dpm for Gamma. Result exceeding the limit of decision is reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 813
Room 1

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
813	-1-	1	7/25/2001	X
813	-1-	2	7/25/2001	X
813	-1-	3	7/25/2001	X
813	-1-	4	7/25/2001	X
813	-1-	5	7/25/2001	X
813	-1-	6	7/25/2001	X
813	-1-	7	7/25/2001	X
813	-1-	8	7/25/2001	X
813	-1-	9	7/25/2001	X
813	-1-	10	7/25/2001	X
813	-1-	11	7/25/2001	X
813	-1-	12	7/25/2001	X
813	-1-	13	7/25/2001	X
813	-1-	14	7/25/2001	X
813	-1-	15	7/25/2001	X
total smears				15

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125318

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: ~~1024~~ KK 1024

Received By
Sign:
Print:
Firm:
Date: Time:

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 813
Room 4

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
813	-4-	1	7/27/2001	X
813	-4-	2	7/27/2001	X
813	-4-	3	7/27/2001	X
813	-4-	4	7/27/2001	X
813	-4-	5	7/27/2001	X
813	-4-	6	7/27/2001	X
813	-4-	7	7/27/2001	X
813	-4-	8	7/27/2001	X
813	-4-	9	7/27/2001	X
813	-4-	10	7/27/2001	X
813	-4-	11	7/27/2001	X
813	-4-	12	7/27/2001	X
813	-4-	13	7/27/2001	X
813	-4-	14	7/27/2001	X
813	-4-	15	7/27/2001	X
total smears				15

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125319

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1024

Received By
Sign:
Print:
Firm:
Date: Time:

P 18 of 24

Seneca Army Depot
Wipe Test for Bldg 813
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 7 (Page 19 of 24) Test Date: 28 July 2001							
1	1.7	0.0	72.9	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	50.2
8	0.0	0.0	0.0				
Room 8 (Page 20 of 24) Test Date: 24 July 2001							
1	0.0	0.0	0.0	9	1.3	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	50.2	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	55.6	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	0.0
8	0.0	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 7 dpm for Beta, and 93 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 813
Room 7

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID	Dry smear date	Dry Smear
813 -7- 1	7/28/2001	X
813 -7- 2	7/28/2001	X
813 -7- 3	7/28/2001	X
813 -7- 4	7/28/2001	X
813 -7- 5	7/28/2001	X
813 -7- 6	7/28/2001	X
813 -7- 7	7/28/2001	X
813 -7- 8	7/28/2001	X
813 -7- 9	7/28/2001	X
813 -7- 10	7/28/2001	X
813 -7- 11	7/28/2001	X
813 -7- 12	7/28/2001	X
813 -7- 13	7/28/2001	X
813 -7- 14	7/28/2001	X
813 -7- 15	7/28/2001	X
total smears		15

RECEIVED
SEP 0 5 2001
125320

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1025

Received By
Sign:
Print:
Firm:
Date: Time:

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 813
Room 8

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
813	-8-	1	7/24/2001	X
813	-8-	2	7/24/2001	X
813	-8-	3	7/24/2001	X
813	-8-	4	7/24/2001	X
813	-8-	5	7/24/2001	X
813	-8-	6	7/24/2001	X
813	-8-	7	7/24/2001	X
813	-8-	8	7/24/2001	X
813	-8-	9	7/24/2001	X
813	-8-	10	7/24/2001	X
813	-8-	11	7/24/2001	X
813	-8-	12	7/24/2001	X
813	-8-	13	7/24/2001	X
813	-8-	14	7/24/2001	X
813	-8-	15	7/24/2001	X
total smears				15

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1025

Received By
Sign:
Print:
Firm:
Date: Time:

Seneca Army Depot
Wipe Test for Bldg 816
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 16 (Page 22 of 24)							
Test Date: 27 July 2001							
1	0.0	0.0	0.0	14	1.3	0.0	0.0
2	0.0	0.0	0.0	15	0.0	0.0	0.0
3	0.0	0.0	0.0	16	0.0	0.0	0.0
4	0.0	0.0	0.0	17	0.0	0.0	0.0
5	0.0	0.0	0.0	18	0.0	0.0	0.0
6	0.0	0.0	0.0	19	0.0	0.0	0.0
7	0.0	0.0	0.0	20	0.0	0.0	0.0
8	0.0	0.0	0.0	21	0.0	0.0	0.0
9	0.0	0.0	0.0	22	0.0	0.0	46.4
10	0.0	0.0	0.0	23	0.0	0.0	0.0
11	0.0	0.0	0.0	24	0.0	0.0	0.0
12	0.0	0.0	0.0	25	0.0	0.0	0.0
13	0.0	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 7 dpm for Beta, and 93 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 816
Room 16

