

W93428D

**DRAFT
WORK PLAN**

RISK ASSESSMENT

**CENTRAL LANDFILL, OPERABLE UNIT 2
JOHNSTON, RHODE ISLAND**

Halliburton NUS Environmental Corporation

EPA Work Assignment No. 41-1L71

EPA Contract No. 68-W8-0117

HNUS Project No. 0889

November 1993



HALLIBURTON NUS
Environmental Corporation

3211

W93428D

DRAFT
WORK PLAN

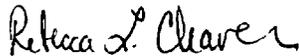
RISK ASSESSMENT

CENTRAL LANDFILL, OPERABLE UNIT 2
JOHNSTON, RHODE ISLAND

Halliburton NUS Environmental Corporation

EPA Work Assignment No. 41-1L71
EPA Contract No. 68-W8-0117
HNUS Project No. 0889

November 1993



Rebecca L. Cleaver
Project Manager



George D. Gardner, P.E.
Program Manager

**TABLE OF CONTENTS
DRAFT WORK PLAN
RISK ASSESSMENT
CENTRAL LANDFILL, OPERABLE UNIT 2
JOHNSTON, RHODE ISLAND**

<u>SECTION</u>	<u>PAGE</u>
1.0 INTRODUCTION	1-1
2.0 SITE DESCRIPTION AND BACKGROUND	2-1
3.0 SCOPE OF WORK	3-1
3.1 Components of the Baseline Human Health Risk Assessment	3-2
3.2 Components of the Baseline Ecological Risk Assessment	3-3
3.3 Deliverables	3-4
3.3.1 Interim Deliverables - Human Health and Ecological Risk Assessments	3-4
3.3.2 Draft Baseline Risk Assessment Report	3-8
4.0 TASK PLAN DESCRIPTION	4-1
4.1 Task 0100 - Project Planning	4-1
4.1.1 Subtask 0110 - Kick-off Meeting/Project Planning Documents	4-1
4.1.2 Subtask 0120 - Work Assignment Administration	4-2
4.2 Task 0600 - Risk Assessment	4-2
4.2.1 Subtask 0610 - Baseline Human Health Risk Assessment	4-5
4.2.1.1 Data Evaluation/Hazard Identification	4-7
4.2.1.2 Exposure Assessment	4-9
4.2.1.3 Dose-Response Assessment/ Toxicity Assessment	4-27
4.2.1.4 Risk Characterization	4-28
4.2.1.5 Uncertainty Analysis	4-31
4.2.2 Subtask 0620 - Baseline Ecological Risk Assessment	4-31
4.2.2.1 Characterization of the Site and Potential Receptors	4-33
4.2.2.2 Selection of Contaminants of Concern, Indicator Species, and Ecological Effects of Concern	4-33

TABLE OF CONTENTS (Continued)
 DRAFT WORK PLAN
 RISK ASSESSMENT
 CENTRAL LANDFILL, OPERABLE UNIT 2
 JOHNSTON, RHODE ISLAND

<u>SECTION</u>	<u>PAGE</u>
4.2.2.3 Exposure Assessment	4-35
4.2.2.4 Ecological Effects Assessment	4-36
4.2.2.5 Risk Characterization	4-38
5.0 PROJECT MANAGEMENT	5-1
5.1 Project Organization	5-1
5.2 Quality Assurance and Data Management	5-3
5.3 Project Schedule	5-3
5.4 Project Costs	5-4
6.0 EQUIPMENT AND SUPPLIES	6-1

FIGURES

<u>NUMBER</u>	<u>PAGE</u>
5-1 PROJECT ORGANIZATION	5-2

1.0 INTRODUCTION

This Draft Work Plan was prepared by Halliburton NUS Corporation (HNUS) at the request of the U.S. Environmental Protection Agency (EPA) under Contract No. 68-W8-0117, to fulfill the requirements of Work Assignment Number 41-1L71 for completing an off-site baseline risk assessment for the Central Landfill, Operable Unit 2 (OU2), located in Johnston, Rhode Island. The Draft Work Plan was developed based on the EPA Scope of Work dated September 24, 1993; the scoping meeting of October 15, 1993; and the results of discussions with the EPA Remedial Project Manager (RPM).

The activities to be conducted under this work assignment include both human health and ecological risk assessments to characterize and quantify, where appropriate, the current and potential human health and environmental risks posed by off-site contamination. The risk assessment will be based upon data to be collected and provided to HNUS by the PRP's contractor during their implementation of the OU2 Remedial Investigation/Feasibility Study at the Central Landfill. Additional detail for performing these activities is provided in the sections which follow.

DRAFT

This Draft Work Plan contains six sections: Section 1.0 provides an introduction; Section 2.0 presents a brief summary of site description/site background information; Section 3.0 summarizes the general activities required to complete the scope of work, as provided by EPA; a detailed task breakdown with specific activities to be conducted under each task or subtask is presented in Section 4.0; the proposed project management approach for the performance of the risk assessment work is presented in Section 5.0; and Section 6.0 identifies the anticipated equipment and consumable supplies necessary to perform the activities identified in this Work Plan.

2.0 SITE DESCRIPTION AND BACKGROUND

For detailed information on the Central Landfill's site description, site history and previous investigations, sampling and analytical results, site geology and hydrogeology, and nature and extent of contamination, the reader is referred to the Central Landfill Remedial Investigation Report, Operable Unit 1, March 1993, prepared for the Rhode Island Solid Waste Management Corporation (RISWMC) by GZA GeoEnvironmental, Inc. A brief site description and general summary of site background information is presented below.

The Central Landfill is located at 65 Shun Pike in Johnston, Rhode Island. The existing 121 acre active (Phase I) Landfill, owned and operated by RISWMC, is unlined, and includes 33 acres covered by a single barrier impermeable cap, and 88 acres covered by an intermediate soil cap. The Landfill will be expanded into the Phase II and III areas, (approximately 33 additional acres, currently inactive), located adjacent to and west of the Phase I area, to have a composite baseliner and leachate collection system prior to expansion into these areas.

DRAFT

The Phase I, II, and III landfill areas (154 acres) comprise the Operable Unit 1 (OU1) study area of the Central Landfill. The RISWMC has expended approximately \$23,000,000 to acquire much of the residentially zoned properties located within a 2,000 foot buffer zone of the Central Landfill property. Operable Unit 2 (OU2) of the Central Landfill, the designated study area for this off-site baseline risk assessment, has been defined as the area within this 2,000 foot buffer zone which surrounds the Landfill, in addition to the Upper Simmons Reservoir, the Almy Reservoir, and the associated wetlands located between the Landfill and these two Reservoirs. Detailed descriptions of these and other surface water bodies in the site vicinity are presented in the Central Landfill RI Report, Operable Unit 1, March 1993.

The Landfill, the largest in Rhode Island, has been active since 1955 and is expected to continue to receive waste at least through the year 2000; most of the population of Rhode Island relies upon the Landfill for their solid waste disposal needs. Prior to 1955, the area was used as a combination sand and gravel/quarry stone operation. The Central Landfill was included on the National Priority List in June 1986. In April 1987, the U.S. EPA and the landfill owner/operator/PRP (RISWMC) entered into a Consent Agreement whereby an RI/FS was to be conducted for the Central Landfill. The RI/FS for OU1 was conducted by the RISWMC's consultant, GZA GeoEnvironmental, Inc. The final RI Report for OU1

DRAFT

was submitted to EPA in March 1993. GZA GeoEnvironmental, Inc. will also conduct the RI/FS for OU2, as the consultant for the RISWMC.

