Treatment Demonstration Report

New York District
Formerly Utilized Sites Remedial Action Program
Maywood Superfund Site

Prepared by:
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for:
US Army Corps of Engineers - Kansas City District
Formerly Utilized Sites Remedial Action Program
Contract No. DACW41-99-D-9001

February 2003, Revision 0

TREATMENT DEMONSTRATION REPORT

FUSRAP MAYWOOD SUPERFUND SITE
MAYWOOD, NEW JERSEY

CONTRACT No. DACW41-99-D-9001
WAD 06 WBS 11

Submitted to:

Department of the Army
U.S. Army Engineer District, Kansas City
Corps of Engineers
700 Federal Building
Kansas City, Missouri 64106

Department of the Army
U.S. Army Engineer District, New York
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26 Federal Plaza
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Submitted by:

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ABBREVIATIONS, ACRONYMS, SYMBOLS, AND UNITS OF MEASURE

ASTM	American Society for Testing and Materials
bgs	Below ground surface
bkg	Background
CDQMP	Chemical Data Quality Management Plan
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act
COCs	Chemicals of Concerns
cpm	counts per minute
CQCP	Contractor Quality Control Plan
DOE	Department of Energy
DQCR	Daily Quality Control Report
DQO	Data Quality Objectives
EM	Engineering Manager
FMSS	FUSRAP Maywood Superfund Site
FOL	Field Operations Leader
FUSRAP	Formerly Utilized Sites Remedial Action Program
gpm	gallons per minute
GPS	Global Positioning System
GSS	Gravel Separation System
LLD	Lower Limit of Detection
MHTDP	Materials Handling, Transport and Disposal Plan
MISS	Maywood Interim Storage Site
mrem/y	millirem per year
MS	Matrix Spike
MSD	Matrix Spike Duplicate
MSS	Maywood Superfund Site
NCR	Nonconformance Report
NCP	National Oil and Hazardous Substances Contingency Plan
NGVD	National Geodetic Vertical Datum
NJDEP	New Jersey Department of Environmental Protection
PCB	polychlorinated biphenyl
pCi	picoCurie
PID	Photoionization Detector
PPE	Personal Protection Equipment
PRGs	Preliminary Remediation Goals
QA	Quality Assurance
QC	Quality Control
Ra-226	radium-226

RMA	Radioactive Materials Area
ROC	Radionuclides of Concern
RSO	Radiation Safety Officer
RSS	Radiological Sorting System
SAA	Soil Acquisition Area
SAP	Sampling and Analysis Plan
SC	Sampling Coordinator
SCC	Soil Cleanup Criteria
SOP	Standard Operating Procedure
SOR	Sum- of-the-Ratios
SSERC	Site-Specific Environmental Restoration Contract
SSHO	Site Safety and Health Officer
SSHP	Site Safety and Health Plan
SVOC	Semivolatile Organic Compound
TCLP	Toxicity Characteristic Leaching Procedure
Th-232	thorium-232
TM	Task Manager
TPWP	Test Pit Work Plan
TS	Task Superintendent
U-238	uranium-238
USACE	U.S. Army Corps of Engineers
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
USEPA	U.S. Environmental Protection Agency
UTM	Universal Transverse Mercator
VOC	Volatile Organic Compound

EXECUTIVE SUMMARY

A Pilot Demonstration Project was conducted at the Maywood Interim Storage Site (MISS) at Maywood, Lodi, and Rochelle Park, New Jersey to evaluate the applicability of implementing soil volume reduction technologies at the Formerly Utilized Site Remedial Action Program (FUSRAP) Maywood Superfund Site (FMSS). The ultimate goal of the project was to identify means for permanent and significant reduction of the volume of hazardous substances at the FMSS. Previous remedial investigations and characterizations of the FMSS during the 1980s and early 1990s showed that the property soils were contaminated with radioactive material, primarily in the form of thorium-232 (Th-232), radium-226 (Ra-226), and uranium-238 (U-238).

Given the radioactive materials present at the FMSS, a limited number of options were available for reducing the volume of soil disposed of as radiologically contaminated material. The most suitable options were physical separation techniques. By employing a soil processing technology that could separate below radiological criteria soil from above radiological criteria soil, remediation costs might be reduced through a reduction in the volume of soil requiring off-site disposal or less expensive disposal options at alternate disposal facilities.

Two technologies were evaluated during the Pilot Demonstration.

1. Material separation based on grain size
2. Soil sorting based on levels of radiological contamination

Approximately 8,000 tons of representative site soil was processed to quantify applicability of these technologies for use during the full-scale FMSS remedial effort.

The soil processing system was composed of two principal subsystems.

- The Gravel Separation System (GSS)
- The Radiological Sorting System (RSS)

The GSS performed physical size separation, first removing rock and debris with a diameter of 6 inches or more with a passive coarse screen (grizzly), then removing the 3/8 to 6-inch fraction using a set of two graded vibratory screens. A rinse unit that was comprised of a rinse system and associated water recycling system was also used to determine the effectiveness of rinsing the gravel to remove adhered fines from the 3/8 to 6-inch fraction. The less than 3/8-inch size fraction was then conveyed to the RSS for radiological sorting.

With respect to the GSS performance, gravel separation followed by rinsing to remove the associated fines produced a significantly cleaner product with regard to radioactivity. The quantity and size of fines associated with the oversize material limited the use of the rinse unit during the Pilot Demonstration. Engineering modifications are required to use this process during remediation.

The effectiveness of the RSS was inconsistent. When the RSS was presented with material containing radioactivity that was consistently above or below the selected criteria, the system identified the material correctly and successfully diverted it to the proper stockpile. The RSS was less reliable when presented with material containing radioactivity near the selected criteria. This could be explained by the soil mixing that occurs during excavation and transport to the system and through the agitation of the soil as it passes through the various screens of the GSS.

The RSS produced two types of sorting errors.

1. A false rejection error resulted when below-criteria soil was routed to the above-criteria stockpile.
2. A false acceptance error resulted when above-criteria soil was routed to the below-criteria stockpile.

False acceptance was the more common error. A false acceptance rate of 32% by weight was observed, compared with a false rejection rate of 8%. Sorting errors were prevalent at feed concentrations close to the setpoint regardless of the numerical value of the setpoint. Sorting errors were generally more common at lower setpoint values than at higher setpoint values.

RSS volume reduction depends on the selected criteria and the composition of the feed material. Corrected for false acceptance errors, the Pilot Demonstration achieved 33% volume reduction of the material processed by the RSS. Material processed during the Pilot Demonstration was selected beforehand for test purposes.

The prevalence of acceptance errors limits utility of the RSS, since acceptance errors result in radiologically affected soils being mischaracterized as unaffected soils. Modifications to excavation and handling methods were developed with no measurable effect on system performance. Using a setpoint artificially lower than the applicable cleanup criteria may minimize the problem. However, this practice will negatively impact the volume reduction and cost savings achieved by the system.

Material processed through the Pilot Demonstration systems was analyzed to determine if chemical constituents tended to concentrate in any one fraction during processing. It does not appear that the chemicals were concentrated during radiological sorting. There was also no clear, visible trend for a differential distribution of chemical constituents with regard to particle size. Of the material processed during the Pilot Demonstration, none of the average chemical constituent concentrations exceeded any New Jersey direct contact concentration limit for either industrial or residential land use or indicated the soil might constitute a hazardous waste.

The cost benefit of volume reduction technologies on the overall remediation of the FMSS was evaluated. Operational experience gained during the Pilot Demonstration was incorporated into site-specific unit costs for key cost elements of the model. Different remediation scenarios were then evaluated to develop an understanding of the FMSS remediation cost sensitivity to potential program constraints and site-specific conditions.

Key cost factors are the rate and cost of processing, transportation and disposal costs, and backfill credit on soil that can be reused on site. The overall cost of soil processing is primarily a function of volume. There are several aspects of volume that are important: the volume of soil excavated, the volume of excavated soil that can be processed, and the volume of soil recovered as below the remediation criteria.

The GSS and RSS cannot or would not process all types of soil. Material anticipated during full-scale remediation that is not processible due to its physical characteristics by the GSS is the process sediment found on the MISS and Stepan Chemical. The GSS operation most likely would not process organic material from the wetlands; pond material; saturated silts, clays, and sands due to the naturally low coarse fraction. The RSS has similar limitations on the material it can process. In addition, it would not be beneficial to have the RSS process highly contaminated or homogeneously contaminated radiological material that is clearly above criteria.

Two cost analysis alternatives were evaluated. It was assumed that the cost of excavation and disposal of clean construction debris is equal in both cases, so these costs are excluded from the analysis.

1. Base Case: This is defined as the "excavate and disposal" alternative. Under this alternative, standard construction methods are employed to remove radiologically-impacted soil above criteria. The material is brought back to the government property where it is transported and disposed as radiologically-impacted soil.

2. Process Case: The same procedure is followed with respect to excavation. The difference is that the material is run through the GSS/RSS process prior to disposal. An alternative "process case" considered operation of the GSS only.

The unit cost for processing soil is sensitive to the volume of material that is not suitable for processing, the volume of below-criteria soil that is acceptable for onsite reuse, and the construction rate. Unit process costs are minimized when the capital equipment is fully employed. Under-utilization of process capacity exists when there is not a sufficient supply of soil suitable for processing. The Maywood Site has certain soil types that are not suitable for processing. These materials include pond sediments buried throughout the site that account for as much as 75,000 cubic yards (cy) of the total construction volume. As the volume of material that is not suitable for processing increases, construction rates must increase to maintain an optimal feed into the system. The ability to increase construction rates is constrained by property access and budgetary constraints. Finally, unit costs are increased if recovered material is not suitable for reuse onsite. Factors affecting reuse suitability include potential chemical contamination and additional processing cost to achieve required physical characteristics (i.e., permeability).

Assuming the highest experienced recovery from the RSS, favorable cost performance of the GSS-RSS process scenario is only achieved when all recovered material is suitable for onsite reuse and the percentage of unsuitable material is less than 50%. Cost performance improves as construction rates increase, however, the ability to achieve these rates is problematic due to the conflicts with ongoing commercial business enterprises. Stockpiling material onsite for intermittent process operations is not considered possible due to physical and operational constraints of the site and public agreements that limit the size of onsite stockpiles.

Given questionable performance of the RSS with the Maywood Site soil conditions, a GSS-only process option was considered. Analysis indicates that the volume of coarse material present in Maywood Site soils is not sufficient to support favorable cost performance over the base case. The Feasibility Study estimates the total volume of processible soil at 66,583 cy. Based on a 15% coarse fraction recovery over the entire project, the recoverable volume is approximately 10,000 cy.

Neither the RSS nor the GSS is recommended for use at the Maywood Site. The RSS was not able to reliably process Maywood Site soils. The degree of soil mixing and false acceptance errors limits the acceptability of this technology at the Maywood Site. The GSS-only process is not recommended due operational and logistical constraints that limit the ability for cost effective implementation.

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1.0 INTRODUCTION

This report presents the results of a Pilot Demonstration performed by Stone & Webster, Inc. (Stone & Webster) for the United States Army Corps of Engineers (USACE) at the Maywood Interim Storage Site (MISS). This Pilot Demonstration was the culmination of efforts to evaluate the benefit of implementing soil volume reduction technologies at the FUSRAP Maywood Superfund Site (FMSS), shown on **Figure 1**. Initial analyses performed at the site indicated that volume reduction of radiologically contaminated material was viable and that this reduction could result in cost savings during remediation. It could also provide several ancillary benefits, including mitigation of community impacts and reduction of material transport and disposal costs. The purpose of the Pilot Demonstration was to validate and quantify these potential benefits.

1.1 BACKGROUND

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) establishes preferences that remedial actions utilize alternative treatment technologies to the maximum extent practicable in providing permanent and significant reduction of toxicity, mobility and volume of hazardous substances, pollutants or contaminants (U.S. Congress 42USC9621, 2000). Additionally, the National Oil and Hazardous Substances Contingency Plan (NCP) mandates that an assessment be performed to determine the extent to which the remedy employs recycling or treatment to reduce toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants (USEPA 40CFR300.430, 2001). Pursuant to these regulations, the evaluation of waste volume reduction has been a stated objective of the FMSS since the project was initiated. In support of the volume reduction initiative, soil processing technology alternatives were identified for evaluation in a soil processing demonstration project.

A portion of the FMSS is located on the former site of the Maywood Chemical Works in Maywood, New Jersey. The chemical works manufactured a variety of industrial products, some of which involved the processing of thorium and lithium compounds. Historical records of the chemical works suggest that wetlands on the western portion of the property were filled, as needed, to support facility expansion. Additionally, retention ponds were constructed on the western end of the property in order to stabilize and store residual waste slurries and unrecoverable wastes from the manufacturing processes.

Previous remedial investigations and characterizations of the FMSS during the 1980s and early 1990s have shown that the property soils are contaminated with radioactive material, primarily in the form of thorium-232 (Th-232), radium-226 (Ra-226), and uranium-238 (U-238), as well as various other non-radiological contaminants. Remediation will necessitate the identification, removal, transport, and disposal of contaminated surface and subsurface soils.

Given the radioactive materials present at the FMSS, a limited number of options are available for reducing the volume of soil disposed of as radiologically contaminated material. The most suitable options are physical separation techniques. By employing a soil processing technology that can separate soil that is radiologically below criteria from soil that is above criteria, remediation costs may be reduced through more efficient soil management. For this Pilot Demonstration, soil management relates to such aspects as soil excavation, transport, processing, staging, and ultimate disposal. Soil management can result in the creation of several streams, each with different handling requirements ranging from offsite disposal to reuse at the FMSS.

In the later part of the 1990s, further characterizations and treatability studies were performed on the soils of the FMSS. The intent of these investigations was to identify soil groupings throughout the site and determine if particle-size separation techniques would be effective in separating the excavated volume of material into contaminated and non-contaminated fractions. Information from geologic borings from site characterizations completed during the 1980s and late 1990s was used to support these characterizations and treatability studies.

The treatability studies evaluated costs for implementing soil separation technologies at the FMSS. Essentially, the treatability studies were performed in two parts.

1. Characterization of the FMSS soils
2. Development of a conceptual flowsheet, or process simulation, for a production-scale soil treatment plant

The conceptual flowsheet used mathematical modeling of the results of the site characterizations to assess the feasibility of selected separation technologies in providing volume reduction of the contaminated fractions. Results from the soil treatability studies concluded that significant cost savings might be realized by combining soil processing and reuse of below criteria soil at the FMSS; and that a further assessment of soil processing technologies and potential application at the FMSS was warranted.

An evaluation of processing options required an identification of appropriate technologies for the FMSS specific soil groups and an economic evaluation of each. The effectiveness of the system types being considered relies on specific characteristics of the feed soil. The two principal characteristics are grain size and contaminant distribution. Both characteristics can be measured with relative ease, and reasonable estimates of the potential success of the processing systems can be made. A technology evaluation was performed in early 1999 to assess the viability of implementing physical separation technologies at the FMSS. The technology evaluation is summarized in the following section.

1.1.1 Technology Evaluation

The technology evaluation served to identify systems within three categories of soil processing technologies.