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
816	-16-	1	7/27/2001	X
816	-16-	2	7/27/2001	X
816	-16-	3	7/27/2001	X
816	-16-	4	7/27/2001	X
816	-16-	5	7/27/2001	X
816	-16-	6	7/27/2001	X
816	-16-	7	7/27/2001	X
816	-16-	8	7/27/2001	X
816	-16-	9	7/27/2001	X
816	-16-	10	7/27/2001	X
816	-16-	11	7/27/2001	X
816	-16-	12	7/27/2001	X
816	-16-	13	7/27/2001	X
816	-16-	14	7/27/2001	X
816	-16-	15	7/27/2001	X
816	-16-	16	7/27/2001	X
816	-16-	17	7/27/2001	X
816	-16-	18	7/27/2001	X
816	-16-	19	7/27/2001	X
816	-16-	20	7/27/2001	X
816	-16-	21	7/27/2001	X
816	-16-	22	7/27/2001	X
816	-16-	23	7/27/2001	X
816	-16-	24	7/27/2001	X
816	-16-	25	7/27/2001	X
total smears				25

RECEIVED
SEP 0 5 2001
125322

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8-29-01 Time: 1026

Received By
Sign:
Print:
Firm:
Date: Time:

Seneca Army Depot
Wipe Test for Bldg 827
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
Room 1 (Page 23 of 24) Test Date: 22 August 2001							
1	0.0	0.0	0.0	9	0.0	0.0	0.0
2	0.0	0.0	0.0	10	0.0	0.0	0.0
3	0.0	0.0	0.0	11	0.0	0.0	0.0
4	0.0	0.0	0.0	12	0.0	0.0	0.0
5	0.0	0.0	0.0	13	0.0	0.0	0.0
6	0.0	0.0	0.0	14	0.0	0.0	0.0
7	0.0	0.0	0.0	15	0.0	0.0	51.3
8	0.0	0.0	48.5				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 7 dpm for Beta, and 93 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 827
Room 1

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID			Dry smear date	Dry Smear
827	-1-	1	8/22/2001	X
827	-1-	2	8/22/2001	X
827	-1-	3	8/22/2001	X
827	-1-	4	8/22/2001	X
827	-1-	5	8/22/2001	X
827	-1-	6	8/22/2001	X
827	-1-	7	8/22/2001	X
827	-1-	8	8/22/2001	X
827	-1-	9	8/22/2001	X
827	-1-	10	8/22/2001	X
827	-1-	11	8/22/2001	X
827	-1-	12	8/22/2001	X
827	-1-	13	8/22/2001	X
827	-1-	14	8/22/2001	X
827	-1-	15	8/22/2001	X
total smears				15

SEP 05 2001
125323

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1020

Received By
Sign:
Print:
Firm:
Date: Time:

Seneca Army Depot
Wipe Test
17-Sep-01

ID	DPM			ID	DPM		
	Alpha	Beta	Gamma		Alpha	Beta	Gamma
(Page 24 of 24)							
Test Date: 29 August 2001							
HS 1	2.0	5.0	0.0	HS 9	0.0	0.0	0.0
HS 2	1.7	0.0	0.0	HS 10	0.0	0.0	0.0
HS 3	1.3	0.0	0.0	HS 11	0.0	0.0	0.0
HS 4	0.0	0.0	0.0	HS 12	0.0	0.0	0.0
HS 5	0.0	0.0	0.0	HS 13	0.0	0.0	0.0
HS 6	0.0	0.0	0.0	HS 14	0.0	0.0	0.0
HS 7	0.0	0.0	0.0	HS 15	0.0	0.0	0.0
HS 8	0.0	0.0	0.0				

NOTE: Limit of Detection (LD) is 3 dpm for Alpha, 7 dpm for Beta, and 93 dpm for Gamma. Results exceeding the limit of decision are reported as defined by NCRP 58.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Health and Safety