The Landfill has received an estimated 17,000,000 cubic yards of refuse, to a maximum depth of greater than 210 feet. Wastes deposited at the Landfill have included solid wastes (municipal, commercial, and industrial); liquid industrial wastes including wastewater treatment plant sludges, reportedly co-disposed with solid wastes throughout the Landfill, and in trenches excavated into bedrock; untreated septage wastes, disposed of in an estimated 5 to 10 acre area, and in pools up to 15 feet deep; and bulk industrial/hazardous wastes which were reportedly disposed of via tank trucks and drums in a series of open trenches excavated to or into bedrock, near the southeast edge of the Landfill. This area was named "hazardous waste disposal area two" (HWDA2) and was designated a "Hot Spot". The 0.5 acre Hot Spot area contains successive layers of chemical sludges, septic sludges, and landfill debris at the surface.

Between 1986 and 1990, the Town of Johnston and the RISWMC made public water available to the area through an extension of the town water line, however it has not been confirmed that all pre-existing private wells have been abandoned and connected to the public water line. A landfill gas collection system is used to produce

DRAFT

electrical power, collecting gas from approximately 90 wells at a rate of approximately 5000 standard cubic feet per minute (scfm).

The Landfill was constructed directly on fractured bedrock, and contaminant migration through the fractured bedrock has been identified as the major exposure pathway. The OU1 Remedial Investigation has determined that the HWDA2 (Hot Spot) is a significant source of volatile and semi-volatile organic compound (VOC/SVOC) contamination in groundwater; the general landfill area is also a (less significant) source of these contaminants and a source of metals contamination in groundwater. Dense non-aqueous phase liquid (DNAPL) has been identified in fractured bedrock underlying the Landfill; the DNAPL which remains in bedrock is estimated to be a significant ongoing source of groundwater contamination.

It is anticipated that the Record of Decision (ROD) for OU1 will require capping of the remainder of the Phase I Landfill area and will attempt to control off-site migration of contaminated groundwater through groundwater extraction and treatment in the Hot Spot area. The objectives of the RI/FS for OU2 are to address the nature and extent of off-site contaminant migration and to evaluate the off-site risks to human health and the environment.

3.0 SCOPE OF WORK

A baseline human health and ecological risk assessment will be completed by HNUS, and will be based upon information and Operable Unit 2 (OU2) data to be collected and reported during the Remedial Investigation/Feasibility Study (RI/FS) to be conducted by the PRP's contractor in the areas surrounding the Central Landfill (CLF, or the Site), located in Johnston, Rhode Island. These off-site areas have been designated Operable Unit 2 (OU2).

The OU2 baseline human health risk assessment will evaluate off-site risks to potential human receptors; the OU2 baseline ecological risk assessment will evaluate off-site environmental risks posed to ecological receptors. All work will be performed and submitted in accordance with the EPA Region I Risk Assessment Statement of Work (SOW) for OU2, dated September 24, 1993. Work described in this work plan is also based upon the project scoping meeting held on October 15, 1993 and on discussions with the RPM. The activities to be performed under this work plan include:

- Project planning activities to include project orientation, a project kick-off meeting, preparation of the work plan and cost estimate, progress reporting and

DRAFT

invoicing, and general planning and cost and schedule tracking functions.

- Risk assessment activities to support preparation of both the human health and ecological portions of the risk assessment, including preparation and submittal of three interim deliverable documents, a Draft Baseline Risk Assessment Report and a Revised Draft Baseline Risk Assessment Report.

3.1 Components of the Baseline Human Health Risk Assessment

Based upon the EPA-Region I SOW referenced above, the baseline human health risk assessment will address the following five categories:

- Hazard Identification
- Dose-response assessment
- Exposure assessment
- Risk characterization
- Limitations and uncertainties

The hazard identification, which identifies contaminants of concern (COCs), will include a statistical data evaluation which will be used in the selection of COCs and will be incorporated into the

DRAFT

estimation of exposure concentrations to be quantitatively evaluated in the risk assessment. The dose-response evaluation will include a toxicity assessment of each COC selected during the data evaluation/hazard identification. Section 4.0 of this work plan presents a detailed discussion of the objectives and methodologies relevant to the individual components of the baseline human health risk assessment listed above.

3.2 Components of the Baseline Ecological Risk Assessment

The baseline ecological risk assessment will include the following activities:

- Characterization of the Site and potential receptors
- Selection of contaminants of concern, indicator species, and ecological effects of concern
- Exposure assessment
- Ecological effects assessment
- Risk characterization

Section 4.0 of this work plan presents a detailed discussion of the objectives and methodologies relevant to the individual components of the baseline ecological risk assessment listed above.

3.3 Deliverables

In accordance with the SOW, portions of the baseline human health risk assessment will be completed by HNUS and submitted to EPA Region I, in conjunction with portions of the ecological risk assessment, as three interim deliverables for review and approval by the Remedial Project Manager (RPM). Each deliverable will be reviewed and approved by the RPM prior to HNUS proceeding with the next interim deliverable. Upon approval of all three interim deliverables, HNUS will submit a Draft Baseline Risk Assessment to EPA as a final report that incorporates all interim deliverables of both the baseline human health and ecological risk assessments, as well as any additional information required for the report. Following EPA review and comments, a Revised Draft Baseline Risk Assessment Report(s) may be required for submittal to EPA Region I which would incorporate EPA's comments and additional work and/or information (e.g., additional validated data that may become available following submittal of the first Draft Report).

3.3.1 **Interim Deliverables - Human Health and Ecological Risk Assessments**

The following briefly outlines the interim deliverables and associated work to be completed by HNUS for the baseline risk assessment for submittal to EPA Region I, per the Risk Assessment

SOW and as determined through discussions with the RPM. As noted previously, more detailed discussions of the objectives and methodologies relevant to the individual components of the baseline risk assessment interim deliverables (human health and ecological) are provided in Section 4.0. Therefore, only brief descriptions for portions of the interim deliverables are provided below:

First Interim Deliverable

Human Health Risk Assessment

- Hazard Identification I: HNUS will perform statistical data evaluation and identify COCs. Hazard identification may also include pictorial representations of extent of contamination (if necessary).
- Exposure Assessment I: HNUS will identify and present all exposure pathways, exposure dose equations, exposure parameters, and potential human receptors.

Ecological Risk Assessment

- The proposed first interim deliverable for the ecological risk assessment includes a definition of objectives; characterization of the site and potential receptors; and

DRAFT

selection of contaminants of concern, indicator species, and ecological effects of concern.

Second Interim Deliverable (To be submitted following EPA review and acceptance of First Interim Deliverable)

Human Health Risk Assessment

- Revised Hazard Identification: HNUS will revise Hazard Identification I based upon EPA comments and incorporate newly acquired validated data if necessary.
- Revised Exposure Pathways and Parameters: HNUS will revise Exposure Assessment I per EPA comments.
- Dose-Response Evaluation: HNUS will discuss potential adverse carcinogenic/noncarcinogenic effects resulting from exposures to COCs, present a toxicity assessment, and present cancer slope factors, reference doses and ARARs consistent with EPA Region I risk assessment guidance.

Ecological Risk Assessment

- The proposed second interim deliverable for the ecological risk assessment includes an exposure assessment; an ecological effects assessment; and a revised first interim deliverable.

Third Interim Deliverable (Following EPA review and acceptance of Second Interim Deliverable)

Human Health Risk Assessment

- Exposure Assessment II: HNUS will estimate average and reasonable maximum exposure levels by coupling average and maximum exposure concentrations with conservative exposure parameters. (Any necessary change(s) will be incorporated into the Draft Baseline Risk Assessment Report.)
- Risk Characterization: HNUS will integrate information from toxicity and exposure assessments to quantitate potential health risks associated with each exposure pathway. HNUS will present resulting carcinogenic/noncarcinogenic risks in separate summary tables.