1. Gravel separation
2. Radiological soil sorting
3. Soil washing

Vendors provided system information in response to a questionnaire. Vendor information was evaluated and each system numerically ranked using a set of evaluation criteria and weighting factors that were relevant and appropriate to the assessment and reflective of the following criteria:

- Efficacy
- Safety
- Environmental
- Schedule
- Cost

The gravel separation operation is basically a coarse screening system to remove material greater than 6 inches in nominal diameter, followed by a vibrating screen that removes soil particles greater than 3/8 inch in nominal diameter. The removed greater than 3/8-inch material is then rinsed in a closed system.

Radiological soil sorting is a process that continuously assays a soil stream and directs soil that exceeds a selected threshold activity level to an above criteria stockpile. The remaining soil with radioactivity less than the selected threshold value is directed to a below criteria stockpile. Radiological sorting is most effective when the contamination is not homogeneously distributed in the soil mass. That is, there is a significant variation in the activity level within the soil being processed, some above criteria and some below.

Soil washing is a water-based process for scrubbing soils ex-situ to remove contaminants. The process removes radioactive contaminants from soils, or reduces the volume of contaminated soil, through particle size separation, gravity separation, and attrition scrubbing. The concept of reducing soil contamination through the use of particle size separation is based on the finding that contaminants of concern originate as smaller particles. Washing processes that separate the fine (i.e., small) clay and silt particles from the coarser sand and gravel soil particles effectively separate and concentrate the contaminants into a smaller volume of soil that can be further treated or disposed.

As part of this evaluation, an economic assessment was prepared that compared the total remediation cost for the site utilizing a variety of technologies. Due to the uncertainties in some key variables, including the fraction of material below cleanup criteria and soil grain sizes, a parametric study was performed to examine the potential cost savings for a range of values for these parameters. The results of the parametric study indicated that the economic benefits of performing volume reduction on the FMSS soils were viable for the anticipated remedial action. The data available during the technology evaluation process were insufficient to select a specific technology or technologies for pilot testing. Therefore, a limited test pit program, summarized below, was implemented in order to design a site-specific Pilot Demonstration.

1.1.2 Engineering Test Pit Program

In August of 1999, an engineering test pit program was performed to gather more detailed information on subsurface soils (USACE, 1999c). The objective of the engineering test pit program was to provide an engineering correlation between data from the test pits and previous data that was generated from soil borings. Specifically, the test pit program was used to:

- Verify the data contained in the boring logs for the site
- Provide additional information on grain size distribution across the site
- Identify the activity distribution associated with grain size
- Provide information on the heterogeneity of radiological contamination
- Provide information to facilitate system selection and sequencing
- Identify appropriate areas for soil acquisition representative of conditions likely to be encountered during full scale operation

Findings from this test pit program concluded that the majority of the contamination was associated with the less than 3/8-inch. The soils at the portion of the site that was evaluated could generally be divided into the following zones: overburden, retention pond, surrounding, and lower. The coarse fraction was found to be associated primarily with the overburden and surrounding soil and on average accounted for 15% of the material by weight. The lower zone soils (below the retention pond level) generally appeared to be both radiologically and chemically uncontaminated. The distribution of radiological contamination at the MISS showed a high degree of heterogeneity as supported by historical data and confirmed by the test pit data.

Information collected during the test pit program revealed that the use of soil processing and separation was a viable option for the site. Additionally, the degree of heterogeneity of radiological contamination enhanced the potential benefits of the soil separation process.

In addition, the engineering test pit program found that chemical contamination existing at the site had the potential for exceeding certain cleanup criteria. While the chemical contaminants would not affect the pilot plant's process, they may have an effect on possible soil reuse or offsite disposal options. Therefore, in situ material was sampled for chemical contaminants prior to excavation for the Pilot Demonstration to characterize the material to be processed. Material processed during the Pilot Demonstration was sampled to determine if chemical contaminants were being concentrated in the resultant process streams.

1.1.3 Pilot Demonstration

Based on the results of the technology evaluation and the test pit program, a Pilot Demonstration consisting of two technologies was recommended.

1. A dry gravel separation with an associated rinse unit
2. A radiological sorting system

The engineering test pit program found substantial quantities of non-radiologically contaminated material greater than 3/8 inch in diameter, supporting gravel separation. An underlying premise of the Pilot Demonstration based on these soil analytical results was that the material above the selected radiological criteria was limited to soil particles less than 3/8 inch in diameter. A dry gravel separation system was selected to minimize water usage and to simplify the management of the process waste streams. The test pit program also confirmed that in situ contaminant distribution supported proposing radiological sorting for the Pilot Demonstration.

The Pilot Demonstration focused on determining the effectiveness of the two technologies in separating excavated material into components above and below selected radiological criteria. The operating performance of the Pilot Demonstration System was also used to evaluate potential cost benefits of the technology. The demonstration was conducted such that all required system operational and soil contaminant data were collected to evaluate the systems' performance and reasonably project and establish full-scale system design / performance economics.

1.2 OBJECTIVE

The objective of the Pilot Demonstration was to evaluate the applicability of the gravel separation and radiological sorting technologies to the FMSS soils. Success of this objective will be measured by the effectiveness of the soil processing technologies to:

- Significantly reduce the volume of radiologically contaminated soils requiring off-site disposal
- Provide community benefits relating to reduced waste transport and disposal
- Reduce costs in remediation of the FMSS

1.3 APPROACH

During the operation of the Pilot Demonstration program, the process technologies were evaluated by measuring the radiological contamination, chemical contamination and weight of pre- and post-processed materials. The following determinations were made during the demonstration.

- Characteristics of the soils prior to processing (radiological, chemical, and physical)
- Impacts that excavation and soil handling had on the contaminant distribution in the processed soil and its impact on soil processing
- Radiological characteristics of the separated soil to evaluate how effectively soil processing separated below criteria soil from radiologically contaminated soil
- The effect of soil processing on chemical and physical characteristics of the separated soil
- Evaluation of soil disposal and reuse alternatives
- Evaluation of costs effectiveness of implementing the technologies in a full-scale operation

2.0 EXECUTION OF WORK PLAN

Stone & Webster completed a Pilot Demonstration project to evaluate two technologies

1. Material separation based on grain size
2. Soil sorting based on levels of radiological contamination

The Pilot Demonstration processed approximately 8,000 tons of representative site soil to quantify applicability of these technologies for the full-scale FMSS remedial effort. The systems used, the soil acquisition areas where representative soil samples were obtained, and the data collection process are described separately below. Photographs of the Pilot Demonstration are included in Appendix A.

2.1 SYSTEM DESCRIPTION

2.1.1 Gravel Separation System

A gravel separation system was used as the initial step in the Pilot Demonstration. The gravel separation system consisted of two main groups of components

1. The Gravel Separation System (GSS)
2. The gravel rinse unit

Figure 2 shows the equipment layout of the individual units that comprised the pilot plant. The gravel separation operation used a coarse screening system (grizzly) to separate material greater than 6 inches in nominal diameter, followed by a vibrating screen that separated soil particles greater than 3/8 inch in nominal diameter. After the vibratory action, two streams were formed from the separation.

1. Material greater than 3/8 inch but less than 6 inches
2. Material less than 3/8 inch

The separated material greater than 3/8 inch was then conveyed through a radial conveyor belt to the rinse unit. Within the enclosed rinse unit, the gravel was sprayed with water to remove adhering fine sand and silts. The rinse water passed first through a sedimentation tank to settle out fines, then through a filtration system to remove the remaining fines. The filtered water was then recycled through a fractionation tank back to the rinse system forming a closed system (see **Figure 2**). There were no surfactants or solvents added to the rinse water. Samples were collected of the recycled water and submitted for alpha spectrometry analysis. The alpha spectrometry data are summarized in **Table 1**.

The less than 3/8-inch material stream was directed via a conveyor to a feed hopper for the radiological sorting system. On occasion, this stream was diverted to a less than 3/8-inch material stockpile in order to assess the gravel separation unit's ability to run at full capacity.

2.1.2 Modifications to the Gravel Separation System

Throughout the course of the Pilot Demonstration, field observations revealed that modifications to the GSS and Rinse Unit were necessary in order to accommodate material being processed. The modifications for these systems and the degree of success of each were as follows:

- Altered openings on the grizzly deck from 6-inch squares to 6-inch slots reduced the amount of entanglement caused by geotextile fabric, polysheeting, and liners within the soil. The grizzly's automatic hydraulic lift arm was also modified to allow for a greater than 90 degree tilt angle, which allowed for easier removal of the greater than 6-inch material.
- The top screening deck of the GSS was modified from 1-inch squares to 1-inch slots. This allowed material to pass to the second screen more easily.
- The top screening deck of the rinse system was replaced with a 4-foot by 1/2-inch opening screen, and 1-inch rubber dams were installed to increase the time in which the gravel was in direct contact with the rinse water. This produced a visually cleaner product.
- The orifice on the spray bars of the rinse unit were changed and required continuous adjustment to maximize the quality of the rinse product.
- Due to the characteristics of the material being processed, a higher than designed volume of water was used within the rinse system to remove cohesive silts and clays adhering to the gravel. The filtration unit was initially designed to handle flow rates ranging from 50 gallons per minute (gpm) to 200 gpm water rinse rate. Actual rates, however, ranged from 300 to 500 gpm. These higher rates required that additional pumps be added to the system and entailed the construction of a sedimentation tank to capture the excess fines exiting the rinse unit. However, the construction of the sedimentation tank lacked the proper length to allow appropriate residence time in order for the fines to settle and not overwhelm the filtration system.
- A high pressure blower was added as the final cleaning step after the gravel was rinsed. It helped to remove mud that had formed but was not removed during the rinse process.

2.1.3 Radiological Sorting System

A Radiological Sorting System (RSS) was used as the second system for the Pilot Demonstration. The RSS received the soils processed by the gravel separation system.

Material that was less than 3/8 inch in nominal diameter was fed to the RSS via conveyor from the GSS. The material entered a grizzly with a 1 1/2-inch screen to remove gravel that might not have been removed by the GSS. The material was then spread to a 2-inch thickness and conveyed under two sets of eight Sodium Iodide (NaI) detectors. These were calibrated for detection of Th-232, Ra-226, and U-238. The detectors performed a continuous assay of the material. The detector then signaled the segmented gates, which actuated to divert soil that was below the selected threshold level to a below-criteria stockpile. When soil was above the threshold criteria, the gates remained unactuated and soil fell past the gates and was directed to an above-criteria stockpile. **Figure 3** is a schematic of the process flow through the RSS. Threshold values were varied throughout the Pilot Demonstration to:

1. Test the range of values that potentially could be used as clean-up criteria during the full-scale remediation
2. Test the range of values that potentially could be used as acceptance criteria for alternative off-site disposal

For quality assurance, the Pilot Demonstration included methods for checking for increased background radiation. These included scans on empty conveyors, daily checks / calibrations of the detectors, and confirmatory sampling on output piles. The operation of the RSS is described in the RSS Technology Description presented in Appendix B.

2.2 SOIL ACQUISITION AND EXCAVATION

A key component of the Pilot Demonstration project was the identification of an area from which soil representative of the entire FMSS could be excavated. After review of the available data, Stone & Webster selected the area west of Building 76, as shown on **Figure 4**. Existing records showed that the area west of Building 76 on the MISS property had soil that was contaminated with radioactive materials, and that the contamination was not evenly distributed through the soil mass. This area also contained fine grained lagoon sediments, and granular "overburden" and "surrounding" soil as defined in the report entitled *Results of 1999 Engineering Test Pits Program at MISS*. Contamination in the soil west of Building 76 was generally shallow and accessible without having to remove large quantities of "clean" overburden. The area consisted of gravel, sandy-silt, and silty-sand. This area was identified as the Soil Acquisition Area (SAA).

The dimensions of the planned excavation were approximately 190 by 165 feet at the ground surface, excavated to 6 feet in depth with a 1.5(H) to 1(V) slope at all sides. The excavation began about 65 feet west of Building 76, along the northern boundary of the SAA, and projected about 40 feet into Retention Pond A. The surface area excavated was partitioned into two areas identified as Stages I and II. Based on previously collected data, the Stage I excavation area was thought to be predominantly granular soils while the Stage II excavation area represented the retention pond sediment covered with granular overburden.

During excavation activities, observations of the conditions of the SAA were noted. Modifications to the original excavation plan were put into effect due to, such things as, abandoned building foundations, discovery of a drum of unknown contents, and difficulty in processing pond material through the systems. These are discussed further in Section 3.0.

2.3 DATA COLLECTION

Prior to excavation activities, a grid system was established within the entire SAA. Each grid was 5 by 5 feet and varied in depth depending on the material to be processed on a specific day. The grid system was established to aid in the designation and tracking of soils during excavation and processing. The surface of the soil to be excavated was scanned using a linked NaI-Global Positioning System (GPS) (See Appendix C – NaI-GPS Walkover Surveys). Areas of soil were referenced to the grid to locate and document radiological contamination. The radiological contamination mapped by the linked NaI-GPS was used to guide the excavation. The grid system was used to select the soil to be processed. The volume of soil processed was known as either a “batch” or a “slug” (see Appendix D for a description of the “slug” and “batch” processing concept). A batch of soil was processed through the system and results were used to assess the systems under full-production efforts. The batches were defined prior to excavation, and fulfilled the characteristics of one of the following scenarios:

1. Granular material to be processed through the gravel separation system only
2. Granular material with radiological activity near the cleanup level
3. Granular material with radiological activity near the offsite disposal facility acceptance criteria
4. Retention pond material with radiological activity near the cleanup level
5. Retention pond material with radiological activity near the offsite disposal facility acceptance criteria
6. Material that is above the cleanup criteria (i.e., hot spot)

7. Material that is below the cleanup criteria (i.e., below criteria)
8. Material that is a combination of both above and below criteria
9. Retention pond material to be processed through the gravel separation system only
10. Retention pond material processed through the soil sorting system only (not included in the original work plan)

Once a batch was designated, a smaller subset of the batch, known as a “slug” was selected. This smaller, more manageable quantity of soil was used to track activity and weight to compare pre-processing radiological measurements with those of the separated stockpiles at the conclusion of the processing. The slug data was used to evaluate mixing / dilution of soil contamination resulting from excavation, handling and processing. Section 4.4.1 evaluates slug activity tracking. The slug was not intended to represent the batch and a slug was not designated for every batch.

Throughout the course of the Pilot Demonstration, substantial sampling of both the slug and batch was performed. Approximately 13 slugs and 40 batches were chosen for processing through the gravel separation and rinse unit, and the soil sorting system. Sampling frequencies were dependent on the volume of soil being processed. Refer to **Tables 2** and **3** for sampling frequencies and sequence. The frequency of sampling increased during slug processing to gather sufficient quantities of detailed data to evaluate the mixing / dilution effects caused by soils handling.

A slug consisted of 9, 5 by 5-foot grids that were established within the soil acquisition area. Depths of excavation within this grid varied throughout the Pilot Demonstration field activities, and are explained further in Section 3.4. In order to locate an appropriate sampling location within each slug, a NaI-GPS walkover was repeated for each grid (refer to Appendix E). An average count rate for each grid was determined, and a grab sample was collected at that location to represent that grid. The sample was sieved to less than 3/8-inch material and then sent to the onsite laboratory for gamma spectroscopy analysis. Supplementary QA/QC samples were also collected and sent off-site. After a sample for each grid was collected, the slug was then excavated and stockpiled for processing. Samples were collected from three locations during the processing of the slug. The first location was the less than 3/8-inch material at the output of the GSS / input to the RSS. The second and third locations were the below and above criteria conveyors at the discharge of the RSS. The samples were collected at 10-minute intervals at each of the three locations in order to represent the total volume of the slug being processed. Each sample collected for this process was treated as a discrete sample and each was analyzed individually.