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID	Dry smear date	Dry Smear
HS 1	8/29/2001	X
HS 2	8/29/2001	X
HS 3	8/29/2001	X
HS 4	8/29/2001	X
HS 5	8/29/2001	X
HS 6	8/29/2001	X
HS 7	8/29/2001	X
HS 8	8/29/2001	X
HS 9	8/29/2001	X
HS 10	8/29/2001	X
HS 11	8/29/2001	X
HS 12	8/29/2001	X
HS 13	8/29/2001	X
HS 14	8/29/2001	X
HS 15	8/29/2001	X
total smears		15

RECEIVED
SEP 05 2001
125324

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1026

Received By
Sign:
Print:
Firm:
Date: Time:

DEPARTMENT OF THE ARMY
UNITED STATES ARMY AVIATION AND MISSILE COMMAND
REDSTONE ARSENAL, ALABAMA 35898-5000

REPLY TO
ATTENTION OF

AMSAM-TMD-SR(C) 17 September 2001

MEMORANDUM FOR Commander, Seneca Army Depot Activity, ATTN: SIOSE-S, 5786 State Rte. 96, Romulus, NY 14541-5001

SUBJECT: Wipe Test Result

1. The result of the Tritium wipe test made for Bldg 816 at your facility on 7 August 2001, which this laboratory received on 5 September 2001, is indicated on the enclosed sheet.

2. Traceability to NIST is provided by H-3 source, SN: 50, last calibrated date: 3 August 1999. This source was calibrated at NIST and was used to calibrate the counters used to evaluate your wipe tests. The NIST calibration documents are maintained on file at this facility. ***This laboratory is ISO-9002 registered.***

3. The POC is Mr. David Walsh, COM 256-876-0613/3340 or DSN 746-0613/3340.

Encl

STEPHEN V. HOWARD
Lead Health Physicist, Nuclear Counting
and Special Projects

Seneca Army Depot
Tritium Wipes (Bldg 816)
17-Sep-01

ID	DPM	ID	DPM	ID	DPM	ID	DPM
	Beta		Beta		Beta		Beta
Room 2 (Pages 21 of 24)							
Test Date: 7 August 2001							
68	0.0						

NOTE: Limit of Detection (LD) is 14.9 dpm for Tritium Beta.

Job No. 730047-01001
Project: Seneca SEAD-12 RI/FS
Contact: Jackie Travers (781) 401-2535

Building 816
Room 2

Bldg. 5417
Redstone Arsenal, AL 35898-5400
MR. Steve Howard/David Walsh

Sample_ID	tritium smear date	Tritium Smear
816 -2- 68	8/7/2001	X
total smears		1

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SEP 05 2001
125307

Sampled and relinquished by
sign: K. Kadlubak
Print: K. Kadlubak
Firm: Parsons
Date: 8.29.01 Time: 1025

Received By
Sign:
Print:
Firm:
Date: Time:

Test Pit Contents

TP12-8 (EM-21)
Concrete, rebar and wire construction debris

TP12-7A (EM-22)
Steel pipe, culvert sections

TP12-5 (EM-23)
Concrete and rebar construction debris

TP12-23 (EM-23)
Steel posts, pipe, lumber

TP12-6 (EM-23)
Concrete and rebar construction debris, asphalt road

TP12-3 (EM-24)
Sheet metal, fiberglass, styrofoam, electrical debris, cone shaped military items removed and drummed