DRAFT

- **Uncertainties and Limitations:** HNUS will discuss uncertainties and limitations, including sources of uncertainty. HNUS will indicate whether uncertainties and limitations result in under- or over-estimation of potential health risks.

Ecological Risk Assessment

- The proposed third interim deliverable for the ecological risk assessment includes a risk characterization and revised first and second interim deliverables.

3.3.2 Draft Baseline Risk Assessment Report

Following completion and acceptance by EPA of the three interim deliverables described above, HNUS will submit the Draft Baseline Risk Assessment Report, including the human health and ecological risk assessments. If necessary, after EPA's review of the draft Report, HNUS will submit a Revised Draft Baseline Risk Assessment Report to include comments provided by EPA on the draft document. The revised draft report will be due to EPA within ten (10) days after HNUS' receipt of the final comments on the draft document.

DRAFT

The Draft and Revised Draft Baseline Human Health Risk Assessment Reports will follow the section format which was detailed in the EPA Region I SOW, as follows:

- 1.0 Introduction/Hazard Identification
 - 1.1 Site Description and History
 - 1.1.1 Present and Future Land Use
 - 1.1.2 Human Receptors (including type, location and numbers)
 - 1.2 Nature and Extent of Contamination Found at the Site
 - 1.3 Selection of Contaminants of Concern
 - 1.3.1 Health-Based ARARs
 - 1.4 Fate and Transport
- 2.0 Exposure Assessment
 - 2.1 Exposure Pathways
 - 2.2 Exposure Scenarios
 - 2.2.1 Exposure Point Concentrations
 - 2.2.2 Exposure Dose Levels
- 3.0 Dose Response Evaluation
 - 3.1 Dose Response Criteria for Carcinogenic Effects
 - 3.2 Dose Response Criteria for Noncarcinogenic Effects

DRAFT

4.0 Risk Characterization

4.1 Narrative and tables summarizing carcinogenic and noncarcinogenic risks by exposure pathways for current and future exposure scenarios

5.0 Uncertainty/Limitations

6.0 References

7.0 Appendices

7.1 Documentation/Data

7.2 Toxicity Profiles for Contaminants of Concern

4.0 TASK PLAN DESCRIPTION

This section describes specific activities to be conducted within each task during the performance of the Central Landfill OU2 Risk Assessment work assignment. The standard RI/FS tasks to be used during the performance of this work assignment include:

- Task 1 (0100) - Project Planning
- Task 6 (0600) - Risk Assessment

4.1 Task 0100 - Project Planning

Task 0100 is comprised of subtasks which describe the project planning activities anticipated under this work assignment. These subtasks include such activities as project orientation; a project kick-off meeting; preparation of the work plans and cost estimates; progress reporting and invoicing; and general planning functions.

4.1.1 Subtask 0110 - Kick-off Meeting/Project Planning Documents

This task includes attendance at the kick-off meeting to initiate the work assignment, held at EPA on October 15, 1993, and preparation of the seven-day scoping letter; project orientation

DRAFT

activities including review of background documents for project familiarization; and preparation of the draft and final work plans and detailed cost estimates. The work plan provides an overview of the technical, project management, and scheduling aspects of the Central Landfill Risk Assessment work assignment. The detailed cost estimate, submitted under separate cover, provides the details of the anticipated cost of implementing the work assignment.

4.1.2 Subtask 0120 - Work Assignment Administration

This activity includes preparation of monthly progress reports, to include a narrative description of the status of the work assignment, as well as a financial summary. Preparation of semi-annual evaluation reports, project cost and schedule tracking, and weekly project meetings will also be conducted under this task.

4.2 Task 0600 - Risk Assessment

This task includes all work efforts related to conducting the off-site baseline human health and ecological risk assessment for the Central Landfill (OU2), in Johnston, Rhode Island. The objective of the risk assessment effort is to characterize, and quantify where appropriate, the current and potential human health and environmental risks that would prevail if no further remedial action is taken at the Site.

DRAFT

The baseline risk assessment will be conducted based upon analytical data to be acquired from samples collected from Operable Unit 2 (OU2), the off-site areas, by the PRP's contractor. The preparation of the human health and ecological risk assessments by HNUS, and adherence to deadlines to be established, will be contingent upon the PRP's contractor providing the necessary information in a timely and orderly manner, through reports to be provided to EPA/HNUS in a usable format. For planning and costing purposes, HNUS has assumed that all analytical data for use in the risk assessment will be digitized, and provided to HNUS in the following format:

- Lotus 1-2-3 or ASCII format
- All numerical values for analytical data will be presented in "stand-alone cells", with data qualifiers in separate cells
- All numerical values will be formatted as values, (without "labels")
- Detection limits ("U" values) will be provided for all samples, including those compounds which were "non-detects"

DRAFT

- Field sample results will be presented separately from QA/QC sample results (i.e., field blanks, trip blanks, duplicates, etc.)
- All data will include the date sampled (including QA/QC sample dates) and the depth interval sampled (including depths for sediment, soils, and surface water samples)
- Data will be presented according to analysis groupings, i.e., volatile organic compound results separate from semivolatile organic compound results, separate from inorganics results; and according to media, i.e., groundwater, surface water, sediments, etc.
- The number of data points is assumed to include 100 groundwater samples, 60 surface water samples, and 40 sediment samples. We currently are assuming no biota, soil, or air samples will be used for the risk assessment.

Task 0600 is comprised of two separate subtasks for tracking the baseline human health risk assessment (Subtask 0610) and the baseline ecological risk assessment (Subtask 0620). These subtasks are described in more detail in the sections which follow.

4.2.1 Subtask 0610 - Baseline Human Health Risk Assessment

As stated in the EPA SOW, the baseline human health risk assessment will be completed in accordance with the guidance, procedures, assumptions, methods, and formats presented in:

Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors" OSWER Directive 9285.6-03 (U.S. EPA, March 25, 1991).

EPA Region I Supplemental Risk Assessment Guidance for the Superfund Program Part 1: Public Health Risk Assessment (EPA 901/5/89-001, June 1989).

Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part A), Interim Final (EPA 540/1-89/002, December 1989).

Guidance for Data Useability in Risk Assessment, Part A (Publication 9285.7-09A/FS, May 1992).

Air/Superfund National Technical Guidance Study Series, Volumes I, II, III, and IV (U.S. EPA 450/1-89-001, 002, 003, 004, July 1989).

DRAFT

Guideline for Exposure Assessment. Federal Register 57:
22888-22938.

Additional guidance that may be used in performing the risk assessment are:

Guidelines for:

- a. Carcinogen Risk Assessment (51 FR 33992, September 24, 1986);
- b. Mutagenicity Risk Assessment (51 FR 34006, September 24, 1986);
- c. The Health Risk Assessment of Chemical Mixtures (51 FR 34014, September 24, 1986); and
- d. The Health Assessment of Suspect Developmental Toxicants (56 FR 63798, December 5, 1991).

Other guidance not listed in the EPA SOW that may be necessary in performing the baseline human health risk assessment for the Central Landfill (OU2) include the following:

DRAFT

Exposure Factors Handbook (EPA/600/8-89/043, May 1989).

Dermal Exposure Assessment: Principles and Applications.
Interim Report (EPA/600/8-91/011B, January 1992).

Risk Assessment Guidance for Superfund, Volume I: Human Health
Evaluation Manual Supplemental Guidance - Dermal Risk
Assessment, Interim Guidance (U.S. EPA, August 18, 1992).

The baseline human health risk assessment will include the following components, which are detailed in the sections below:

- Data Evaluation/Hazard Identification
- Dose-Response Assessment
- Exposure Assessment
- Risk Characterization
- Limitations/Uncertainties

4.2.1.1 Data Evaluation/Hazard Identification

The Hazard Identification will present a compilation of the available analytical data for the hazardous substances present at the site. It is assumed that OU2 analytical data will be provided to HNUS by the PRP's contractor, in Lotus 1-2-3 or ASCII format.