After the slug processing was complete, the associated batch was then excavated and stockpiled. The batch was used to simulate full-production level efforts. Batch sampling data was primarily used to evaluate the effectiveness of the processing systems and determine options for final disposition of the processed materials. Samples were also analyzed to determine if chemical contaminants became concentrated in the individual process streams (see Section 5.3). Samples were collected at varying points during processing. An initial sample was collected from each stream at the 1 cubic yard (cy) mark and then every 50 cy thereafter. The process streams consisted of:

- Greater than 6-inch material
- 3/8- to 6-inch material
- Less than 3/8-inch material

The less than 3/8-inch process stream was assayed by the radiological sorting system and directed into the above or below criteria stockpiles. The sorting criteria were varied during the Pilot Demonstration to evaluate performance at a range of likely clean-up criteria. Samples collected from these varying streams were analyzed for both chemical and radiological parameters. See Appendix F for chemical and radiological lab results. Supplementary QA/QC samples were also collected and submitted for analysis. In addition, some samples were collected between the gravel and the rinse system and associated water recycling system to evaluate the applicability of the rinse unit in cleaning of the gravel. Note that the diameter of gravel sampled at this location and post rinse was limited to sample container size. Refer to Section 4.1.2 for evaluation of the rinse system. These samples were analyzed by gamma spectroscopy only.

During the course of the Pilot Demonstration, the physical characteristics of the material processed were also evaluated. Such aspects as grain size, moisture content of pond material, and debris within the soil were observed and are discussed in later sections of this report.

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3.0 DEVIATIONS FROM THE WORK PLAN

The work plan for the Pilot Demonstration was prepared using the information available. Field conditions encountered during the Pilot Demonstration were, in several instances, different from conditions that were anticipated in the work plan. These changed conditions required field modifications to the work plan. The changed conditions and the modifications to the work plan are described separately below, and project records have been updated accordingly.

3.1 POND MATERIAL

There was an attempt to process pond material using both the GSS and RSS. The pond material contained a moisture content greater than 40%, and an initial attempt to process the material was unsuccessful. High moisture content caused the screens in the GSS to clog and interfered with RSS operation. This, in turn, limited the ability to analyze the RSS effectiveness on segregating pond material. This material was therefore not processed for the remainder of the Pilot Demonstration. The Pilot Demonstration determined that in its current state, pond material could not be processed through either the GSS or the RSS.

During field activities test pits within the SAA indicated pond depths in excess of 14 feet below ground surface (bgs). This contributed to the abandonment of excavation activities of this material due to greater volumes than originally anticipated.

3.2 MODIFICATIONS TO EXCAVATION PLAN

Since pond material could not be processed and reached depths in excess of 14 feet bgs, excavation of pond material was abandoned.

Remnants of a concrete foundation were exposed during excavation activities within the SAA. To demolish and remove the foundation, specialized equipment beyond the scope of the Pilot Demonstration would have been required.

During excavation activities in Stage II of the SAA, a drum with unknown contents was discovered. Work in this portion of the SAA was stopped and excavation in the area was abandoned.

3.3 SCENARIOS

As part of daily soil processing, batches were named after one of nine scenarios described in Section 2.3 of this report. During the Pilot Demonstration, field conditions revealed that processing of soil for all ten scenarios could not be achieved. Scenarios 4, 5, 9, and 10 were eliminated due to difficulty experienced in processing the pond material.

The final cleanup criteria and disposal criteria were not known during the field activities. As a result, the threshold criteria for the RSS unit were varied between potential cleanup levels and possible alternative off-site disposal scenarios to enable direct evaluation of the system when the final cleanup level was ultimately selected.

3.4 EXCAVATION CUTS

It was difficult to maintain the heterogeneity in the excavated material when strictly utilizing a 1-foot cut. The equipment used to excavate the soil (backhoe) tended to mix the excavated material rather than "scoop" the soil when the cuts were shallow. Based on this observation, the excavation approach was modified from 1-foot to 3-foot deep cuts to accommodate the equipment and help maintain heterogeneity in the material.

3.5 SEQUENCED BATCH

The Pilot Demonstration Work Plan identified two methods of feeding the soil processing units(s): batch and slug. Descriptions of slug and batch excavations are also presented in Section 2.3. During the demonstration, a third method of feeding the soil processing unit(s) was developed and implemented. This method was named a Sequenced Batch based on the associated excavation, stockpiling, and the sampling applied.

3.5.1 Background

Several observations were made during the field operations suggesting that modification to the excavation methods being employed at the SAA would give additional insight and performance improvement to the pilot system. During normal batch operations, soil excavated from the SAA would be placed in a feed stockpile. Multiple truckloads of soil were incorporated in the stockpile making differentiation of the individual truckloads impossible. A 6-cy bucket loader was used to convey soil from the feed stockpile to the gravel separation feed hopper. The bucket loader would, at times, obtain soil from the same point in the stockpile that the trucks were dumping. The additional handling and mixing of individual loads of the excavated soil and the "dressing up" of the stockpile by the equipment operator resulted in additional loss of soil contaminant heterogeneity. The loss of heterogeneity reduced the effectiveness of the RSS, which operates more effectively when heterogeneity is preserved (refer to Section 4.1.3, Radiological Sorting System).

3.5.2 Description of Sequenced Batch

In response to these observations, a Sequenced Batch method of excavation and handling was developed in the field. The new method changed primarily the way the soil was staged (stockpiled) in the operations area and minimized the extra handling of the excavated soil. The Sequenced Batch excavation and material handling procedure was specifically designed to persevere the heterogeneity of the soil from the SAA to the extent possible. Appendix G represents sequenced batch coordinates and walkover surveys. During soil acquisition, soil was systematically excavated in bucket-wide strips from one side of the excavation to the other. For example, if the excavation called for a 3-foot deep cut, the excavator made a 3-foot cut and advanced the grade by making a series of strip cuts across the proposed excavation area. Each bucket was placed into the truck upon excavation. Each truck, when filled, was sent to the operation pad and dumped to form a discrete pile. The identity of each pile was maintained by directing each truck to dump in a designated location. When sufficient soil had been stockpiled, soil processing was initiated. Soil was fed to the soil processing units from each single dump stockpile in the same sequence it was dumped (first in, first out). As a stockpile area was processed, a new load was dumped. The first in, first out dump / load sequence was continued to the completion of the sequenced batch.

3.5.3 Observations

The excavation and handling of the soil using the sequenced batch method resulted in two observations that demonstrated the advantage and applicability of the method.

1. The sequenced batch method resulted in minimizing the blending of the soil and the homogenization of the batch soil. This reduced blending was intended to enhance the performance of the RSS by maintaining soil contaminant heterogeneity. During the sequenced batch operation, radiological sorting was anticipated to correlate well with the results obtained during the NaI-GPS walkover. However, this anticipated correlation was not in fact evident. The weak correlation between walkover survey results and RSS performance may be attributed to both, either from adjacent radioactive soils not included in the batch, shielding of buried soils by relatively less contaminated material, or both.
2. The excavation and special stockpiling maneuvers did not substantially lower the rate of the excavation. Continuous excavation was maintained by cycling two trucks between the operations area and the soil acquisition excavation. The sequenced batch method of excavation could be easily adapted to full-scale operations. The stockpile footprint, though larger than what would be needed if more standard stockpiling techniques were employed, would not be excessively restrictive.

3.6 SAMPLING DEVIATIONS

Deviations from the Sampling and Analysis Plan (SAP) (Volume 4 of the Work Plan) were executed due to changes in field conditions. The following stockpiles (see SAP, **Figure 2**) were not sampled as initially intended in the SAP:

- Stockpile B: Retention pond material was not processed or excavated as described previously; therefore, sampling was not conducted
- Stockpile I: Filter cake material was not produced by the rinse unit's filtration system as expected; therefore, sampling was not necessary
- Stockpile K: No material was excavated that was not processed through the Pilot Demonstration system; therefore, this stockpile was eliminated from the sampling sequence

3.7 STAGE III ACTIVITIES

Within the Pilot Demonstration Work Plan, Stone & Webster states that Stage III activities will be completed once sufficient data were collected to adequately evaluate the performance of the soil processing systems. These activities may have included testing of various screening techniques, testing of throughput limits of soil management systems, compaction method testing, implementation of the MARSSIM Final Status Survey Methodology, and evaluation of techniques for surface water control and management. Stage III activities were not completed due to the extent and depth of contamination, and due to unexpected pond sediments and other obstructions encountered during excavation activities that required portions of the SAA to be abandoned.

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4.0 PROCESSING PERFORMANCE DATA

4.1 PROCESSING SYSTEM COMPONENTS

The processing system was composed of two principal subsystems: the GSS and the RSS. The GSS performed physical size segregation, removing first rock and debris with a diameter of 6 inches or more with a passive coarse screen (grizzly) followed by removal of 3/8 to 6-inch fraction using a set of two graded vibratory screens. A rinse unit, which was comprised of a rinse system and associated water recycling system, was also provided to determine the effectiveness of gravel rinsing to remove adhered fines from the 3/8- to 6-inch fraction. The less than 3/8-inch size fraction was then conveyed to the RSS for radiological separation. Each of these system components was evaluated during the Pilot Demonstration. **Figure 2** shows the locations of equipment and various stockpiles discussed below. **Figure 3** shows the process flow through the system.

4.1.1 Gravel Separation System

The GSS consisted of a passive 6-inch grizzly and a 2-stage vibratory screening plant. Raw excavated soil was transported to the feed stockpile (Stockpile C, **Figure 2**) from the SAA. Stockpiled soil was then passed through the grizzly using a front-end loader. Material greater than 6 inches was selectively rejected by the grizzly. This oversize material was periodically collected using a front-end loader and placed in a segregated storage pile (Stockpile E, **Figure 2**).

Material less than 6 inches was transported by a conveyor belt to the two-stage vibratory screening plant, where material greater than 3/8 inch was retained and material less than 3/8 inch passed through the screen and was conveyed to the RSS. The 3/8 to 6-inch material from this process was transported by a conveyor belt either to the gravel rinse unit or to a stockpile (Stockpile J, **Figure 2**). Based on previous information, the GSS was expected to remove 15% of processed material as 3/8 to 6 inches. However, their removal rate varied from 17.4 to 47.8% for the course of the field program, with a total average removal rate of 32%. **Table 4** reports removal percentages on a batch basis. (Field measurements were made on a weight basis. The bulk density for gravel and soil was assumed equal in the analysis.)

Production rates for the GSS ranged from a minimum of 2.64 tons/hour to a maximum of 160.84 tons/hour. The average production rate for the course of the field program was 37.83 tons/hour. Rates were calculated by dividing the weight of material processed that day (in tons) by the "working hours" for that day. Such things as breaks, morning meetings, and weather related issues were subtracted from the scheduled 10-hour workday to determine the "working hours". Low production rates were not due to lack of available feed stock or GSS limitations. Under full-scale operating conditions, the GSS would be expected to operate at or near the observed maximum throughput rate, or approximately 150 tons/hour. **Table 5** summarizes production rates on a daily basis for the course of the Pilot Demonstration.

4.1.2 Rinse Unit

The rinse unit, which was comprised of a rinse system and associated water recycling system, was provided as an integral part of the GSS. Oversize material from the vibratory screens was passed through the rinse unit. The rinse system consisted of a deck of three graded static screens with integral rinse bars to continuously spray water over the gravel as it passed through the system. Washed gravel was conveyed to Stockpile J (**Figure 2**). Water and entrained fines flowed first to a sump, then a sedimentation tank, and finally through a filtration system. Filtered water was collected in a fractionation tank and sent back to the rinse water supply tank to maintain a closed system. The fines that were periodically recovered from the sump were disposed of at the load out area with the processed material.

4.1.3 Radiological Sorting System

The RSS is a transportable gamma radiation detection system designed to sort soil based upon measured activity level. It consists of a motorized conveyor belt, which passes a uniform geometry of soil beneath two banks of NaI detectors. The detectors assay the soil to determine the activity level and send the information to an integrated computer. The computer processes the information to determine what portion of the soil is below the pre-set criteria, and sends instructions to air actuated gates at the end of the conveyor to actuate and catch below-criteria soil as it falls from the conveyor. Material caught by the gates is conveyed to a below-criteria stockpile. The remainder of the soil falls past the gates and is conveyed to an above-criteria pile.

The sorting conveyor, detector arrays, segmented gates, and all downstream conveyors and subsystems were controlled through the computer, which was located in a mobile van near the RSS (see **Figure 2**).

4.1.3.1 Material Flow

Soil material less than 3/8 inch was transported from the GSS by conveyor belt to a surge hopper. From there, the material was fed onto another conveyor belt, through a leveling gate, and then into the RSS. The RSS was set to discriminate between soil containing activity levels greater than and less than set criteria values. Material that was above the set criteria values was diverted and carried via conveyor to a contaminated soil stockpile on one side of the unit (Stockpile G). Material that was below the set criteria values was carried via conveyor to a clean soil stockpile (Stockpile H) on the opposite side of the unit.

Production rates for the RSS ranged from a minimum of 1.16 tons/hour to a maximum of 25.26 tons/hour. The average production rate for the course of the field program was 14.56 tons/hour. **Table 6** summarizes production rates on a daily basis for the course of the Pilot Demonstration.

4.1.3.2 Theory of Operation

The computer made soil-processing decisions based on parameters entered by the operator. Soil greater than the selected criteria values fall onto a conveyor to a “contaminated pile.” Soil that is less than the selected criteria values was sent through “gates” that funnel the clean soil to a different conveyor, and ultimately to a clean soil pile.

The RSS was setup for the Pilot Demonstration to use reject criteria values for both the individual segments seen by each detector, and for groups of 80 segments. The system used the two sets of reject criteria logic. Segments of material that are clearly much higher than the setpoint are sent to the contaminated material pile. The segments of material remaining are analyzed as an RSS batch, allowing for better counting statistics. System logic is discussed further in Appendix B.

The RSS as used at Maywood used two arrays of eight NaI detectors each. Windows are set in each NaI detector to look at total counts due to gamma interactions with the detectors for a given energy range. **Table 7** gives array specific detector information used, set up for the Pilot Demonstration. Note that although Array 1 detects gamma radiation from Ra-226 and Th-232, the RSS did not distinguish between these radionuclides. All of the counts detected in Array 1 energy window were treated as Th-232, the more abundant of the radionuclides of concern.

Detection and quantitation of U-238 is performed by a different array of detectors from those used for Ra-226 and Th-232. Operation of these detector arrays is also discussed in Appendix B. The output from the U-238 detectors is processed through a compensation software routine to eliminate the contribution of Ra-226 and Th-232 gamma radiation. The uranium compensation software originally did not compensate adequately for Ra-226 and Th-232 in the soil. The RSS calculated an artificially elevated U-238 activity, resulting in rejecting soil for elevated U-238 that was in fact well below the acceptance criteria for all contaminants of concern (COCs).