TP12-4 (EM-24)
Large stainless steel cylinder found but not removed

TP12A-8
None

TP12A-7
None

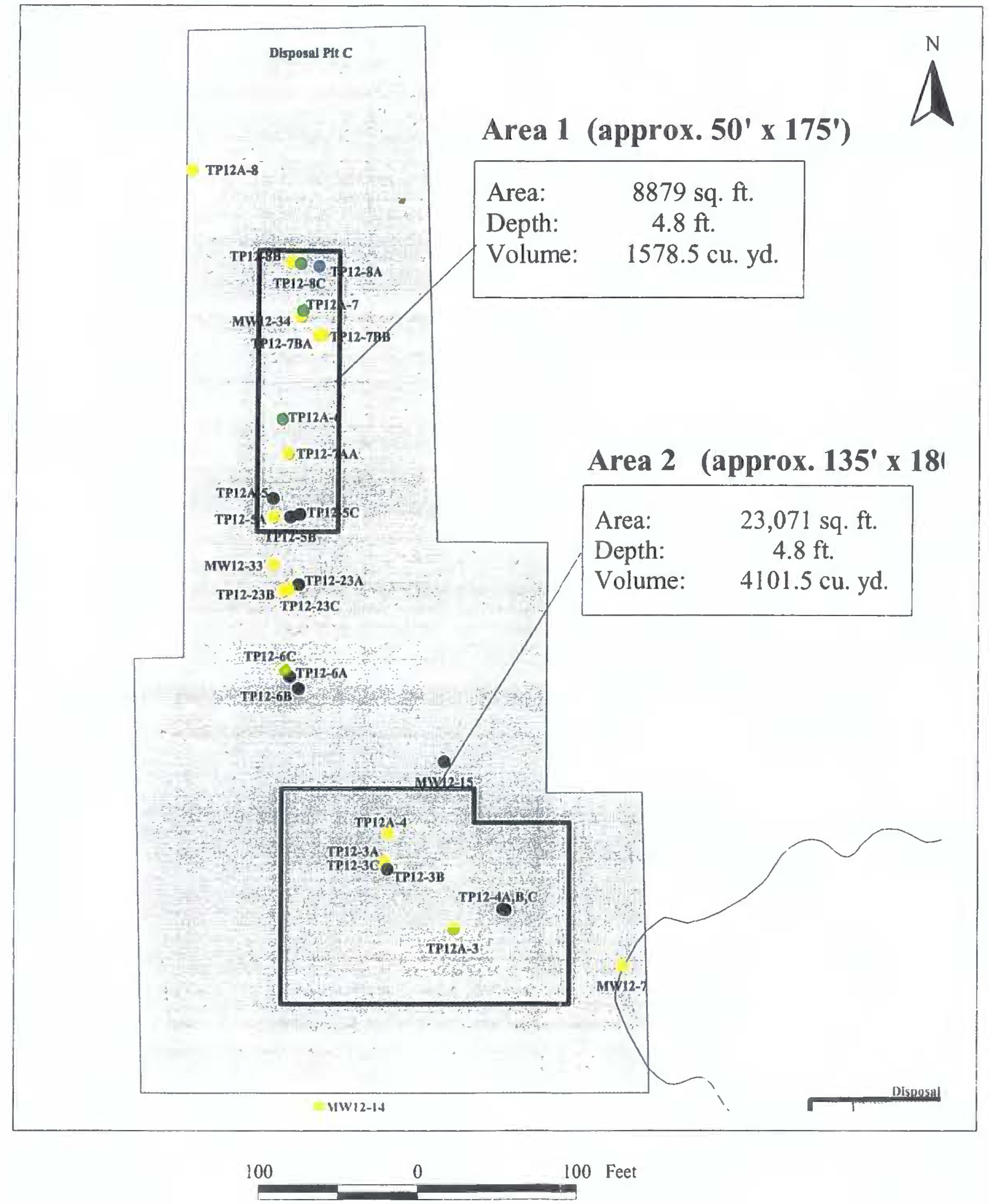
TP12-7B
Culvert pipe, fired NATO 7.62 black casing, heavy gauge wire, aluminum foil