DRAFT

Data summary tables that include the frequency of detection of each contaminant, the range of detections, the location of the maximum positive detection, selected relevant regulatory criteria, and mean concentrations will be developed by HNUS, on a medium-specific basis, for use in the baseline human health risk assessment.

Statistical procedures (goodness-of-fit tests) will be completed to determine if data are normally or log-normally distributed. The summary tables will include either the arithmetic or geometric mean, depending on the results of the goodness-of-fit tests. If necessary, figures that display the nature and extent of contamination will be developed during the data evaluation task; the spatial distribution of contamination will be considered during the risk assessment data evaluation task.

For those contaminants detected in each medium, one half of the analyte-specific detection limit will be used for non-detections. Comparison of site concentrations with anthropogenic and non-anthropogenic background levels will be completed. Site-specific background data as well as literature background concentrations will be considered. This evaluation will focus on naturally-occurring chemicals (metals) and any ubiquitous organic chemicals detected in background samples.

DRAFT

Selection of the contaminants of concern (COCs) will be based upon EPA Region I risk assessment guidance (U.S. EPA, June 1989). The important factors considered in choosing COCs will include the detected concentrations, the frequency of detection, location, the potential for contaminant releases, environmental mobility, potential migration routes, contaminant toxicity, and contaminant persistence. The data evaluation/hazard identification process will include the selection of COCs based on a toxicity screening process, as outlined in EPA guidance (U.S. EPA, December 1989).

Data summary and COC selection tables or spreadsheets prepared during the Hazard Identification will be forwarded to EPA for review and comment (First Interim Deliverable - Human Health Risk Assessment - Hazard Identification I). EPA comments will be reviewed and incorporated into the Revised Hazard Identification (Second Interim Deliverable), and subsequently, the Draft Baseline Human Health Risk Assessment, as necessary.

4.2.1.2 Exposure Assessment

The exposure assessment for the baseline human health risk assessment will identify plausible off-site present and potential future exposure pathways (First Interim Deliverable - Exposure Assessment I). The identification of plausible exposure pathways will be made based on information provided to HNUS under the

DRAFT

Central Landfill RI/FS Oversight work assignment. The exposure scenarios developed for the CLF OU2 will consider existing and future conditions, land, and water use. Exposure parameters will be selected in accordance with EPA guidance (U.S. EPA, March 1991; U.S. EPA, June 1989; U.S. EPA, December 1989).

The exposure assessment will provide estimates of the magnitude of human exposures by identifying exposure pathways, receptors, and dose parameters under appropriate exposure scenarios; estimating exposure point concentrations; and finally by combining exposure concentrations with dose parameters in the exposure dose equations under each scenario. Although specific exposure scenarios are not known at this time, and not detailed in the EPA SOW, HNUS assumes that the range of pathways may include the following:

- Groundwater pathway - Ingestion, dermal contact while bathing and inhalation of organic COCs that volatilize while showering. Potential current and future exposures to bedrock groundwater COCs that have migrated from the CLF will be evaluated for off-site adult and child (ages 0-6 years) residents. After future discussions with EPA, however, dermal contact and inhalation may not be retained for quantitative analysis.

DRAFT

- Surface water pathway - Off-site exposures to surface water COCs will be evaluated under current and future recreational land use scenarios for adults and older child (ages 7-18 years) receptors who may swim and wade in the reservoirs, ponds and streams in the vicinity of the CLF. Recreational surface water exposure pathways include ingestion and dermal contact. In addition, potential future domestic use of reservoir surface water will be evaluated for ingestion, dermal contact while bathing, and inhalation of volatilized organics while showering. These surface water pathways will be evaluated for adults and young child (ages 0-6 years) receptors. However, as is the case with groundwater used for domestic purposes, future discussion with EPA may result in the elimination of dermal contact and inhalation from quantitative analysis.
- Food chain pathway - Ingestion of fish taken from contaminated surface waters. At the direction of EPA, exposure concentrations may be estimated from either analytical data on fish tissues, bioconcentration factors (BCFs coupled with surface water concentrations), or both analytical data and BCFs. Evaluation of exposures to other food chain pathways, e.g., homegrown vegetation, beef, and dairy products may also be performed if EPA

considers it necessary. Since fish sampling may not be required and PRP data may not be available, the potential concentration of contaminants will have to be estimated using the chemical specific BCF.

- Sediment pathway - Dermal absorption and incidental ingestion of sediment COCs will be evaluated under current and future recreational land use scenarios for adults and older child (ages 7-18 years) receptors.
- Air pathway - Available information produced from previous air monitoring activities indicate that the air emissions from the CLF are not adversely impacting air quality in the surrounding areas. However, if required by EPA, inhalation of fugitive VOCs emanating from contaminated soils/dusts in the CLF, if applicable. CLF stack emissions are not subject to evaluation in this risk assessment since they are regulated under a permit issued by RIDEM. Current and future off-site adult and child (ages 0-6 years) residents will be evaluated in the baseline human health risk assessment. At the direction of EPA, exposure concentrations to be used will be derived from either air sampling data, air modeling results (obtained from an EPA-approved air model), or both sampling and modeling data. Evaluation of the air

DRAFT

pathway is not included in the Draft Detailed Cost Estimate.

- Soil pathway - At the direction of EPA, inhalation of COCs in fugitive dusts originating from the CLF, if applicable. Current and future off-site adult and child (ages 0-6 years) residents will be evaluated in the baseline human health risk assessment. Ingestion and dermal contact with CLF COCs in OU2 soils, which would originate from aerial deposition, will not be evaluated in this baseline human health risk assessment since aerial deposition of COCs is assumed to be negligible.

Exposure point concentrations may be developed for selected media on an area-specific basis, contingent upon the results of the data evaluation process ("hot spot" identification). Both mean and maximum observed (or simulated) concentrations will be used as exposure point concentrations in accordance with EPA Region I risk assessment guidance (U.S. EPA, June 1989).

Exposure doses will be estimated, based on Region I guidelines using standard default values as dose input parameters (U.S. EPA, March 1991) (Third Interim Deliverable - Exposure Assessment II). The following subsections specify the exposure dose input

parameters that will be used to develop exposure doses for each exposure pathway identified in the preceding paragraphs.

4.2.1.2.1 Estimation of Exposure Doses Resulting from Residential Use of Groundwater and Surface Water

The exposure dose for the residential ingestion of groundwater/surface water used as drinking water will be estimated assuming that an adult (70 kg) consumes 2 Liters/day and a young child (15 kg) consumes 1 Liter/day. The exposure frequency (EF) will be set at 350 days/year. The exposure duration for the adult and child receptors will be 30 yrs and 6 yrs, respectively. The following equation will be used to estimate the exposure dose for the ingestion of groundwater exposure pathway:

$$\text{Dose (mg/kg/day)} = \frac{C * IR * EF * ED}{BW * AT * 365 \text{ days/year}} \quad \text{EQUATION 1}$$

Where:

- C = Groundwater concentration of contaminant (mg/L)
- IR = Daily water ingestion rate (L/day)
- EF = Exposure frequency (days/year)
- ED = Exposure duration (years/lifetime)
- BW = Body weight (Kg)