The uranium compensation software was disabled after August 18, 2000 pending software revisions. The Pilot Demonstration proceeded since radiological analysis of the Pilot Demonstration soils showed that U-238 activities were very much lower than the rejection criterion for this isotope. Analytical results confirmed that no material passing the radium+thorium criteria would have been rejected by a properly operating uranium detection and quantitation program.

On October 17, 2000, a revised compensation program was installed. The limited data collected after October 17, 2000 indicates that U-238 was still frequently over-quantified. Some slugs and batches run after this date may have been adversely affected by the inability of the RSS to accurately quantify the U-238 activity.

A dependable radium+thorium compensation program was not available during the course of the Pilot Demonstration. Consequently, no evaluation of the RSS to separately detect and quantify U-238 in the presence of other radionuclides could be performed.

4.1.3.3 Performance Capability

The RSS has been evaluated and used at a number of sites, including three that were contaminated with depleted uranium and / or natural uranium. Prior experience with the RSS indicated that:

- Moisture content of soil samples should be less than 20%
- Extensive pre-deployment site characterization is beneficial
- The soil contaminant should be heterogeneously distributed
- The method of excavation is essential to success i.e., to avoid soil mixing

The Lower Limit of Detection (LLD) of an instrument determines the ability of the instrument to detect levels of radiation above background. The LLDs for the RSS used for the Pilot Demonstration were determined using uncontaminated material as described in Appendix B. The measured LLDs were calculated at the less than or equal to 5% error acceptance criteria for false positive and false negative results. LLDs for the Pilot Demonstration RSS are presented in **Table 8**.

The LLD values given were determined based on background counts using clean backfill soil. As discussed in Appendix B, the RSS did not separately quantify Th-232 and Ra-226. All counts in detector Array 1 (**Table 7**) were treated by the RSS as arising from Th-232. The RSS results were reported as Ra-226 + Th-232.

4.2 INITIAL SOIL CHARACTERIZATION

4.2.1 Sampling and Analysis

4.2.1.1 Background

Soil from backfill at an off-site location was chosen to characterize background for the Pilot Demonstration. Two aliquots of a single grab sample were analyzed at the off-site laboratory. The measured values appear to be in the range expected for naturally occurring levels of these radionuclides.

The same soil was used to determine background levels and LLDs for the RSS unit as described in Appendix B. Laboratory and RSS background values are presented in **Table 9**.

4.2.1.2 Particle Size Analysis

Grab samples of less than 3/8-inch material were obtained from the RSS unit feed belt on four separate dates, September 14, October 2, October 6, and October 27, 2000, during normal operating activities. These samples were submitted to an off-site testing facility for grain size analysis. The individual size fractions recovered during grain size analysis were subsequently analyzed by alpha spectroscopy to determine the distribution of radioactive material with regard to particle size fraction for material greater than 200 mesh.

The result of the grain size analysis is presented in Appendix H. The result of the radiological analysis of the individual size fractions is presented in **Table 10**.

All of the four samples showed a general tendency for elevated radioactivity in the finer size fractions. In all four cases, the highest radioactivity in a size fraction was found in the #100 to #200 mesh fraction, with radioactivity generally declining with increasing size fraction. This supports the results of the test pit investigation that radioactivity is concentrated in the finer fractions on the site, supporting particle size separation as a useful technique for reducing the volume of material containing elevated radioactivity.

4.2.1.3 Slug Characterization

Each designated slug was sampled prior to excavation and processing (Appendix E). Slugs were divided into 9, 5 by 5-foot grids, each of which was sampled, providing 9 grab in situ samples per slug. The grab samples were screened to separate the less than 3/8-inch fraction. The less than 3/8-inch material was then analyzed separately for radionuclide content by gamma spectroscopy using the onsite radiological laboratory. One of the slugs, designated the “onsite slug,” was obtained from an existing stockpile of excavated soil. The material from this slug was sampled as nine separate grab samples, as described previously. However, the SAA grid system was not used for locating or designating the grab samples since this material did not originate from the SAA.

Another slug, designated the “engineered slug,” was manufactured by layering approximately equal volumes of rock dust and contaminated soil that had been previously processed through the system. The engineered slug was stockpiled first by placing the processed material (obtained from the above criteria stockpile from the previous run) onto the Stockpile C feed stock area (see **Figure 2**). Approximately an equal volume of rock dust was then placed on top of the processed material in the feed stock area. The total volume of the engineered slug was then treated in the same manner as all other slugs. This slug was characterized by analyzing three grab samples of each component prior to stockpiling.

The results of the slug characterization are presented in **Tables 11a – 11m**.

4.2.2 Field Measurements

Field measurements of radioactivity were conducted throughout the SAA as excavation activities proceeded. The results of these walkover surveys are presented in Appendix C. These surface radioactivity measurements were used to help select the boundaries of individual batches and assign the scenario to which they belonged.

In addition to the walkover surveys of the SAA, the individual slugs were surveyed in detail prior to excavation, and the observed counts recorded for each 5 by 5-foot grid. This information is presented in Appendix E.

4.3 GRAVEL SEPARATION

4.3.1 Quantities

The quantity of material removed by the GSS was determined for both batches and slugs. This information is presented in **Tables 12** and **13**. The total quantity of greater than 6-inch material was 2.46% by weight, including both slug and batch data. The total quantity of 3/8 to 6-inch material was 31.85% by weight.

4.3.2 Radiological Characteristics

The 3/8-inch to 6-inch material generated during batch processing was routinely sampled and analyzed for radioisotopes of concern. These analytical results are presented in **Table 14**. Analytical results presented in the table are total radionuclide activities not adjusted for background. The oversize material was generally lower in measured radioactivity than the associated fines from each batch that was analyzed. The oversize material had an average Th-232 activity of 5.60 pCi/g, with an average Ra-226 of 1.52 pCi/g and U-238 of 2.81 pCi/g. The highest activity associated with the oversize material was 24.4 pCi/g Th-232 found in Sequence Batch #5. The highest observed Ra-226 and U-238 activity was 5.12 pCi/g and 9.48 pCi/g, respectively, in Batch #13 1-5. Based on the results of tests conducted using the rinse unit discussed in Section 5.3.3, much of the radioactivity, particularly the Th-232 component, is contributed by the residual fines adhering to the oversize material.

The measured radiological properties of the oversize material are not strictly representative. The oversize fraction contains individual particles up to 6 inches in diameter. Radiological analysis by gamma spectroscopy could not accommodate individual particles greater than about 1.5 inches in diameter. As a result, the reported radioactivity associated with the oversize material is artificially elevated by an indeterminate amount.

The rinse unit was not generally used during the Pilot Demonstration. The fines generated by the rinsing operation quickly clogged the filtration system. The fines were of smaller size and in greater quantity than anticipated. Consequently, relatively little data was generated on the radiological characteristics of oversize material (greater than 3/8 to 6-inches) before and after rinsing.

Data were gathered for five tests of the rinse unit using both fresh water and recycled water for the rinse. Substantial reductions of radioactivity were achieved, particularly for Th-232. Absolute activities of Ra-226 and U-238 were, on average, lower than Th-232 activities in the oversize material prior to processing through the rinse unit. Changes in Ra-226 and U-238 were less pronounced than those for Th-232 following rinsing. The results of radiological analysis of oversize material before and after rinsing are found in **Table 15**.

4.4 RADIOLOGICAL SORTING

The RSS was operated for both slug and batch testing. The results of each type of test are presented in the following sections.

4.4.1 Slug Tests

Slug tests were run on 11 well-characterized slugs of soil from the SAA. Two additional slugs originated on the MISS from previously excavated and stockpiled material. Therefore, a total of 13 slugs were processed during the Pilot Demonstration. The first slug, the “onsite slug,” was processed on August 17, 2000. The final slug, 6-3, was processed on October 20, 2000.

Each slug was analyzed for radioactivity prior to processing. Samples of the feed material (less than 3/8-inch) to the RSS were obtained prior to processing, as were samples of the below-criteria and above-criteria material after sorting. These results were compared with the in situ grab sample analytical results, obtained prior to excavation, and to the measurements recorded the RSS instrumentation array to determine the effectiveness of the RSS. The analytical results from the slug tests can be found in **Tables 11** and **16**. Slug test laboratory radioisotope activities included native background contributors estimated as presented in **Table 9**. The RSS operated using background subtraction techniques as described in Appendix B.

A variety of setpoints for radium+thorium were used to evaluate the performance of the RSS at several different radiological criteria. Radium+thorium setpoints of 5, 10, 15, and 24 pCi/g were used during slug processing. Eight slugs were processed using a 5 pCi/g setpoint for radium+thorium. One slug was run using a setpoint of 10 pCi/g. Two slugs each were processed at 15 and 24 pCi/g.

4.4.1.1 Slug Test, Ra + Th Setpoint of 24 pCi/g

The highest setpoint, 24 pCi/g, was used for slugs 6-2 and 8-3. The material used for slug 6-2 contained radium+thorium uniformly above the setpoint activity based on nine in situ samples taken prior to excavation of the slug. Most of the material (23,400 pounds) was rejected by the sorter as containing radioactivity above the setpoint. Radiological analysis of the rejected material confirmed that it contained radium+thorium in excess of the setpoint. Approximately 1000 pounds of material from slug 6-2 (approximately 4%) was accepted by the RSS. Radiological analysis of soil from the below criteria stockpile showed that it contained radioactivity in excess of the setpoint.

The material used for slug 8-3 also contained radium+thorium approximately equal to the setpoint activity based on nine in situ samples taken prior to excavation of the slug. All of the material was accepted by the sorter as containing radioactivity below the setpoint. Radiological analysis of the accepted material confirmed that it contained radium+thorium below the setpoint.

Based on these observations, the RSS can generally distinguish between uniformly contaminated soils containing radioactivity above and below the setpoint values of 24 pCi/g radium+thorium. A 4% false acceptance rate was observed in one instance. This setpoint value is significantly larger than any cleanup criteria proposed for the Maywood site. Performance of the RSS sorter should be expected to improve with increasing concentrations of uniformly distributed contamination.

4.4.1.2 Slug Test, Ra + Th Setpoint of 15 pCi/g

Two slugs, the “engineered slug” and the “onsite slug”, were processed using a setpoint of (approximately) 15 pCi/g for radium+thorium. The engineered slug consisted of equal volumes of contaminated soil and rock dust (see Section 4.2.1.3). The onsite slug was obtained from a stockpile of previously excavated soil at the Maywood site.

The engineered slug was processed using an exact setpoint of 13.75 pCi/g for radium+thorium. This value was calculated by using half of the setpoint (27.50 pCi/g radium+thorium) that the contaminated soil of the engineered slug was processed during the previous run. Radiological analysis of both the rejected and accepted material indicated that they both contained radionuclides in excess of the Ra+Th setpoint. The activity of the above-criteria pile was significantly higher than the activity of the below-criteria pile, indicating the RSS was distinguishing the slug materials, although not down to the setpoint level.

The onsite slug contained radium+thorium at approximately 12 pCi/g based on nine samples obtained prior to processing. All of the onsite slug was rejected as containing radioactivity in excess of the setpoint. Radiological analysis of the rejected material showed that it did not contain radioactivity in excess of the setpoint. Note that U-238 sorting was enabled for this test, and was disabled for subsequent tests until new software was implemented in October 2000.

The RSS did not efficiently or accurately sort mixed material at 15 pCi/g. Soil contaminated in excess of the setpoint was accepted by the sorter. Also, the sorter is subject to rejecting material that is not contaminated in excess of the setpoint. Performance was not reliable at the 15 pCi/g level of contamination.

4.4.1.3 Slug Test, Ra+Th setpoint of 10 pCi/g

One slug, slug 7-1, was processed at a setpoint of 10 pCi/g. This slug contained radium+thorium at approximately 25 pCi/g based on 9 in situ samples obtained prior to excavating the slug. Radioactivity was approximately equal in all nine samples. All soil in this slug was diverted to the above-criteria pile. Radiological analysis of the above-criteria pile confirmed that it contained activity in excess of the setpoint. Based on processing one slug at this setpoint, the RSS can detect and reject soil containing a constant and significant excess of radioactivity above this setpoint.

4.4.1.4 Slug Test, Ra+Th Setpoint of 5 pCi/g

The remaining eight slugs were processed using a setpoint of approximately 5 pCi/g radium+thorium. Of these slugs, 6-1 and 8-1 consistently contained radium+thorium activity greatly in excess of the setpoint. (Slug 8-1 had two in situ samples with activities near the setpoint and one sample with activities less than the setpoint. The average for the slug, however, was approximately 53 pCi/g. Individual and average activities measured for the processed material from this slug suggest that the three low in situ values were not representative of a significant portion of the total slug). These slugs were successfully rejected by the RSS. Radiological analysis of the rejected material confirmed that it contained radium+thorium consistently and significantly in excess of the setpoint.

Slug 8-2 contained radium+thorium at approximately 11 pCi/g. The radiological sorter successfully rejected 5.3 tons of the material comprising this slug. Radiological analysis of the rejected material confirmed that it contained radium+thorium in excess of the setpoint by a factor of approximately 2.

Slug 6-3 contained radium+thorium in a slight excess over the setpoint, approximately 7.5 pCi/g evenly distributed through the 9 samples obtained prior to excavating the slug. This slug was successfully rejected by the RSS. Radiological analysis of the rejected material confirmed that it contained radium+thorium in excess of the setpoint.

Slugs 7-2 and 7-3 contained very low concentrations of radium+thorium. While background radium and thorium activities are not yet known, these slugs were not dissimilar from typical background concentrations of these radionuclides. The RSS accepted these slugs as containing radium+thorium at concentrations below the setpoint. This was confirmed by radiological analysis of the accepted material.

Slugs 7-4 and 8-4 contained radium+thorium at concentrations close to the setpoint. For slug 7-4, the RSS accepted approximately 5 tons of material and rejected 12 tons. Radiological analysis of the accepted and rejected material showed that both contained radioactivity in excess of the setpoint. Slug 8-4 was accepted by the radiological soil sorter as containing radioactivity below the setpoint. Radiological analysis of the accepted material showed that it did contain radioactivity at levels less than the setpoint.

In conclusion, the Pilot Demonstration showed that material consistently contaminated with activity significantly well below or above the setpoint is successful rejected or accepted by the RSS. The sorter did not reliably discriminate between soils when the radioactivity content was near the setpoint. Note that U-238 activities were consistently lower than the U-238 setpoint, and therefore were not crucial to the selection process.

4.4.2 Batch Tests

Batches were typically larger volumes of soil than slugs. Batches were not characterized prior to processing. Analytical samples of processed material were obtained periodically (approximately every 50 cy per process stream). A variety of Ra + Th setpoints for rejecting soil as contaminated were used in the batch testing program as well as in the slug testing program. Results of the batch testing program are shown in **Table 17**.

Slugs with the same number as a batch compose a discrete subset of the same numbered batch. Some of the individual slugs do not have corresponding batches.

The physical extent of in situ material for individual batches was established by performing a surface gamma radiation survey prior to excavation. This survey was used to identify locations likely to contain desired levels and distributions of radioactivity for the individual batches. The results of these surveys are presented in Appendix C.