TP12A-6
None

TP12A-5
Piece of glass

TP12A-4
Large cylindrical object composed of concrete and styrofoam

TP12A-3
Foreign components, (4) SEAD 'Trainer' 1950's style



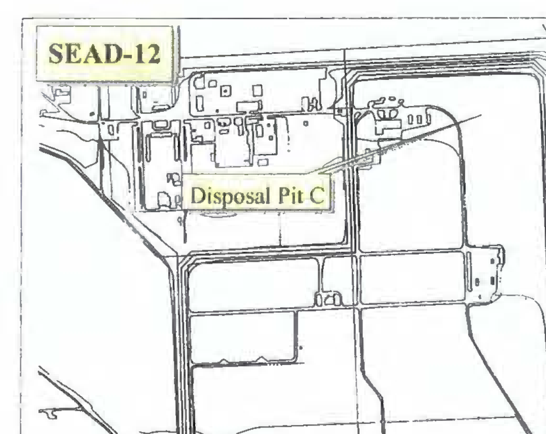
Loc_id	Parameter	Depth Range (feet)	Value	Criteria Level	Units
TP12-3A	Methylene chloride*	0.8-0.8	180	100	UG/KG
TP12-3B	Arsenic Silver Sodium Zinc	5.5-5.5	11.1 1 8 881 208	8.9 0 8 188 115	MG/KG MG/KG MG/KG MG/KG
TP12-3A	Mercury	0.8-0.8	0.14	0.1	MG/KG
TP12-5A	Lead	0.5-0.5	36.2	24.4	MG/KG
MW12-14	Thallium	8-10	1.2	0.855	MG/KG
MW12-14	Thallium	10-12	0.92	0.855	MG/KG
TP12-7BA	Sodium Thallium Zinc	1-1	267 1.1 656	188 0.855 115	MG/KG MG/KG MG/KG
TP12-7AA	Lead Thallium Zinc	1-1	39.8 1.7 172	24.4 0 855 115	MG/KG MG/KG MG/KG
TP12-7BB	Copper Lead Thallium Zinc	2-2	33.9 34.6 1.1 411	33 24.4 0.855 115	MG/KG MG/KG MG/KG MG/KG
TP12-8A	Benzo(a)pyrene Dibenz(a,h)pyrene	1-1	100 26	61 14	UG/KG UG/KG
TP12-8C	Benzo(a)pyrene Dibenz(a,h)pyrene Calcium	2-2	67.0 19.0 224,000	61 14 125,300	UG/KG UG/KG MG/KG
TP12-8B	Calcium Sodium	3-3	139,000 205	125,300 188	MG/KG MG/KG
TP12-6C	Calcium	3.5-3.5	138,000	125,300	MG/KG
MW12-7	Thallium	4-6	1.2	0.855	MG/KG
MW12-7	Thallium	8-10	1.3	0.855	MG/KG
MW12-33	Thallium	6-8	0.98	0.855	MG/KG
MW12-33	Thallium	10-12	1.3	0.855	MG/KG
MW12-34	Thallium	10-12	1.3	0.855	MG/KG
TP12A-3	Lead	2. 5-2.5	25.7	24.4	MG/KG
TP12A-4	Potassium Zinc	4-4	2880 281	2623 115	MG/KG MG/KG
TP12A-6	Benzo(a)pyrene Dibenz(a,h)pyrene	1-1	92 43	61 14	UG/KG UG/KG
TP12A-6	Lead	7-7	431	24.4	MG/KG
TP12A-7	Benzo(a)pyrene Dibenz(a,h)pyrene Copper Lead Potassium Mercury Thallium Zinc	4-4	180 99 38.4 49 3670 0.11 0.98 155	61 14 33 24.4 2623 0.1 0.855 115	UG/KG UG/KG MG/KG MG/KG MG/KG MG/KG MG/KG MG/KG
TP12A-8	Magnesium	7-7	36,100	21,700	MG/KG
TP12-23B	Magnesium Thallium	2-2	25,100 1.1	21,700 0.855	MG/KG MG/KG
TP12-23C	Copper Cyanide Iron Lead Mercury Sodium Zinc	3-3	74.5 2.2 51,000 90.9 0.15 1420 6080	33 2.0 37,410 24.4 0.1 188 115	MG/KG MG/KG MG/KG MG/KG MG/KG MG/KG MG/KG

Note: The highest value between a sample and a duplicate sample was taken

* Indicates a Pesticide/PCB parameter
** Indicates a Volitale Organic parameter.

LEGEND

- ● MW12-15 — Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. No exceedences present
- ● MW12-15 — Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Metal and Semi Volatile Organic exceedences present
- ● MW12-15 — Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Metal exceedences present
- ▲ MW12-15 — Background Sub-surfacerface Soil with Loc_ID analysed for chemical parameters.
- ● MW12-15 — Sub-surface Soil sample with Loc_ID analyzed for chemical parameters. Semi Volatile Organic exceedences present.
- Potential Release Area
- Area to be Excavated



PARSONS
PARSONS ENGINEERING SCIENCE, INC.

SENECA ARMY DEPOT ACTIVITY
RI/FS
SEAD-12

FIGURE 2-10
REMEDIATION VOLUME ESTIMATE FOR SOIL AT DISPOSAL PIT C

SCALE	DATE	REV	
1:100	AUG 2001		Sheet 1 of 1

O:\SENECA\SEAD-12\SUB_SOIL.APR