DRAFT

AT = Number of years over which the exposure is averaged

- 70 years for carcinogenic effects
- ED for noncarcinogenic effects

If directed by EPA, the exposure dose resulting from dermal contact with groundwater/surface water while bathing will be estimated for an adult and young child (ages 0-6 years) per EPA dermal guidance (U.S. EPA, January 1992 and U.S. EPA, August 18, 1992). This may also include the dermal screening procedure as provided in the cited guidance. The evaluated skin surface areas for the adult and young child receptors (central values) available for contact would be 20,000 cm² and 7,213 cm², respectively. Both surface area values were derived from EPA's Exposure Factor Handbook (May 1989). Event frequency and exposure frequency of bathing would be 10 minutes/event and 350 day/year. The exposure duration for the adult and child receptors would be 30 yrs and 6 yrs, respectively. The following equation would be used to estimate the exposure dose for residential dermal contact with groundwater/surface water:

$$\text{Dose (mg/kg/day)} = \frac{DA_{\text{event}} * EV * ED * EF * A}{BW * AT * 365 \text{ days/year}} \quad \text{EQUATION 2}$$

Where:

DA_{event} = Absorbed dose per event (mg/Kg-day)

A = Skin surface area available for contact (cm²)

EV = Event frequency (events/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years/lifetime)

BW = Body weight (Kg)

AT = Number of years over which the exposure is averaged

- 70 years for carcinogenic effects
- ED for noncarcinogenic effects

The absorbed dose (DA_{event}) for each COC would be calculated from estimated chemical-specific dermal permeability constants using equations presented in EPA dermal guidance (U.S. EPA, January 1992 and U.S. EPA, August 18, 1992). All exposure dose assumptions and permeability constants used to develop dermal exposure doses would undergo review by EPA Region I risk assessment personnel before they are used in the baseline risk assessment.

The exposure dose resulting from the inhalation of organic COCs that may volatilize from shower water (and other domestic uses) will be estimated for adults and young children (ages 0-6 years) if this is retained as a significant exposure pathway after EPA's review and comment on this work plan. These receptors would be

DRAFT

evaluated using an inhalation rate of 0.83 m³/hour (light activity rate for both adult and young child obtained from EPA's Exposure Factor Handbook, May 1989) and assuming an exposure time and frequency of 12 minutes/day (0.2 hours/day) and 350 days/year, respectively. The exposure duration for the adult and child receptors would be 30 yrs and 6 yrs, respectively. The following equation would be used to estimate the exposure dose for inhalation of volatilized organic COCs while showering:

$$\text{Dose (mg/kg/day)} = \frac{\text{CA} * \text{IR} * \text{ET} * \text{EF} * \text{ED}}{\text{BW} * \text{AT} * 365 \text{ days/year}} \quad \text{EQUATION 3}$$

Where:

CA = Estimated air concentration of contaminant (mg/m³)

IR = Daily inhalation rate (m³/hour)

ET = Exposure time (hours/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years/lifetime)

BW = Body weight (Kg)

AT = Number of years over which the exposure is averaged

- 70 years for carcinogenic effects

- ED for noncarcinogenic effects

DRAFT

Values for CA may be estimated from existing groundwater/surface water concentrations by using a widely known and accepted partitioning model, e.g., Andelman 1985 or Foster and Chrostowski, 1987. All inhalation exposure dose assumptions and modeling results (including air exposure concentrations) will be reviewed by EPA Region I personnel before being incorporated in the baseline human health risk assessment.

4.2.1.2.2 Estimation of Exposure Doses Resulting from Recreational Use of Surface Water

Available information regarding the surface water bodies in the vicinity of the CLF indicate that they are currently used for recreational activities. These activities may include swimming in reservoirs and ponds, and wading through streams (e.g., Upper Simmons Reservoir, Almy Reservoir, and Cedar Swamp Brook). Exposure doses will be estimated for adults and older children (ages 7-18 years, body weight of 43 Kg) who may accidentally ingest surface water during these activities, at a rate of 0.05 liters per hour. It will be assumed by HNUS that swimming and wading activities will occur for 2 hours per day, 24 days per year (activities assume to occur one per week over the summer months). The exposure duration for both the adult and older child receptors will be 12 years. The following equation will be used to estimate

the exposure dose resulting from the accidental ingestion of surface water:

$$\text{Dose (mg/kg/day)} = \frac{C * IR * ET * EF * ED}{BW * AT * 365 \text{ days/year}} \quad \text{EQUATION 4}$$

Where:

C = Measured/estimated surface water concentration of the contaminant (mg/L)

IR = Surface water ingestion rate (L/hour)

ET = Exposure time (hours/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years/lifetime)

BW = Body weight (43 Kg)

AT = Number of years over which the exposure is averaged

- 70 years for carcinogenic effects

- ED for noncarcinogenic effects

Exposure doses will also be calculated for dermal contact with surface water by adults and older children that occur during swimming and wading activities. Dermal exposures during swimming will be estimated for the surface waters in the reservoirs and ponds, while dermal exposures during wading will be estimated for

DRAFT

the surface waters in the streams. The exposure time, frequency and duration assumed for the accidental ingestion of surface water will also be used for dermal contact. The skin surface areas for the adult and older child receptors (central values) available for contact while swimming will be 20,000 cm² and 13,328 cm², respectively. Both surface area values were derived from EPA's Exposure Factor Handbook (May 1989). HNUS will assume that the skin surface areas available for surface water contact during wading are 25% of the total body surface areas, or 5,000 cm² and 3,332 cm², respectively.

EQUATION 2 above will be used to calculate the absorbed doses resulting from dermal contact with surface water COCs during both swimming and wading activities. The absorbed dose (DA_{event}) for each COC will be calculated from estimated chemical-specific dermal permeability constants using equations presented in EPA dermal guidance (U.S. EPA, January 1992 and U.S. EPA, August 18, 1992). All exposure dose assumptions and permeability constants used to develop dermal exposure doses will be reviewed by EPA Region I risk assessment personnel before they are used in the Baseline Risk Assessment.

4.2.1.2.3 Estimation of Exposure Doses Resulting from Recreational Contact with Sediments

Swimming and wading activities in the OU2 ponds, reservoirs and streams in the vicinity of the CLF will result in direct contact exposures to sediment COCs for adult and older child receptors, in addition to the previously discussed surface water COC exposures. Accidental ingestion of pond and reservoir sediments may occur during swimming when surface water containing suspended sediments is swallowed. While wading through streams, it is assumed that sediments get onto the hands of an adult or a child receptor who puts their hands into the stream (e.g., to pick up objects, i.e., rocks, organisms, etc., from the stream). Accidental ingestion of stream sediments may then occur during or after wading when sediment particles, which are adhered to the hands, get into the mouth. This may happen, for example, while eating food without washing the hands.

It will be assumed by HNUS that the accidental ingestion of sediments during these activities will occur at a rate of 100 mg per day, 24 days per year, over 12 years for both the adult and child receptor. The following equation will be used to estimate the exposure dose resulting from the accidental ingestion of sediments:

$$\text{Dose (mg/Kg/day)} = \frac{C * IR * EF * ED * 10^{-6} \text{ Kg/mg}}{BW * AT * 365 \text{ days/year}} \quad \text{EQUATION 5}$$

Where:

C = Measured contaminant concentration in sediment
(mg/Kg)

IR = Soil ingestion rate (mg/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years/lifetime)

BW = Body weight (Kg)

AT = Number of years over which the exposure is averaged

- 70 years for carcinogenic effects

- ED for noncarcinogenic effects

Dermal contact exposures to sediment COCs may also occur to adults and older children while swimming and wading in contaminated reservoirs, ponds and streams. The exposure duration and exposure frequency time frames assumed will be those set for the accidental ingestion of sediments. A sediment contact rate (SCR) of 500 mg/day will be assumed for this pathway. This SCR value, which is specified in the EPA Region I Guidance Manual, was originally developed for residential and recreational exposures to contaminated soils, but may also be applicable to sediment exposures. The value of 500 mg/day is based upon a deposition rate of 0.5 mg/cm², a potentially exposed skin surface area of 2,000 cm².