Batches were processed using a variety of Ra + Th setpoints. These setpoints and their associated batches are listed as follows:

- 5 pCi/g: 7,8,9,1-1, 8-1, 8-2, 6-1, 1-2, Sequence Batch 1, Sequence Batch 2, Sequence Batch 3, Sequence Batch 4, Sequence Batch 5, 7-4, 7-5, 7-6, 6-5, 6-6, and 6-7
- 15 pCi/: 1,2,3,4,5,6-1, 1-3, 1-4, 1-5, Batch Test 2 (17 pCi/g), 8-3, 6-6, 6-7, and 8-5
- 20 pCi/g: 7-1
- 32 pCi/g: 7-1, 8-3

Some of the batches, i.e., 6-7, 6-6, 8-3, and 6-1, were processed using more than one setpoint.

Individual batches were not sampled and analyzed prior to excavation and processing. As described previously and in Appendix C, walkover surveys were conducted to estimate the level and distribution of radionuclides in a batch prior to excavation. Some of the batches were composed of soils, whose average concentration were either all above or below the setpoint criteria. As was observed during slug processing, these batches were successfully processed and sorted into the appropriate stockpiles. Batches that contained material close to the setpoint criteria were less successfully sorted. This performance behavior is presented in detail in **Table 17**. Performance of the RSS was evaluated by comparing the laboratory values for the accepted and rejected material against the RSS setpoint value in use for each particular batch. Batch test laboratory radioisotope activities included natural background contributions estimated as in **Table 9**. The RSS operated using background subtraction techniques as described in Appendix B.

4.5 PERFORMANCE SUMMARY

The Pilot Demonstration evaluated both the RSS and GSS for their effectiveness to reduce the weight and volume of excavated soils that would require special handling management, and disposal as radioactive material. Weight and radioactivity tracking of individual process streams are presented in **Table 11** through **17**.

4.5.1 Gravel Separation

The GSS produced an oversize product (3/8 to 6 inch material) with an average radionuclide concentration of 5.60 pCi/g Th-232, 1.52 pCi/g Ra-226, and 2.81 pCi/g U-238 prior to rinsing to remove adhering fine material. The oversized fraction resulting from the GSS size separation has a lower activity level than the in situ soil, particularly with regard to Th-232. The reduction in Ra-226 and U-238 was marginal by comparison. For all the material processed, including the oversize, the average radioactivity content was 10.11 pCi/g Th-232, 2.07 pCi/g Ra-226, and 2.94 pCi/g U-238. The total oversize material (i.e., greater than 3/8 inch) comprised 34% of the material by weight. Of the total material, 32% was contained in the 3/8-inch to 6-inch fraction. The performance of the GSS with regard to both mass separation and radiological characteristics of the recovered oversize material is presented in **Table 14**. Separated gravel generally achieved total activity less than 15 pCi/g above background, although not in all cases. Gravel separation alone did not reliably achieve total activity less than 5 pCi/g above background.

Gravel separation, followed by rinsing to remove the associated fines, will produce a significantly cleaner product with regard to radioactivity. Based on radiological analysis of six batches of washed oversize material, operating the rinse unit resulted in an average decrease of 55% in Th-232, 33% in Ra-226, and 35% in U-238. Applied to the measured activity of the oversize prior to rinsing, a final washed gravel product with an average radionuclide concentration of approximately 2.52 pCi/g Th-232, 1.02 pCi/g Ra-226, and 1.83 pCi/g U-238. The activity in rinsed oversize material was reduced by up to 84% (**Table 15**). The quantity and size of fines associated with the oversize material from the SAA limited the use of the rinse unit during the Pilot Demonstration. Engineering modifications would be required to use this process during remediation. Additional evaluation of fines dewatering, management, and disposal would have to be performed to develop an estimate of the cost effectiveness of this technology. In most cases, gravel separation and rinsing produced a product with a total activity less than 5 pCi/g above background. However, additional data would be needed to demonstration this conclusively.

4.5.2 Radiological Sorting System

4.5.2.1 Volumetric Performance

The RSS divided the processed soils into two different stockpiles. One stockpile (Stockpile G) contained soil with radioactivity above the setpoint criteria as determined by the RSS. The other stockpile (Stockpile H) contained soil with radioactivity below the setpoint criteria as determined by the RSS. The relative amount of soil in each stockpile is a function of the radioactivity in the soil, the RSS setpoint, and the ability of the RSS to discriminate between accepted and rejected material.

As such, the performance of the Pilot Demonstration can provide guidance with regard to expected potential volume reduction, but it cannot be used to produce a reliable numerical estimate of the volume reduction that should be achieved in a full production operating mode. There are several reasons for this:

- The Pilot Demonstration was conducted using several different set points. In general the RSS is able to discriminate better at higher setpoints, especially if the feed material is significantly higher or lower than the setpoint value.
- Most of the Pilot Demonstration was conducted at a relatively low setpoint value compared to the anticipated standard of 15 pCi/g above background of Ra-226 + Th-232, and 50 pCi/g above background of U-238.
- The Pilot Demonstration soil was not necessarily similar in extent, distribution, or intensity of radioactivity compared with material to be processed during site remediation.

- The actual volume of below-criteria soil separated by the RSS cannot be greater than the amount of below-criterion soil fed through the system. In order to prevent acceptance errors (above-criteria soil erroneously directed to the below-criteria stockpile), a substantial amount of below-criteria soil will inevitably be lost to the above-criteria stockpile.

The entire batch processing effort generated 48% by weight accepted (i.e., below-criteria) soil. However, of this amount 32% consisted of acceptance errors. Most, but by no means all, of the acceptance errors were at low setpoints. Higher setpoints were generally used with selected higher-activity soils so observed error rates cannot be taken as representative of average system performance.

The acceptance error rate can be substantially lowered, if not eliminated, by artificially decreasing the setpoint below the enforceable cleanup standard. This will result in including some below-criteria soil with the above-criteria soil, but will minimize acceptance errors.

Eliminating the observed 32% error rate for the accepted soil results in a net volume reduction of approximately 33% of the RSS feed material. Approximately one third of the soil entering the RSS is expected to be accepted by the RSS as containing radioactivity below the setpoint confirmed by subsequent laboratory analysis.

4.5.2.2 Radiological Performance

The effectiveness of the RSS was inconsistent. Reviewing the slug data show that when the RSS was presented with material that was significantly and consistently above or below the selected rejection criteria, the system performed properly. Soil that is uniformly above the radioactivity criteria was identified as such and rejected. Soil that is uniformly below the radioactivity criteria was identified as such and accepted. The RSS did not perform reliably when presented with material that was not significantly and consistently above or below the acceptance criteria.

Tables 18 and **19** show the separation performance of the RSS for the slugs and batches. The reported quantities in these tables were determined by weighing the accepted and rejected material after processing. Sorting errors were identified by comparing the average radiological analysis values for the accepted or rejected materials to the criteria setpoints in use for a particular slug or batch. For the slugs, the RSS did not falsely reject any soil found by radiological analysis to be below criteria. There was a problem with false acceptance of material found by radiological analysis to be above criteria. A false acceptance rate of 18.4% by weight was found for the slugs.

The “Onsite” slug was rejected as containing radioactivity above the operating setpoint, 15 pCi/g radium+thorium, while radiochemical analysis of the rejected material showed an average radium+thorium activity of approximately 11 pCi/g. This erroneous rejection was not presented in **Table 18**, nor considered in the evaluation of the RSS.

The onsite slug was among the first materials processed during the Pilot Demonstration. The compensation software for uranium was not operating properly, and this resulted in the rejection of the slug material. If the uranium quantitation function of the RSS operated properly, this material probably would not have been rejected as containing radioactivity above the operating setpoint. Consequently, data from the onsite slug was not used further to evaluate the performance of the RSS.

Acceptance errors occurred in slugs 6-2, 7-4, and the engineered slug. In all three cases, the average radionuclide content of the accepted material was relatively close to the setpoint value. For example, for Slug 6-2, the falsely accepted material had a radium + thorium activity of 24.76 pCi/g versus a setpoint of 24 pCi/g. For slug 7-4, the falsely accepted material had a radium + thorium activity of 8.53 pCi/g versus a setpoint of 5 pCi/g. The engineered slug falsely accepted material that had a radium + thorium activity of 15.35 pCi/g versus a setpoint of 13.75 pCi/g.

The batches processed by the RSS were not characterized prior to processing, so the radiological characteristics of the accepted and rejected soil cannot be compared to a known preprocessing average soil activity. However, the radiological quality of the accepted and rejected soil can be compared to the processing criteria setpoint. Similar behavior was observed when a batch of soil was either entirely accepted or entirely rejected. The RSS generally identified and sorted correctly incoming soil that was entirely above or below criteria.

Batch processing performance was substantially less reliable in the case of mixed input soil, i.e., a batch of soil that contained material that was accepted and material that was rejected. The RSS produced a considerable number of errors based on radiological analysis of the accepted and rejected soil.

The majority of the material processed during the Pilot Demonstration, including both slugs and batches, used an operating setpoint of approximately 5 pCi/g radium+thorium. Most of the acceptance errors identified during the Pilot Demonstration also occurred at this setpoint. Another objective of the study was to determine the performance characteristics of the RSS at the so-called “industrial land use criteria”. These criteria were 15 pCi/g Ra-226 and Th-232 and 50 pCi/g uranium-238 (with a sum of ratios not to exceed one), commonly abbreviated as the 15/15/50 cleanup criteria.

RSS performance at these criteria appears on the surface to be more reliable. All of the batches processed at these criteria (30% by weight of the Pilot Demonstration), were successfully identified and sorted by the RSS. However, the performance diagnostic value of these data by themselves is somewhat limited in that most of this material was substantially above or below the 15 pCi/g radium+thorium setpoint. Where batch radioactivity was consistently above or below the operating setpoint, the RSS performed acceptably at all setpoint values tested during the Pilot Demonstration.

Only two slugs, the onsite slug and the engineered slug, were processed at 15 pCi/g. (The engineered slug was actually processed using a setpoint of 13.75 pCi/g). Of these, the onsite slug results are unsuitable for evaluation for reasons addressed previously in this section. The RSS did not successfully separate the engineered slug into above-criteria and below criteria components. Performance of the RSS for separating soils at the 15/15/50 cleanup level was not clearly demonstrated based on the Pilot Demonstration.

The excavation and management of soil from the five sequenced batches is described in Section 3.5 of this report. Sequenced batch tests were performed to minimize soil handling prior to processing through the GSS and RSS units to better preserve soil heterogeneity.

The results from Sequenced Batch 1 were promising. Approximately 40% of the batch was rejected. Subsequent radiological analysis of the rejected material showed radioactivity in excess of the setpoint criteria. The remainder of the batch was accepted by the RSS as containing radioactivity below the setpoint criteria. This too was confirmed by subsequent radiological analysis.

Approximately 40% of Sequenced Batch 2 was rejected by the RSS. Radiological analysis showed that the rejected soil contained radioactivity in excess of the setpoint criteria. However, the 60% of the batch accepted by the RSS as containing radioactivity below the setpoint criteria was found on subsequent radiological analysis to contain radioactivity above the setpoint criteria. In fact, the radioactivity of the accepted soil was essentially identical to the radioactivity of the rejected soil.

Sequenced Batch 4 was similar to Sequenced Batch 2. Rejected material (approximately 20%) was found to contain radioactivity in excess of the setpoint criteria. However, the remaining accepted material was also found to contain radioactivity in excess of the setpoint criteria.

Sequenced Batch 5 contained radioactivity well in excess of the setpoint criteria. All of this batch was successfully rejected by the RSS.

Performance of the RSS during batch processing was less accurate than the slug processing performance. Batch processing performance is indicative of the level of performance expected during full-scale operation. There were errors in the identification of both above criteria soils and below criteria soils. The error rate for false acceptance was considerably higher than for false rejection, 32% versus 8%. The error rate for false acceptance under batch processing conditions was higher than for slug processing. The difference between the measured radioactivity of falsely accepted material and the applicable setpoint was also greater for batch material than for the smaller, more manageable slugs.

The detection and data processing functions of the RSS are discussed in detail in previous sections of this chapter and in Appendix B. In addition to identifying and segregating above criteria soil, the RSS performs a continuing assay of the accepted and rejected soils based on the radioactivity measured by the detectors, the density of the soil, and the amount of material passing through the RSS. These computed values were found to be substantially different from the results of radiological analysis of samples from the same stockpiles. The differences were such, both in magnitude and direction, that a meaningful comparison proved difficult. The data are not presented in this report.

There are multiple potential causes for the identification and processing errors observed during the Pilot Demonstration. When operating within an optimal material input, the RSS is theoretically capable of successfully discriminating between above criteria soil and below criteria soil. The greatest source of sorting error was probably a result of the material itself and the extent of material handling that was performed. Successful operation of the RSS when both above criteria and below criteria material is present is based on having a fairly sharp physical boundary between contaminated soil and uncontaminated soil. (The absolute difference between the activity of the above criteria and below criteria soil was also critical to successful sorting). This boundary was substantially lost during soil processing prior to passing through the RSS. The operation of the GSS had the most effect on mixing the feed soils and degrading the boundary between above and below criteria soils. This was shown by the absence of improved performance during processing of the sequenced batches.

The soil from the SAA contained a wide range of particle sizes and types. The RSS was provided a fairly uniform feed of 3/8-inch or smaller material to produce an even layer of soil passing under the detectors. This required that the soil from the SAA be passed through a grizzly and a vibratory GSS before delivery to the RSS. Each of these processes results in mixing and homogenizing the soil, particularly the vibratory GSS. As a result of these necessary soil handling processes upstream of the RSS, the boundary between contaminated soils and uncontaminated soils in the same batch is compromised or even lost. Without clear boundaries to define contaminated portions of the soil stream passing through the RSS, performance of the system is inevitably degraded regardless of the systems inherent capabilities. The degraded performance of the RSS during the Pilot Demonstration is certainly due in part (and perhaps in large part) to the necessarily vigorous physical processing of the soil prior to sorting by the RSS.

5.0 ENVIRONMENTAL CONSIDERATIONS

5.1 DUST

Total aerosol monitoring, or "dust monitoring," was conducted in and around different work areas of the Pilot Demonstration over a period of three months, from August 17, 2000 to November 8, 2000. Dust monitoring was conducted at the Pilot Plant RMA and the SAA. The monitors were placed downwind from soil processing activities at the RMA boundary and on the perimeter of the SAA. They were operated in a continuous datalogging mode. Monitors were also placed in the work areas that had the potential to generate dust, such as the GSS vibrating screens and the RSS platform.

TSI DustTrak® Model 8520 aerosol monitors were used during the daily monitoring periods. The DustTrak is a portable, laser photometer that measures and records real time airborne dust concentrations while data is simultaneously logged into memory. This instrument measures particles in the size range 0.01 to 10 microns and a mass concentration ranging from 0.001 to 100 micrograms per cubic meter ($\mu g/m^3$). Results from dust monitoring conditions are presented in Appendix I.

The FMSS Site Safety and Health Plan (SSHP), Section 8.1.1, requires work stoppage when work site dust levels reach 4 milligram per cubic meter (mg/m^3), during activities that disturb the soil, such as excavation, removal, separation, etc. This limit was never reached during the Pilot Demonstration. Doses to workers working on the Pilot Demonstration were less than 100 mrem Total Effective Does Equivalent (TEDE) for the duration of the Pilot Demonstration.

The SSHP also requires a personnel protection equipment (PPE) upgrade to respiratory protection whenever dust levels reach 1 mg/m^3 in the work area during activities that disturb the soil. This action level was exceeded on two separate occasions:

- On August 17, 2000, an instrument anomaly of 1.25 mg/m^3 was recorded in the general work area that lasted approximately 1 minute. Dust levels returned to an acceptable range for the remainder of the workday.
- On November 2, 2000, a level of 1.013 mg/m^3 was recorded in the manlift operating area near the GSS vibrating screens. Levels returned to an acceptable range after less than 5 minutes and remained as such for the remainder of the day.

Respiratory protection was not warranted on these two occasions since these slightly elevated dust levels lasted for a brief period. In addition, the project team was immediately notified of the elevated levels and responded by applying dust control practices to suppress the levels.

The FMSS SSHP, Sections 8.1.1 and 8.1.4 also identify a site perimeter peak limit of 0.05 mg/m^3. This is a derived value used to limit offsite exposures of Th-232 to 10 millirem per year (mrem/y). On four separate occasions in September 2000, this limit was exceeded:

- Three of the four limit situations were attributed to weather interference (i.e., fog, haze, and rain) with the dust monitoring equipment.
- The fourth instance occurred on September 20, 2000. On this date, dust levels at the SAA and Pilot RMA reached 0.066 mg/m^3. Weather conditions were clear and fair during this monitoring period. The elevated levels were attributed to inadequate dust control measures being employed in these areas. In response, corrective actions were implemented and the dust levels dropped below action levels.

Except for the instances identified previously, dust levels remained below established limits throughout the Pilot Demonstration. This was accomplished through aggressive use of dust control techniques including sprayers built into the pilot plant systems, fire hoses operated by the labor force, and a water truck spraying the grounds and driving surfaces. When applied conscientiously, these measures proved adequate for controlling airborne dust concentrations with minimal impact on plant operations. The maximum Annual Effective Does Equivalent to an individual in the public due to Pilot Demonstration related work is 5.6 E-4 mrem/year (USACE, 2000b).

5.2 NOISE

The operation of the Pilot Demonstration facility had the potential for increasing the ambient sound levels in the area. In order to assess this impact, sound level surveys were conducted before and during the facility operation. The first survey took place in February 2000, primarily on West Central Avenue adjacent to the FMSS, prior to site operations. Further measurements were taken in October and November 2000 during the Pilot Demonstration program. The data from the two surveys were compared to quantify the noise impact of the soil processing equipment. The results of the second survey are tabulated in Appendix J, and both surveys are summarized in **Table 20**.

Two different measures of sound level were used: the L_{90} and the L_{eq}. The L_{90} is the ambient level exceeded 90% of the time. It is often referred to as the background sound level. It is representative of the quiet periods between transient sounds, such as passing cars. Any new noise source introduced into the sampling area would be most audible during the quiet periods quantified by the L_{90}.

The L_{eq} is the energy average sound level. It is generally used to measure variable vehicular sound from construction sites, highways and aircraft. Since the L_{eq} represents the energy average of all intrusive sound, and the L_{90} level represents the quite periods in the absence of intrusive noise, the L_{90} level is always less than the $L_{eq.}$ Both the L_{90} and L_{eq} were simultaneously measured during the 10-minute sampling periods at the locations shown on **Figure 5**.

A Quest Model Q-200 Type 2 Noise Dosimeter was used to conduct the survey. The instrument was set to a 3 decibel (dB) exchange rate for calculating L_{eq}s, and was calibrated before and after each use as specified by the manufacturer.

The sound levels were measured in the following locations:

- Location 1: Sidewalk at corner of Eccleston Place and West Magnolia Ave.
- Location 2: Sidewalks on the North side of West Central Ave., halfway between Ramapo Ave. and Eccleston Place.
- Location 3: Sidewalk on the North side of West Central Avenue, halfway between Eccleston Place, and Hergesell Avenue.
- Location 4: Sidewalk North of West Central Avenue, halfway between Hergesell Avenue and NJ State Rt. 17.

5.2.1 Results

The sound level survey measurements are summarized in **Table 20** and tabulated in Appendix J. All sound levels were measured between 11:00 a.m. and 2:00 p.m. during continuous operation of the rinse unit. Only eight survey samples were obtained due to the variability of the rinse unit run times during the Pilot Demonstration process.

Front-end loaders were used to transfer soil / material from the SAA to the Pilot Plant screening, rinsing and segregating units. The equipment's backup alarms and diesel engines were clearly audible at the survey locations on West Central Avenue, as were the gravel rinsing vibrating screens. The rinse unit was the loudest when materials were being added to the screening process.

The facility operation was "just audible", "plainly audible", and "dominate" at Locations 2, 3, and 4 respectively. The operational sound was distinguishable from background levels as high as 69 dBA. The L_{90} background sound levels during facility operations were from 2 to 5 dBA higher than those measured during the pre-operation survey. The L_{eq} levels ranged up to 9 dBA higher than the pre-operational levels. The highest L_{eqs} were at Location 2 and ranged from 71 to 73 dBA.

5.2.2 Conclusions

The L_{eq} levels measured at Location 2, ranged from 71 to 73 dBA. These levels indicated that sound from the operation of the Pilot Demonstration Rinse Unit will exceed the NJ Noise Ordinance (N.J.A.C. 7:79) of 65 dBA for the township of Maywood, and noise code limit of 60 dBA for the township of Rochelle Park, during daytime hours.

A further detailed study of the Pilot Demonstration units will need to be conducted to determine noise source impacts, and, as necessary, abatement methods that would reduce the gravel rinse unit's noise impact on the local community.

5.3 CHEMICAL

Material processed through the Pilot Demonstration systems was analyzed to determine if chemical constituents tended to concentrate in any one fraction during processing. In situ material was sampled and analyzed for chemical characteristics, as was the total greater than 3/8-inch fraction and the total less than 3/8-inch fraction material. Accepted and rejected material from the RSS was also characterized to determine if any chemicals were preferentially associated with the radioactive constituents. Fines removed by the rinse unit were analyzed to determine if any chemicals were preferentially associated with the fines compared to the coarser materials.

Wipe samples were collected of the greater than 6-inch material. Each wipe sample was collected over 1/8 of a rock surface; therefore, each analytical result was multiplied by eight to make it representative of the entire rock surface. All units were then converted to milligrams (mg). The average mass of a rock in the greater than 6-inch material was 13.18 kilograms. This average mass was obtained by assuming an average rock diameter and density of 8 inches and 3 g/cm^3, respectively. Each sample result was then divided by this mass to get a concentration in units of mg/kg. This also assumes that there are no target analytes present inside the rock. These concentrations were then compared to cleanup action levels in order to evaluate options for disposition of this stockpile.

A summary of chemical results is presented in **Table 21**. For each analyte, only samples that had detectable concentrations were considered. The average concentration and standard deviation were calculated for each analyte at each stockpile. Next, the average concentrations (in mg/kg) were graphed for specific analytes that best represent a broad range of concentrations and differences in variability in the process system. The following analytes were selected: aroclor-1254, aroclor-1260, lead, molybdenum, manganese, dieldrin, 4,4'-DDE, toluene, pyrene, benzene, benzo(a)anthracene, and reactive sulfide. These bar graphs are presented in Appendix K.

Where available, in situ data and data for stockpiles I ("filter cake" fines), F (total less than 3/8 inch), J (total greater than 3/8 inch), E (greater than 6 inch), G (radiologically rejected less than 3/8 inch), and H (radiologically accepted less than 3/8 inch) were graphed. In reviewing these data, it does not appear that the chemicals were concentrated during radiological sorting. There was also no clear trend visible for a differential distribution of chemical constituents with regard to particle size. None of the average chemical constituent concentrations exceeded any New Jersey direct contact concentration limit for either industrial or residential land use. None of the analyses indicated that the soil might constitute a hazardous waste.

6.0 TREATMENT SYSTEM COST ANALYSIS

A primary objective of the Pilot Demonstration was to gain a better understanding of the costs and benefits of volume reduction technologies on the overall remediation of the FMSS. This section builds on the cost model developed in the Technology Evaluation Report. Operational experience gained during the Pilot Demonstration is incorporated into site-specific unit costs for key cost elements of the model. Different remediation scenarios are then evaluated to develop an understanding of the FMSS remediation cost sensitivity to potential program constraints and site-specific conditions. Factors affecting system performance and efficacy with respect to remediation of the entire FMSS are discussed below. Supporting calculations are presented in Appendix L.

6.1 ECONOMIC MODEL

The economics of processing material is a function of the volume of the material, processing costs, disposal costs, and cost credits. The objective of the selected technologies is to remove material that is below the cleanup criteria and minimize the volume of material requiring off-site disposal. Accordingly, costs are most sensitive to changes in volume and, within certain limits, costs are directly proportional to the volume of soil processed and the volume of clean soil recovered. In order to facilitate direct comparison of alternatives, the cost model was developed to calculate the total unit cost per cy of soil remediated. The cost model is summarized as follows:

$$\textbf{\textit{Total Unit Cost}} = \frac{\textbf{\textit{Process Cost + Rad Disposal Cost + Alternative Disposal Cost – Backfill Credit}}}{\textbf{\textit{Total Construction Volume}}}$$

Each cost factor in the model is expressed mathematically as follows:

$$\begin{aligned} \text{Process Cost} &= (100\text{-}\ a) \text{ x } V \text{ x } P \\ \text{Rad Disposal} &= [a + (100 - a)\ (100 - R)] \text{ x } V \text{ x } D_r \\ \text{Alternative Disposal} &= (100 - r)[(100 - a) \text{ x } R \text{ x } V] \text{ x } D_a \\ \text{Backfill Credit} &= r \text{ x } [(100 - a) \text{ x } R \text{ x } V] \text{ x } B_c \end{aligned}$$

Where:
V = total construction volume
a = percent of soil that can not be processed
R = percent of soil recovered as below criteria
r = percent of recovered soil that can be reused onsite
P = process cost per cy
D_r = disposal cost per cy for radiologically-contaminated soil
D_a = disposal cost per cy for non-radiologically-contaminated soil
B_c = credit per cy on backfill for volume of soil reused onsite

6.2 KEY COST FACTORS

Key cost factors in the economic model include the rate and cost of processing, transportation and disposal costs, and backfill credit for below criteria soil that is recovered and can be reused onsite. The total cost of soil processing is ultimately a function of soil volume: the volume of soil excavated, the volume of excavated soil that can be processed, and the volume of soil recovered as below cleanup criteria. Each of these cost factors is discussed below.

6.2.1 Processing Costs

The Pilot Demonstration included soil acquisition since there was no active remediation to provide a feed source to the system. Since soil acquisition costs are required under either a strict "excavate and dispose" scenario or a "soil processing" scenario, excavation and soil transport to the MISS costs are not considered in this analysis. Processing costs include only the costs that would not otherwise be incurred under the "excavate and disposal" scenario. Three areas of cost unique to the processing scenario were considered: process management, gravel separation, and radiological sorting. These costs are presented in detail in Appendix L and are summarized below.

All the processing costs assume continuous operations. Budgetary constraints, access to vicinity properties, and unprocessible soils could result in process interruptions. This would have the effect of reducing operational effectiveness and could increase the processing costs of any or all of the various components. For example, an operator running the gravel rinse system may not be able to be integrated into construction activities if there was not material available to support process operations. The alternative is to operate the system at a lower throughput rate or demobilize the system operators. In either case, the unit cost of processing would be increased. This cost uncertainty is discussed in greater detail in subsequent sections.

6.2.1.1 Process Management

Process management includes task management, radiological, health and safety oversight, and materials management. Task Management time is required to coordinate process operations with other site operations, direct construction superintendents, and subcontract management. A field construction superintendent oversees the daily operations and directs craft labor. A sample technician is responsible for collection and management of soil and water samples and ensuring results are received in a timely manner from the laboratory. A QC Inspector will review operations and ensure that all applicable standards and procedures are being implemented. In addition, the QC Inspector prepares a daily QC Report for the USACE. Two operators and loaders accomplish material management. They are responsible for feeding material into the system and managing the "above" and "below" criteria material piles. The estimated daily cost for process management, radiological, health and safety oversight, and material management is $3,600.

6.2.1.2 Gravel Separation System

The GSS involves the physical separation of material greater than 3/8 inch through a series of screens and vibrators. The coarse fraction or "overs" are then conveyed to a rinse system to remove any fine particles that might have adhered to the coarse fraction. The system requires an operator to run the screening system. In addition, three laborers are needed to support the operation and maintenance of the two systems and the connecting conveyor belts.

A second operator is required for the gravel rinse system. Although there is an on-site water treatment plant for pre-treatment of construction water, the gravel rinse system needs to be a stand-alone system. The gravel rinse system is a closed-loop system. Water is recycled through a treatment system to minimize makeup water useage. As a result, water disposal is minimal due to process losses. Fines that are removed would be disposed as radiological waste material. The estimated daily cost to operate the GSS is $5,600. The equipment was already capitalized during the Pilot Demonstration and is not include in the analysis.

The daily production capacity is a function of process rate and equipment availability. The maximum process rate experienced during Pilot Demonstration however was 160 tons per hour or 125 cy per hour. This rate was used for evaluation purposes.

The actual available production time for the GSS experienced during the Pilot Demonstration was 6 hours based on a 10-hour day. The difference accounts for safety briefings, dress-in/out of the radiation control area and breaks, and an average of 1.24 hours per day of equipment downtime for nontest-related equipment problems and required maintenance. Based on maximum production rates and daily equipment availability experienced during the Pilot Demonstration Project, the GSS has the capacity to process on estimated 750 cy of soil per day.

The GSS would not be used to process all types of material anticipated during remediation. This is due to material characteristics that would not yield desired results. Material characteristics that would prevent processing include pond material that liquified when vibrated by the GSS, organic material from the wetlands, saturated clays, silts and sands deposits with little or no coarse fraction, and chemically contaminated soil. As the percentage of material that is not processed increases, the overall construction volume must increase in order to keep the GSS operating at optimum capacity. Unused capacity results in a higher unit process cost for the GSS.

6.2.1.3 Radiological Sorting System

The GSS system conveyed less than 3/8-inch soil directly to the feed hopper on the RSS. The RSS screeds the soil to a uniform thickness and width on a horizontal conveyor belt prior to passing below the radiological detectors. Per the equipment manufacturer, the RSS requires five staff onsite: one supervisor, two system operators, and two craft operators. The total daily operating cost for the RSS is dependent on the overall duration of operations. The analysis assumes that capital cost for the RSS is recovered over the project duration; the annual capital recovery of the RSS decreases as the duration increases. Additional personnel mobilization costs are also incurred for each construction season. Assuming construction over a 7-year period, the daily operating cost for the RSS is approximately $7,000. The limited commercial availability of equipment and trained operators reduces the ability to attain more competitive pricing.

The process rate of the RSS is determined by the belt speed and width. The RSS conveyor belt operates at a constant speed. The RSS used during Pilot Demonstration was capable of 25 cy per hour. Under full-scale operations, a wider belt would be specified to enable a process rate of 50 cy per hour.

As with the GSS, daily production is also dependent on equipment availability. The actual available production time for the RSS experienced during the Pilot Demonstration was 6.5 hours based on a 10-hour day. The difference accounts for safety briefings, dress-in/out and breaks, and an average of 0.43 hours per day of equipment downtime for non-test-related failures and maintenance. Based on maximum production rates and daily equipment availability, it is estimated that the RSS has the capacity to process estimated 325 cy of soil per day.