DRAFT

and a factor of 50% accounting for the fraction of total skin area likely to be exposed.

The following equation will be used to estimate the exposure dose incurred by a receptor as a result of dermal contact with contaminated sediments:

$$\text{Dose (mg/kg/day)} = \frac{C * SCR * RAF * EF * ED * 10^{-6} \text{ Kg/mg}}{BW * AT * 365 \text{ days/year}} \text{ EQUATION 6}$$

Where:

C = Contaminant concentration in sediments (mg/Kg)

SCR = Soil contact rate (mg/day of exposure)

RAF = Relative absorption factor (unitless)

EF = Exposure frequency (days/year)

ED = Exposure duration (years/lifetime)

BW = Body weight (Kg)

AT = Number of years over which the exposure is averaged

- 70 years for carcinogenic effects

- ED for noncarcinogenic effects

The chemical-specific absorption factors (RAFTs) presented in the dermal assessment guidance (U.S. EPA, January 1992 and U.S. EPA, August 18, 1992) will be used to estimate the exposure doses resulting from dermal contact with contaminated sediments.

DRAFT

Unfortunately, definitive, quantitative information regarding dermal absorption of contaminants from soils/sediments is limited. The cited guidance documents present sufficient data for only dioxin, cadmium and 3,3',4,4'-tetrachlorobiphenyl (TCB). The RAF for TCB may be applied as a surrogate for all polychlorinated biphenyl compounds (PCBs). The RAF ranges presented for these chemicals are as follows: 0.1% to 3% for dioxin, 0.1% to 1% for cadmium, and 0.6% to 6% for TCB. With EPA's approval, HNUS proposes to conservatively employ the upper limit of each RAF range, where applicable. Due to a lack of dermal absorption data, HNUS will qualitatively evaluate dermal exposures to all other COCs.

4.2.1.2.4 Estimation of Exposure Doses Resulting from Fish Ingestion

Available information regarding the surface water bodies in the vicinity of the CLF indicate they are currently used for recreational activities. Based on this information it will be assumed that the ponds and reservoirs are used for sports fishing. Exposure doses will be estimated for adults who consume fish caught during this activity. It will be assumed that a sports fisherman consumes fish at a rate of 0.054 Kg per day, 350 days per year, for 30 years. It will also be assumed that the fraction of fish consumed from OU2 surface water bodies is 0.25. The following

DRAFT

equation will be used to estimate the exposure dose for the ingestion of fish from OU2 surface water bodies:

$$\text{Dose (mg/kg/day)} = \frac{\text{CF} * \text{IR} * \text{FI} * \text{EF} * \text{ED}}{\text{BW} * \text{AT} * 365 \text{ days/year}} \quad \text{EQUATION 7}$$

Where:

CF = Measured/estimated contaminant concentration in fish tissue (mg/Kg)

IR = Daily fish ingestion rate (Kg/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years/lifetime)

BW = Body weight (Kg)

AT = Number of years over which the exposure is averaged

- 70 years for carcinogenic effects

- ED for noncarcinogenic effects

The concentration of contaminant in fish tissue will either be directly measured or estimated by multiplying the surface water concentration of the contaminant by the corresponding chemical-specific BCF.

4.2.1.2.5 Estimation of Exposure Doses Resulting from CLF Emissions of Volatilized Organic Compounds and Fugitive Dusts

Available information from previous air monitoring activities indicate that the air quality in the vicinity of the CLF is not being adversely impacted by volatilized emissions. It was also indicated that dust emissions from the CLF are kept to a minimum by watering the area down. Based on this information, these air exposure pathways become insignificant for quantitative evaluation in the baseline human health risk assessment. However, if the EPA determines it necessary to evaluate these pathways, HNUS will employ the following equation to determine adult residential exposure doses resulting from the inhalation of VOCs/fugitive dusts that may potentially migrate to off-site areas located downwind of the CLF:

$$\text{Dose (mg/kg/day)} = \frac{\text{CA} * \text{IR} * \text{ET} * \text{EF} * \text{ED}}{\text{BW} * \text{AT} * 365 \text{ days/year}} \quad \text{EQUATION 8}$$

Where:

CA = Modeled/measured air concentration of contaminant
(mg/m³)

IR = Daily inhalation rate (m³/day)

EF = Exposure frequency (days/year)

ED = Exposure duration (years/lifetime)

BW = Body weight (Kg)

AT = Number of years over which the exposure is averaged

- 70 years for carcinogenic effects

- ED for noncarcinogenic effects

An inhalation rate of 20 m³ per day (default value), 150 days per year (HNUS assumption), for 30 years would be used to evaluate potential exposure doses and risk levels to off-site adult residents performing outdoors activities.

4.2.1.3 Dose-Response Assessment/Toxicity Assessment

The toxicity assessment will include preparation of toxicity profiles and dose-response parameter summary tables. Brief, easily understood toxicity profiles will be prepared for the primary chemicals of concern at the site and will be included in the text of the baseline risk assessment report. More detailed toxicity profiles will be included in an appendix to the report.

A dose-response evaluation will be completed and submitted to EPA Region I (Second Interim Deliverable - Dose Response Evaluation) that will include identification of Reference Doses and Cancer Slope Factors. The most recent version of the Integrated Risk

DRAFT

Information System database and EPA's Health Effects Summary Tables will be the primary sources of the dose-response parameters. In addition, other appropriate information will be identified and summarized in table format, such as Drinking Water Equivalent Levels, Drinking Water Health Advisories, Maximum Contaminant Levels, Maximum Contaminant Level Goals, Threshold Limit Values, Permissible Exposure Limits, and Ambient Water Quality Criteria.

It may be necessary to derive Reference Doses (RfDs) for some chemicals. In these cases, published toxicity information such as No Observed Effects Levels will be identified and used (with appropriate uncertainty and modifying factors) to develop the RfDs. Calculations will be submitted to EPA for approval prior to use in the baseline risk assessment.

4.2.1.4 Risk Characterization

The results of the exposure and toxicity assessments will be integrated to complete the risk characterization process. Both non-carcinogenic and carcinogenic risk estimates will be developed (Third Interim Deliverable - Risk Characterization).

Non-carcinogenic risks will be determined for each individual chemical and exposure route using the Hazard Quotient. The Hazard Quotient (HQ) will be determined using the estimated average and

DRAFT

reasonable maximum exposure dose and a published (or derived) Reference Dose (RfD) or other suitable reference concentration, as follows:

$$HQ = \text{Exposure Dose (mg/Kg/day)} / \text{RfD (mg/Kg/day)}$$

Cumulative non-carcinogenic risks will be determined by using the Hazard Index for chemicals having similar toxic endpoints. The Hazard Quotients for individual chemicals will be summed for each exposure route and for multiple exposure routes. Media-specific

Hazard Indices (HI) and total Hazard Indices (HI_t) will therefore be determined as follows:

$$HI = \sum_{j=1}^m HQ_j$$

$$HI_t = \sum_{i=1}^n \sum_{j=1}^m HQ_{ij}$$

DRAFT

Where m is the number of chemicals with the same toxic endpoint and n is the number of routes by which the same receptor is exposed. Both media-specific and total Hazard Indices will be presented in the risk assessment. Toxic endpoints will be considered only if the Hazard Index exceeds unity (1.0), indicating that more detailed analysis is necessary.

Carcinogenic risks will be determined for each individual carcinogenic substance and for each exposure route considered. The Excess Incremental Lifetime Cancer Risk (ILCR) will be determined using the exposure dose (time-weighted to account for years of exposure) and a published Cancer Slope Factor (CSF), as follows:

$$\text{ILCR} = \text{Exposure Dose (mg/Kg/day)} \times \text{CSF (mg/Kg/day)}^{-1}$$

Cumulative incremental cancer risks will be determined for each individual exposure route and for multiple exposure routes in the same manner as described for the non-carcinogens. However, the toxic endpoint is the same for all carcinogens. The cumulative Incremental Cancer Risk will be determined as follows:

$$\text{Risk} = \sum_{i=1}^n \sum_{j=1}^m \text{ICR}_{ij}$$

DRAFT

Where m is the number of carcinogens and n is the number of routes by which the same receptor is exposed.

4.2.1.5 Uncertainty Analysis

An uncertainty analysis will be prepared which includes a discussion of the degree of confidence in the risk estimates (Third Interim Deliverable - Uncertainty Analysis).

4.2.2 **Subtask 0620 - Baseline Ecological Risk Assessment**

The objectives of the baseline ecological risk assessment for the Central Landfill (the Site) are: assess the risk posed to ecological receptors from contaminants present in the study area, and provide information to support the development and evaluation of remedial alternatives as part of the Feasibility Study for the Site.

The baseline ecological risk assessment will be based primarily on the information to be generated during the Operable Unit 2 Remedial Investigation, which will be conducted by the PRP's contractor. The preparation of the ecological risk assessment and adherence to deadlines to be established will be contingent upon EPA and/or the PRP making the necessary information and reports available to HNUS in a timely and usable manner and format.

DRAFT

The ecological risk assessment will be performed in accordance with the guidance, methods and formats contained in:

- EPA Region 1, Supplemental Risk Assessment Guidance for the Superfund Program, Part 2: Guidance for Ecological Risk Assessments (EPA 901/5-89-001, June 1989).
- Risk Assessment Guidance for Superfund, Volume II: Environmental Evaluation Manual (EPA 540/1-89/001, March 1989).
- Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference (EPA 600/3-89/013, March 1989).

The ecological risk assessment will include the tasks listed below, which are detailed in the sections which follow:

- Characterization of the Site and potential receptors
- Selection of contaminants of concern, indicator species, and ecological effects of concern
- Exposure assessment
- Ecological effects assessment
- Risk characterization

4.2.2.1 Characterization of the Site and Potential Receptors

Data provided by the PRPs will be evaluated to identify potential contaminants of concern (COCs), potentially contaminated media, affected habitats, and species that are known or expected to inhabit or use the study area. These items will be identified based on reports to be provided by EPA and/or the PRP regarding background site information, flora and fauna survey results, historical contaminant release data, study area visits, biological surveys, and environmental sampling and analytical results.

4.2.2.2 Selection of Contaminants of Concern, Indicator Species, and Ecological Effects of Concern

Analytical results from soil, sediment, and surface water sampling will be evaluated prior to use in the ecological risk assessment. Pertinent results from additional studies on the nature and extent of contamination in the study area will be considered if they are made available by EPA and/or the PRP in a timely and usable manner to meet the established deadlines for the ecological risk assessment. After evaluation of the available information, acceptable analytical data and results from additional field studies will be used to fully characterize the nature and extent of contamination in the study area. Media-specific COCs will be selected based on toxicity, persistence, bioaccumulation potential,

DRAFT

comparison to background concentrations, and detection frequency. The purpose of selecting COCs will be to focus the ecological risk assessment on the contaminants that potentially pose the greatest risk of adverse effects to ecological receptors.

The selection of indicator species and ecological effects of concern will be based on availability of appropriate assessment data and methodologies, information on sensitivity to COCs, and relative ecosystem importance. Depending on the availability of toxicological information, all or the majority of the species selected as indicator species will be species known to be present or potentially present at the Site; however, if necessary, surrogate species may be selected as indicator species based on ecological considerations and the availability of information. Ecological effects of concern will include direct toxic effects to organisms, such as lethal and sublethal effects, and effects on habitats, populations and communities. Adverse effects at the organism level are expected to include mortality, changes in growth, reproductive impairment, and alterations in behavior. Effects of concern at the population and community level may include changes in abundance, distribution and diversity of species.

4.2.2.3 Exposure Assessment

The purpose of the exposure assessment will be to evaluate the exposure potential of ecological receptors to the contaminants present at the Site. The exposure assessment will identify and characterize the contaminant source(s) and exposure pathways relevant to the study area, and will discuss the fate and transport characteristics of the COCs and the exposure scenarios. The fate and transport of COCs originating from the contaminant source(s) will be assessed both spatially and temporally.

The discussion of exposure scenarios will consider factors such as contaminant source(s) and release mechanisms, retention or transport media, points of potential contact, and exposure routes. The magnitude, duration, and frequency of exposure will be presented for critical exposure scenarios. Critical exposure scenarios are defined as those scenarios contributing the majority of the potential hazard to ecological receptors. The exposure concentrations within each medium will be estimated based on total contaminant concentrations. In addition, modelling for bioavailable contaminant concentrations may be conducted based on partition coefficients and equilibrium partitioning.

DRAFT

A discussion of the limitations and uncertainties involved in the exposure assessment will be presented, indicating their potential impacts in the assessment.

4.2.2.4 Ecological Effects Assessment

The ecological effects assessment will discuss the known adverse effects of the contaminants of concern, and will present the appropriate benchmark toxicity values for the individual COCs by medium. The discussion of adverse effects will be based on information reported in the literature regarding toxicity and other effects of the specific COCs. Toxicity data from the literature will generally describe the relationship between exposure and biological effect (exposure/response or dose/response). The physical, chemical, and biological properties associated with the COCs that potentially affect ecotoxicity will be identified.

Most of the literature data on adverse effects of COCs is expected to be based on laboratory tests using either standard laboratory test species or sensitive wildlife species exposed to single chemicals. Literature data from field studies relating the toxicity of COCs to indicator species or closely related species will also be utilized, if available. For those COCs for which ecotoxicity data are lacking, chemical structure activity

DRAFT

relationships will be used to relate the toxicity of a tested chemical to the toxicity of a related, untested chemical.

Toxicity data for indicator species are most appropriately based on species-specific data. However, if such data are not available, interspecies extrapolations will be used to fill gaps in toxicity data for indicator species.

Benchmark toxicity values for COCs in surface water will consist of chronic ambient water quality criteria (CAWQC), when available. For those COCs for which CAWQC are unavailable, surrogate values will be used. Surrogate values for CAWQC may include no observed effects concentrations (NOECs), with safety factors applied, as appropriate. Benchmark toxicity values for inorganic COCs in sediments will include available sediment quality guidelines or appropriate biological effects data. Benchmark toxicity values for specific organic COCs in sediments are expected to include, as appropriate, the following: CAWQC (comparable to interstitial water concentrations as extrapolated through equilibrium partitioning), EPA's Proposed Sediment Quality Criteria for the Protection of Benthic Organisms, Wisconsin's interim criteria for sediments from Great Lakes harbors for disposal in water, and Long and Morgan's Effects Range-Low data (NOAA 1991). Benchmark toxicity values for COCs in soil will include available soil quality guidelines or appropriate biological effects data.

DRAFT

A discussion of the limitations and uncertainties involved in the ecological effects assessment will be presented, indicating their potential impacts in the assessment.

4.2.2.5 Risk Characterization

The characterization of risk from the contaminants of concern present in the study area will be achieved by the integration of the exposure assessment data and the ecological effects assessment information. More specifically, the likelihood of adverse effects to ecological receptors will be determined by comparing the exposure concentrations of the specific COCs to the appropriate benchmark toxicity values. The quotient method is expected to be the primary method used to accomplish the integration of exposure and ecological effects data for this assessment.

The risks associated with individual COCs will be presented for each medium. In addition, the risks from the individual COCs within each medium will be summed and cumulative risks will be predicted based on the principle of chemical additivity. Depending on the availability of information, the risks to individual species may also be assessed. Species assessed will include site-specific indicator species as much as possible, or surrogate species where applicable.