The RSS has similar limitations on the material suitable for processing as the GSS. The pond material could not be processed. Homogeneously contaminated radiological material that is clearly above criteria would also not be processed.

6.2.2 Transportation & Disposal Costs

The cost of disposal is largely dictated by market conditions. Market competition might secure more competitive rates for transportation and disposal of contaminated soil from the FMSS. The current analysis utilizes the best pricing currently available to the project.

Two disposal scenarios are considered in the evaluation. The first scenario is for highly active radiologically-impacted soil. Under this scenario, it is assumed that soils are transported and disposed of at a licensed, “11(e)2” disposal facility. The model uses rail transportation costs developed under open commercial competition. The disposal cost is based on pricing under an existing government contract. In addition, costs for loading railcars were included. The current unit cost for loading railcars, rail transportation, and disposal at an “11(e)2” facility under this scenario is $233 per cy. This cost is expected to come down as a result of competitive procurement of combined transportation and disposal services.

An alternative disposal scenario considered material that contains less radioactivity and/or has chemical contamination. This scenario would involve soils that are below the radiological cleanup criteria but are determined unsuitable for onsite reuse. The same rail transportation cost was used as above but disposal was assumed at the Envirosafe landfill in Idaho. Unit prices from the existing government contract were used. The unit cost for loading railcars, rail transportation, and disposal under this scenario is $203 per cy.

Disposal at a local Subtitle “D” was considered; however, no landfills were identified that were willing to accept waste containing residual radioactive contamination. A Subtitle “D” waste stream is anticipated during remediation. This waste stream would be comprised of construction debris that is not contaminated (e.g., surface pavements). This debris waste stream is not included in the volumes used in this analysis.

6.2.3 Backfill Credit

A credit is realized for every cy of “below criteria” soil that is recovered and can be reused onsite. The backfill credit is dependent on the volume of “below criteria” material recovered and whether the properties of the recovered soil are suitable for backfill. The suitability of the recovered backfill includes meeting New Jersey standards and definitions of “clean” backfill and permeability characteristics. There is a cost associated with this determination and involves the analysis of samples for radiological and chemical parameters. The actual number of confirmation samples required by the regulators in not known. It was assumed that one sample for every 100 cy of “below criteria” soil is required to demonstrate conformance to applicable standards. Additional samples would be required to meet quality control objectives. The cost of this analysis reduces the backfill credit realized since it adds a cost to the recovered material.

It is assumed reuse would only occur on the government property or limited portions of Stepan or Sears properties. This minimizes additional costs associated with transporting the soil to the backfill area. The backfill credit is based on the cost to purchase backfill and associated conformance testing minus the testing costs associated with demonstrating the recovered material meets chemical parameters. The net credit was determined to be $1.02 per cy (see Appendix L for additional cost detail). This credit assumes that the combination of recovered soils (fine and coarse fractions) are sufficient to meet the physical characteristics for backfill.

6.2.4 Volume

As shown in the cost model, key cost factors are a function of volume. The model considers several different volumes: the total construction volume, the processible volume, the volume of coarse fraction (greater than 3/8 inch), the recovered “below criteria” volume, and the reuse volume. Most of these volumes are expressed as percentages of the total volume since experience has shown actual volumes may vary from estimated volumes. For the purpose of this analysis, the total volume (345,896 cy) was derived from Stone & Webster Calculation 0402-030 (Appendix L) by applying a 30% bulking factor. Similarly, the initial cost analysis assumed a 30% coarse fraction for all material processed during the Pilot Demonstration based upon actual results of 31.85%. A subsequent cost analysis is presented using a 15% coarse fraction as estimated in the Engineering Test Pit Report (USACE, 1999c).

The volume of material that is not suitable for processing was considered a variable in the analysis. The Pilot Demonstration verified that the system has limitations on the types of soil that are acceptable. The pond material was determined to fall into this category. The volume of pond material has been estimated to be approximately on the order of 75,000 cy. There is some concern this volume may increase since a significant amount of pond material was encountered in the SAA that was not previously identified. Contaminated debris (e.g., buried drums), chemically contaminated soil, and saturated soils also fall into the category of unacceptable soil for processing. In addition, soil that is homogeneously contaminated with radiological waste above the criteria would not be processed by the RSS. The volume of this category of soil is estimate to range from 40 to 70% of the overall volume of soil identified for remediation. The percentage is towards 70% for the RSS and 40% for the GSS since the GSS is not sensitive to homogeneous contaminated soil.

The volume of material that is not suitable for processing has significant implications to the operational efficiency of the system. As discussed under processing costs, as the volume of material suitable for processing is reduced the unit cost for processing goes up since daily processing costs are generally considered fixed. The ability to stockpile material to optimize equipment utilization during process operations is limited at the Maywood Site. Other site infrastructure including the process plant itself will not accommodate the large stockpiles that would be required. In addition, agreements with the local community limit stockpiles to 1,000 cy.

The recovery of below criteria material is dependent upon system performance. The volume recovery from the GSS is assumed equal to the coarse fraction. The volumetric reduction from the RSS was discussed in Section 4.5.2.1. Volume reduction is highly dependent upon the characteristics of the feed material and the selected criteria. The volume recovery from the RSS is assumed to equal 32% of the entire volume of the fine fraction. This number is assumed to be a maximum volume recovery and assumes that the feed soils are heterogeneously contaminated and the level of activity is close the acceptance criteria. It is assumed that below criteria material that is not suitable for reuse (i.e., does not pass chemical testing) is disposed at an alternative landfill (Envirosafe).

6.3 ALTERNATIVE COMPARISON

Two alternatives are evaluated:

1. The Base Case is defined as the “excavate and disposal” alternative. Under this alternative, standard construction methods are employed to remove radiologically-impacted soil above criteria. The material is brought back to the government property where it is transported and disposed of as radiologically-impacted soil at $233 per cy.

2. The second alternative is the Process Case. Under the Process Alternative, the same procedure is followed with respect to excavation. The difference is that the material is run through the GSS/RSS process prior to disposal. Since the cost of excavation is equal in both cases, these costs are excluded from the analysis.

The unit cost sensitivity to the volume of material that is not suitable for processing and the volume of “clean” soil that is reused onsite is presented in **Exhibit 1** and is shown graphically on **Exhibit 2**. This analysis demonstrates the sensitivity of the Unit Cost for the Processing Case to changes in the volume of unprocessible soil and the volume of soil reused. In this analysis, the construction rate is fixed and is assumed to equal the optimum process rate of the system [RSS daily rate (100 + percent coarse fraction)]. The analysis also assumes that the recovery from the RSS is fixed at 32% of the less than 3/8-inch material (fines). All material that is not suitable for processing or reuse is disposed of as radiologically contaminated. The shaded area on **Exhibit 2** bounds the range of unprocessible soils that are anticipated. The analysis indicates that when unprocessible soil volume exceeds 50% of the total volume process costs exceed the base case (excavate and dispose option). Under a fixed construction rate, process costs become favorable when all recovered material is suitable for reuse and the percent of unprocessible soils are less than 50%.

Given unlimited resources, no operational conflicts, and no fiscal budgetary constraints, construction rates would equal the maximum processing rate of the system. Under this condition, capital equipment is fully employed, and processing costs per yard of soil are minimized. If construction is limited by funding or property access, the potential exists for underutilization of the process capacity. Underutilization of process capacity can also exist when the construction rate is not sufficient to supply the system with processible soil at the process capacity.

Exhibits 3 and 4 examine the sensitivity of the construction rate on unit processing costs. In this analysis, the construction rate is the key variable. Reuse is assumed fixed at 100%, and the volume of unprocessible soil is bounded by 40 and 70% of the total construction volume. The Total Unit Cost declines as the construction rate increases until the daily construction volume minus the volume of unprocessible soil is equal to the optimum process rate. The analysis shows that unit process costs decline as the construction rate increases. Construction rates would have to exceed 600 cy per day to have a favorable unit cost over the base case when unprocessible soils equal 70%. Unit costs are more favorable as the percent of unprocessible soils decrease. When unprocessible soil equals 40%, the unit costs for the process scenario are all less than the base case.

Given questionable performance results of the RSS on the soils found at the Maywood Superfund Site, a derivation of the Process Case involving a “GSS-only” operation was evaluated. The unit cost analysis for this case is shown on **Exhibits 5 and 6** using the same assumptions as for the combined GSS/RSS case. In this GSS-only case, the unit processing cost is reduced however no volume recovery is realized on the less than 3/8-inch fraction. The analysis is similar to the analysis combine process case. There is a slight improvement in cost performance but the analysis still indicates the need for 100% reuse and unprocessible soil volume of less than 50% to have favorable cost performance over the base case.

The unit cost sensitivity to construction rate of the “GSS-only” scenario is shown on **Exhibits 7 and 8.** Assuming a 100% reuse of the coarse fraction, the GSS indicates the potential to lower total unit costs per cy. The results are similar to the combined GSS/RSS case; unit costs decrease as the construction rate increases towards the optimum system rate (750 cy per day for the GSS). Since the GSS is less sensitive to homogeneously contaminated soil, a higher volume of processible soil is expected for the GSS system alone.

The percent coarse fraction recovery during the Pilot Demonstration was around 30%. The Engineering Test Pit evaluation of the overall site soils found the coarse fraction was only 15%. To determine the cost implications of the uncertainty of the percent of coarse fraction, additional analyses were completed at the lower coarse fraction level (15%). **Exhibits 9 and 10** were run at a fixed construction rate and **Exhibits 11 and 12** were run at varying construction rates. At the projected volume of the coarse fraction for the Maywood Site soils and construction rate, the GSS-only process does not have favorable cost performance. In order for the GSS-only system to have favorable cost performance would require less than expected percentage of unprocessible soil and higher than expected daily construction rates.

Exhibit 1 – Unit Cost Analysis – GSS & RSS Processing Construction Constrained – 400 cy/d

Given: GSS & RSS Processing

390 cy/day system capacity
50,000 cy/season max
400 construction rate

Assume:

V = 345,896 cy Fixed for all cases
P = dependant on construction duration and soil throughput
D_r = \$233 per cy Fixed
D_a = \$203 per cy Fixed
B_c = \$1.02 per cy Fixed
R = 52% of volume recovered as below criteria

Assume all coarse fraction is recoverable	Coarse Fraction =	30% by volume
Percent of remaining fines that are recoverable	Fines Fraction =	32% by volume

a	r							
% Unprocessible	% Reuse	P	Process Factor	Rad Disposal	Alt Disposal	Backfill Credit	Unit Cost	Base
30%	100%	$ 58	$ 14,043,373	$ 51,033,729	$ -	$ 129,598	$ 188	$ 233
40%	100%	$ 67	$ 13,905,014	$ 55,256,988	$ -	$ 111,084	$ 200	$ 233
50%	100%	$ 81	$ 14,008,783	$ 59,480,247	$ -	$ 92,570	$ 212	$ 233
60%	100%	$ 101	$ 13,974,193	$ 63,703,506	$ -	$ 74,056	$ 224	$ 233
70%	100%	$ 134	$ 13,905,014	$ 67,926,764	$ -	$ 55,542	$ 236	$ 233
30%	50%	$ 58	$ 14,043,373	$ 51,033,729	$ 12,878,286	$ 64,799	$ 225	$ 233
40%	50%	$ 67	$ 13,905,014	$ 55,256,988	$ 11,038,531	$ 55,542	$ 232	$ 233
50%	50%	$ 81	$ 14,008,783	$ 59,480,247	$ 9,198,776	$ 46,285	$ 239	$ 233
60%	50%	$ 101	$ 13,974,193	$ 63,703,506	$ 7,359,021	$ 37,028	$ 246	$ 233
70%	50%	$ 134	$ 13,905,014	$ 67,926,764	$ 5,519,266	$ 27,771	$ 252	$ 233

V = total construction volume
P = process cost per cy
D_r = disposal cost per cy for radiologically-contaminated soil
D_a = disposal cost per cy for non-radiologically-contaminated soil
B_c = credit per cy on backfill for volume of soil reused onsite
R = percent of soil recovered as below criteria

Exhibit 2 – Unit Cost Analysis – GSS & RSS Processing Construction Constrained – 400 cy/d

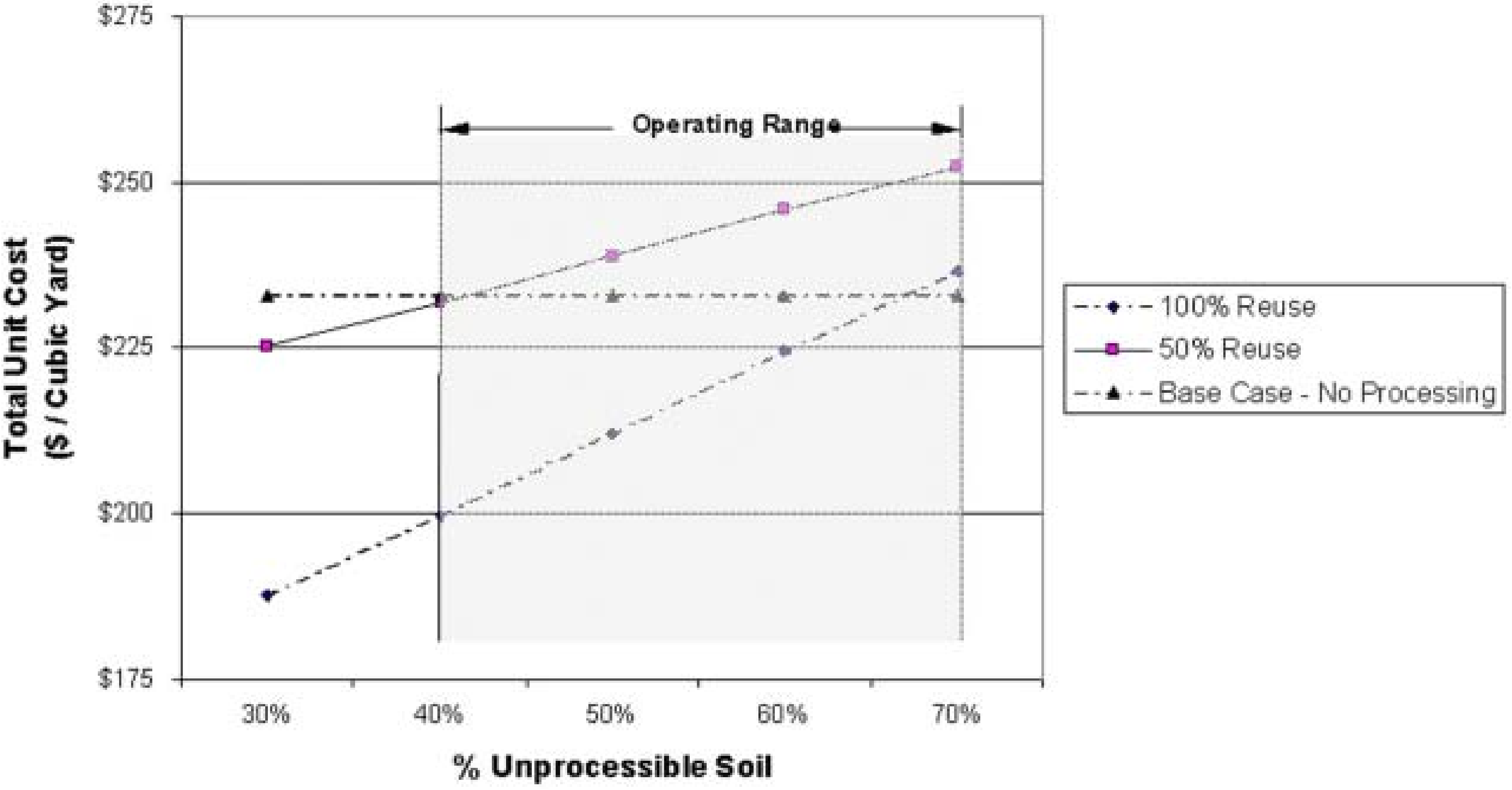


Exhibit 3 – Unit Cost Sensitivity – GSS & RSS Processing – Varying Construction Rate