DRAFT

A discussion of the limitations and uncertainties involved in the risk characterization will be presented, assessing the degree of confidence in the risk estimates.

5.0 PROJECT MANAGEMENT

The overall project management and control of the risk assessment work to be conducted under this work assignment are discussed below.

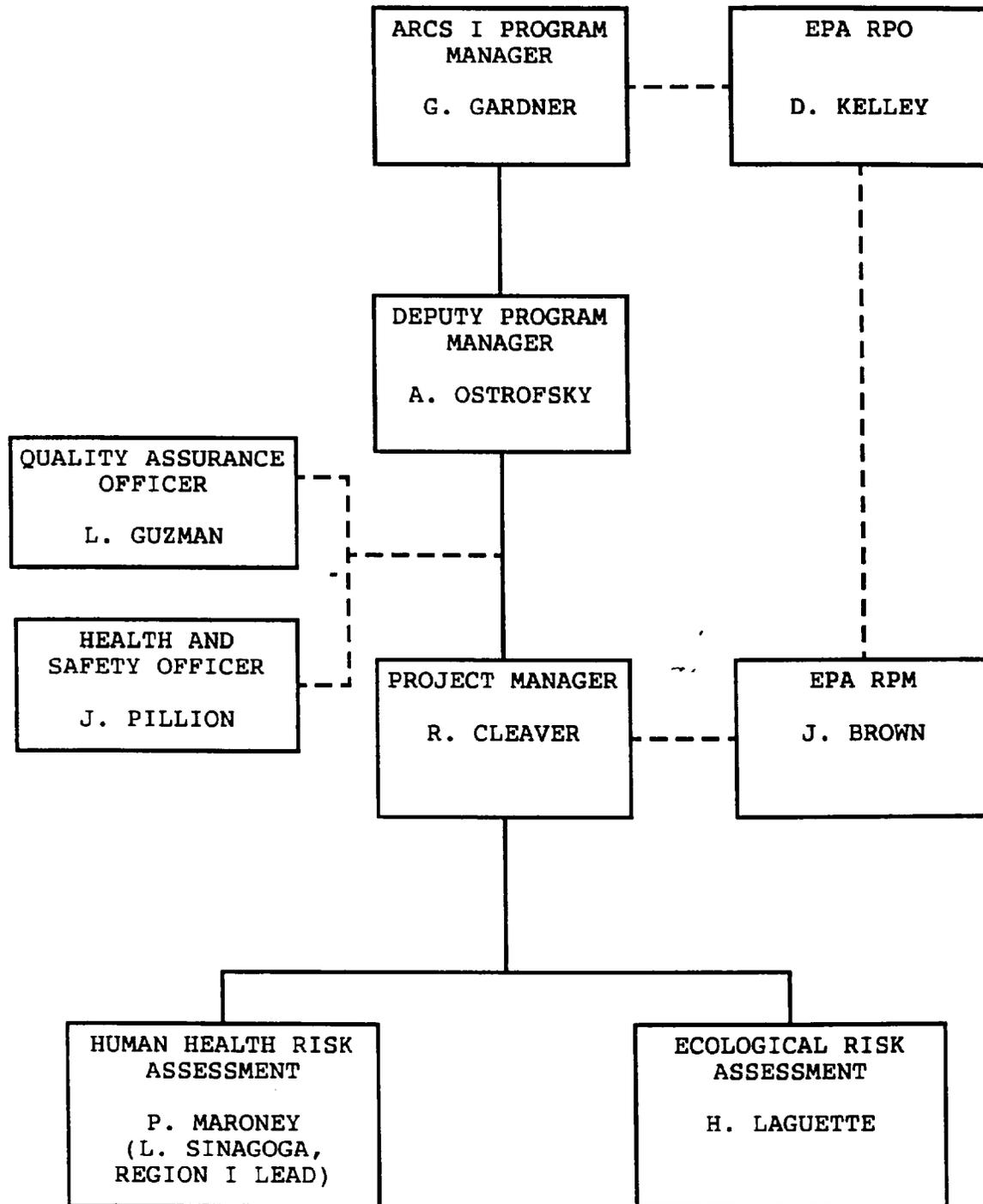
5.1 Project Organization

Mr. George Gardner, the Program Manager, is responsible for the overall management and implementation of the HNUS ARCS I contract performed in U.S. EPA Region I. Ms. Rebecca Cleaver will serve as the project manager for Work Assignment 41-1L71 and has primary responsibility for implementation and execution of the work assignment, including technical quality, oversight/review, control of costs and schedule, and implementation of appropriate quality assurance procedures during all phases of the work assignment.

The technical lead and support staffing for the work assignment will be divided between two task managers, one for performing the human health risk assessment and one for completing the ecological risk assessment. The proposed project organization with lines of authority and coordination for the Central Landfill Risk Assessment work assignment is presented in Figure 5-1.

**FIGURE 5-1
PROJECT ORGANIZATION
DRAFT WORK PLAN
RISK ASSESSMENT
CENTRAL LANDFILL, OU2, JOHNSTON, RHODE ISLAND**

DRAFT



Note: _____ Line of communication, direction, and authority
 - - - - - Line of communication and coordination

5.2 Quality Assurance and Data Management

All work will be performed in accordance with the HNUS ARCS I QA Program Plan which was previously submitted to the EPA Remedial Project Officer under separate cover.

5.3 Project Schedule

The schedule for performing the risk assessment work specified in this work assignment is dependent upon the schedule which will be maintained by the PRP's contractor as they implement the OU2 RI/FS and forward to EPA/HNUS the necessary analytical data to be utilized during the-risk assessment process.

The PRP's current contractor (GZA) has estimated in their May 1993 Draft Operable Unit 2 Remedial Investigation Work Plan, Central Landfill, (not yet reviewed or approved by EPA), that field studies, data collection, and data reduction activities may require approximately twelve months from the time of work plan approval. They estimate their "draft final report" will be submitted approximately three months following the completion of field activities. Actual start-up and completion dates for risk assessment activities to be conducted by HNUS will be determined following EPA's review and final approval of the GZA OU2 Work Plan

DRAFT

for Central Landfill. Specific due dates for deliverables to EPA will be agreed upon by the EPA RPM and the HNUS project manager.

The preparation of the human health and ecological risk assessments by HNUS, and adherence to deadlines to be established, will be contingent upon the PRP's contractor providing the necessary information in an orderly manner, through reports to be provided to EPA/HNUS in a timely and usable format. For planning and costing purposes, it is assumed that all analytical data for use in the risk assessment will be provided to HNUS in digitized format requiring little to no revision or manual translation. Further detail on the required data format for use in the risk assessment is provided above, in Section 4.2.

5.4 Project Costs

The overall cost for the performance of the risk assessment as described in this Draft Work Plan is presented in a separate document, the Detailed Cost Estimate.

6.0 EQUIPMENT AND SUPPLIES

The following equipment and supply needs are anticipated during the performance of the risk assessment activities, for potential use in conjunction with onsite visit(s):

Nonexpendable Equipment

- Field vehicle(s)
- HNu/Microtip and Calibration Accessories
- Mini-Alert Radiation Detector
- MSA Respirators
- Camera
- Cellular phone
- Personal Computers

Consumable Supplies

- Health and Safety: Disposable Gloves, Chemical Resistant Cover Boots, Hard Hats, First Aid Kit, MSA Respirator Cartridges
- Decontamination Supplies: Tubs, Brushes, Detergents/Rinses, Garbage Bags

DRAFT

- Documentation Supplies: Logbooks, Film, Batteries

Note that costs associated with acquisition of the above items are not included in the Detailed Cost Estimate for this Work Plan.