Given: GSS & RSS Processing
390 cy/day system capacity
50,000 cy/season max
100 Reuse

Assume:

V = 345,896 cy Fixed for all cases
P = dependant on construction duration and soil throughput
D_r = $233 per cy Fixed
D_a = $203 per cy Fixed
B_c = $1.02 per cy Fixed
R = 52% Fixed Coarse Fraction = 30%
Fines Fraction = 32%
r = 100%

a % Unprocessible	Construction Rate	P	Process Factor	Rad Disposal	Alt Disposal	Backfill Credit	Unit Cost	Base
40%	300	$ 89	$ 18,470,840	$ 55,256,988	$ -	$ 111,084	$ 213	$ 233
40%	400	$ 67	$ 13,905,014	$ 55,256,988	$ -	$ 111,084	$ 200	$ 233
40%	500	$ 54	$ 11,207,026	$ 55,256,988	$ -	$ 111,084	$ 192	$ 233
40%	600	$ 45	$ 9,339,189	$ 55,256,988	$ -	$ 111,084	$ 186	$ 233
40%	700	$ 38	$ 7,886,426	$ 55,256,988	$ -	$ 111,084	$ 182	$ 233
70%	300	$ 179	$ 18,574,608	$ 67,926,764	$ -	$ 55,542	$ 250	$ 233
70%	400	$ 134	$ 13,905,014	$ 67,926,764	$ -	$ 55,542	$ 236	$ 233
70%	500	$ 107	$ 11,103,258	$ 67,926,764	$ -	$ 55,542	$ 228	$ 233
70%	600	$ 89	$ 9,235,420	$ 67,926,764	$ -	$ 55,542	$ 223	$ 233
70%	700	$ 77	$ 7,990,195	$ 67,926,764	$ -	$ 55,542	$ 219	$ 233

V = total construction volume
P = process cost per cy
D_r = disposal cost per cy for radiologically-contaminated soil
D_a = disposal cost per cy for non-radiologically-contaminated soil
B_c = credit per cy on backfill for volume of soil reused onsite
R = percent of soil recovered as below criteria
r = percent of recovered soil that can be reused onsite

Exhibit 4 – Unit Cost Sensitivity – GSS & RSS Processing (100% Reuse)

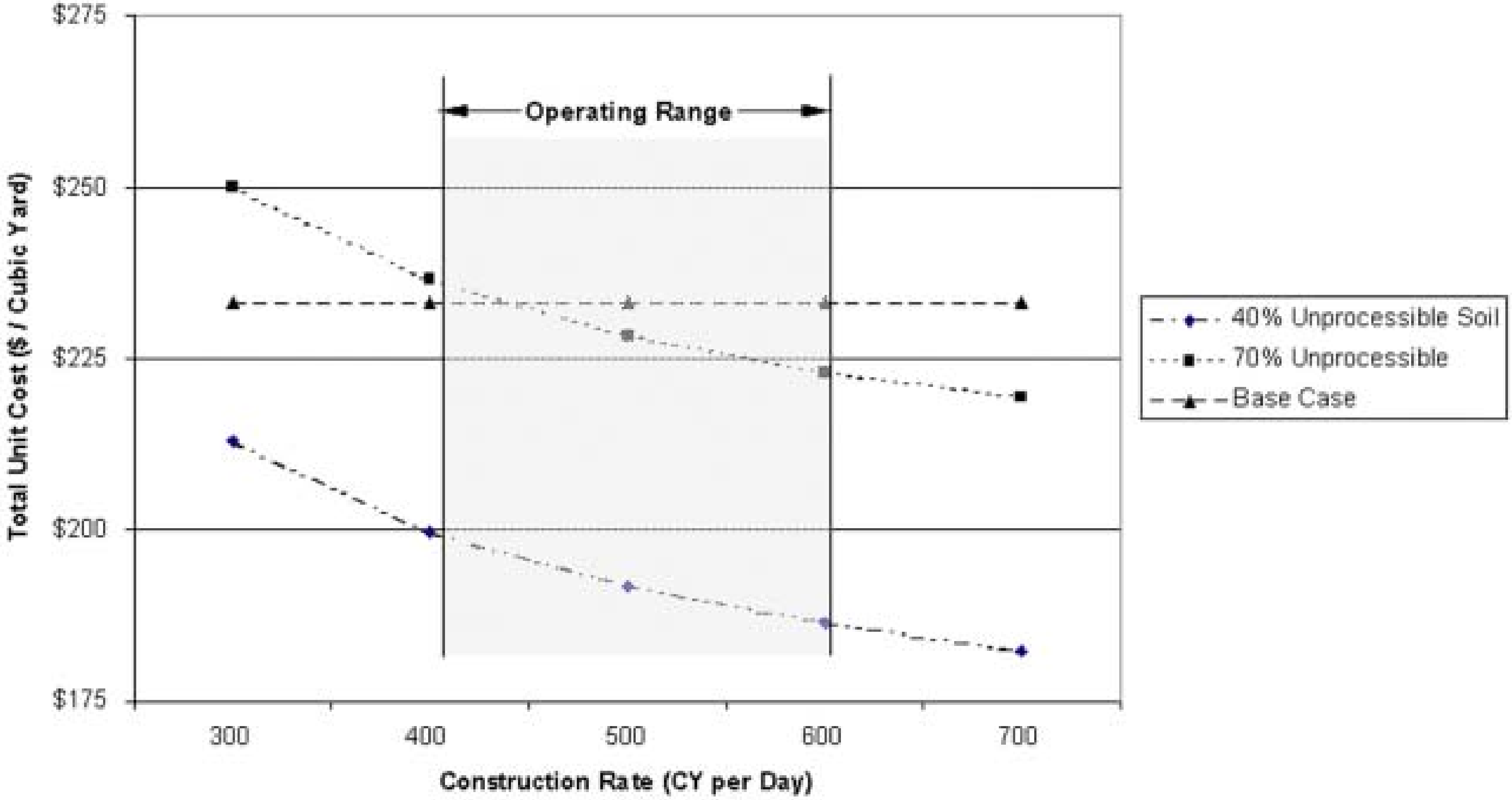


Exhibit 5 – Unit Cost Analysis – GSS Processing Construction Constrained – 400

Given: GSS Processing
750 cy/day system capacity
50,000 cy/season max
400 construction rate

Assume:

V = 345,896 cy Fixed for all cases
P = dependant on construction duration and soil throughput see sample calc
D_r = \$233 per cy Fixed
D_a = \$203 per cy Fixed
B_c = \$1.02 per cy Fixed
R = 30% Fixed Coarse Fraction = 30% by volume
Fines Fraction = 0%

a	r							
% Unprocessible	% Reuse	P	Process Factor	Rad Disposal	Alt Disposal	Backfill Credit	Unit Cost	Base
30%	100%	\$33	\$ 7,990,195	\$ 63,671,267	\$ -	\$ 74,197	\$ 207	\$ 233
40%	100%	\$38	\$ 7,886,426	\$ 66,089,163	\$ -	\$ 63,598	\$ 214	\$ 233
50%	100%	\$46	\$ 7,955,605	\$ 68,507,059	\$ -	\$ 52,998	\$ 221	\$ 233
60%	100%	\$57	\$ 7,886,426	\$ 70,924,956	\$ -	\$ 42,398	\$ 228	\$ 233
70%	100%	\$76	\$ 7,886,426	\$ 73,342,852	\$ -	\$ 31,799	\$ 235	\$ 233
30%	50%	\$33	\$ 7,990,195	\$ 63,671,267	\$ 7,373,065	\$ 37,099	\$ 228	\$ 233
40%	50%	\$38	\$ 7,886,426	\$ 66,089,163	\$ 6,319,770	\$ 31,799	\$ 232	\$ 233
50%	50%	\$46	\$ 7,955,605	\$ 68,507,059	\$ 5,266,475	\$ 26,499	\$ 236	\$ 233
60%	50%	\$57	\$ 7,886,426	\$ 70,924,956	\$ 4,213,180	\$ 21,199	\$ 240	\$ 233
70%	50%	\$76	\$ 7,886,426	\$ 73,342,852	\$ 3,159,885	\$ 15,899	\$ 244	\$ 233

V = total construction volume
P = process cost per cy
D_r = disposal cost per cy for radiologically-contaminated soil
D_a = disposal cost per cy for non-radiologically-contaminated soil
B_c = credit per cy on backfill for volume of soil reused onsite
R = percent of soil recovered as below criteria

Exhibit 6 – Unit Cost Analysis – GSS Processing Only
Construction Constrained – 400 cy/d
(30% Coarse Fraction Volume)

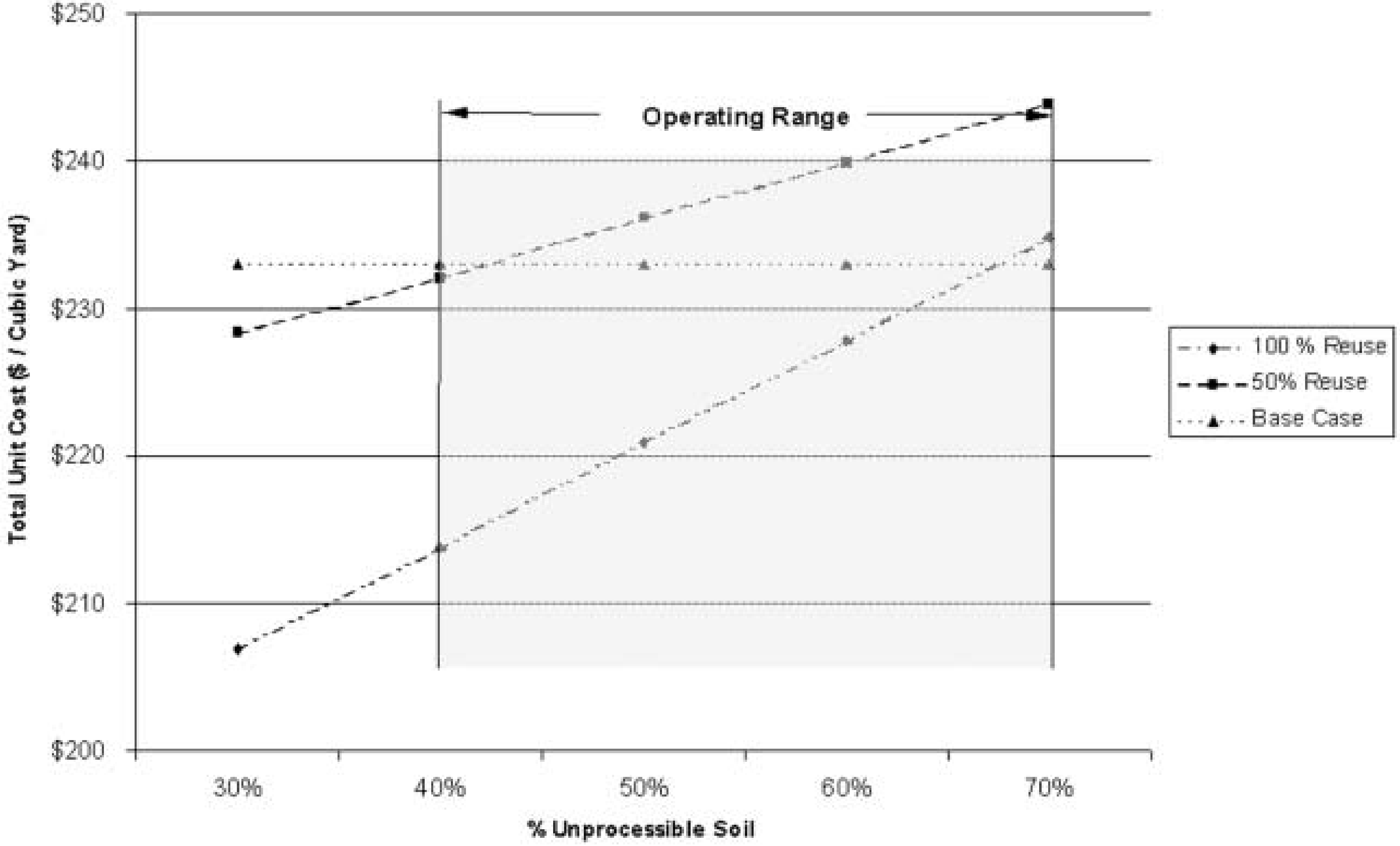


Exhibit 7 – Unit Cost Sensitivity – GSS Processing – Varying Construction Rate

Given: GSS Processing
750 cy/day system capacity
50,000 cy/season max
100 Reuse

Assume:

V = 345,896 cy Fixed for all cases
P = dependant on construction duration and soil throughput see sample calc
D_r = \$233 per cy Fixed
D_a = \$203 per cy Fixed
B_c = \$1.02 per cy Fixed
R = 30% Fixed Coarse Fraction = 30%by volume
r = 100% Fines Fraction = 0%

a % Unprocessible	Construction Rate	P	Process Factor	Rad Disposal	Alt Disposal	Backfill Credit	Unit Cost	Base
40%	300	$51	$ 10,584,414	$ 66,089,163	$ -	$ 63,598	$ 221	$ 233
40%	400	$38	$ 7,886,426	$ 66,089,163	$ -	$ 63,598	$ 214	$ 233
40%	500	$30	$ 6,226,126	$ 66,089,163	$ -	$ 63,598	$ 209	$ 233
40%	600	$25	$ 5,188,438	$ 66,089,163	$ -	$ 63,598	$ 206	$ 233
40%	700	$22	$ 4,565,826	$ 66,089,163	$ -	$ 63,598	$ 204	$ 233
70%	300	$101	$ 10,480,645	$ 73,342,852	$ -	$ 31,799	$ 242	$ 233
70%	400	$76	$ 7,886,426	$ 73,342,852	$ -	$ 31,799	$ 235	$ 233
70%	500	$61	$ 6,329,895	$ 73,342,852	$ -	$ 31,799	$ 230	$ 233
70%	600	$51	$ 5,292,207	$ 73,342,852	$ -	$ 31,799	$ 227	$ 233
70%	700	$43	$ 4,462,057	$ 73,342,852	$ -	$ 31,799	$ 225	$ 233

V = total construction volume
P = process cost per cy
D_r = disposal cost per cy for radiologically-contaminated soil
D_a = disposal cost per cy for non-radiologically-contaminated soil
B_c = credit per cy on backfill for volume of soil reused onsite
R = percent of soil recovered as below criteria
r = percent of recovered soil that can be reused onsite

Exhibit 8 – Unit Cost Sensitivity – GSS Only
(100% Reuse; 30% Coarse Fraction Volume)

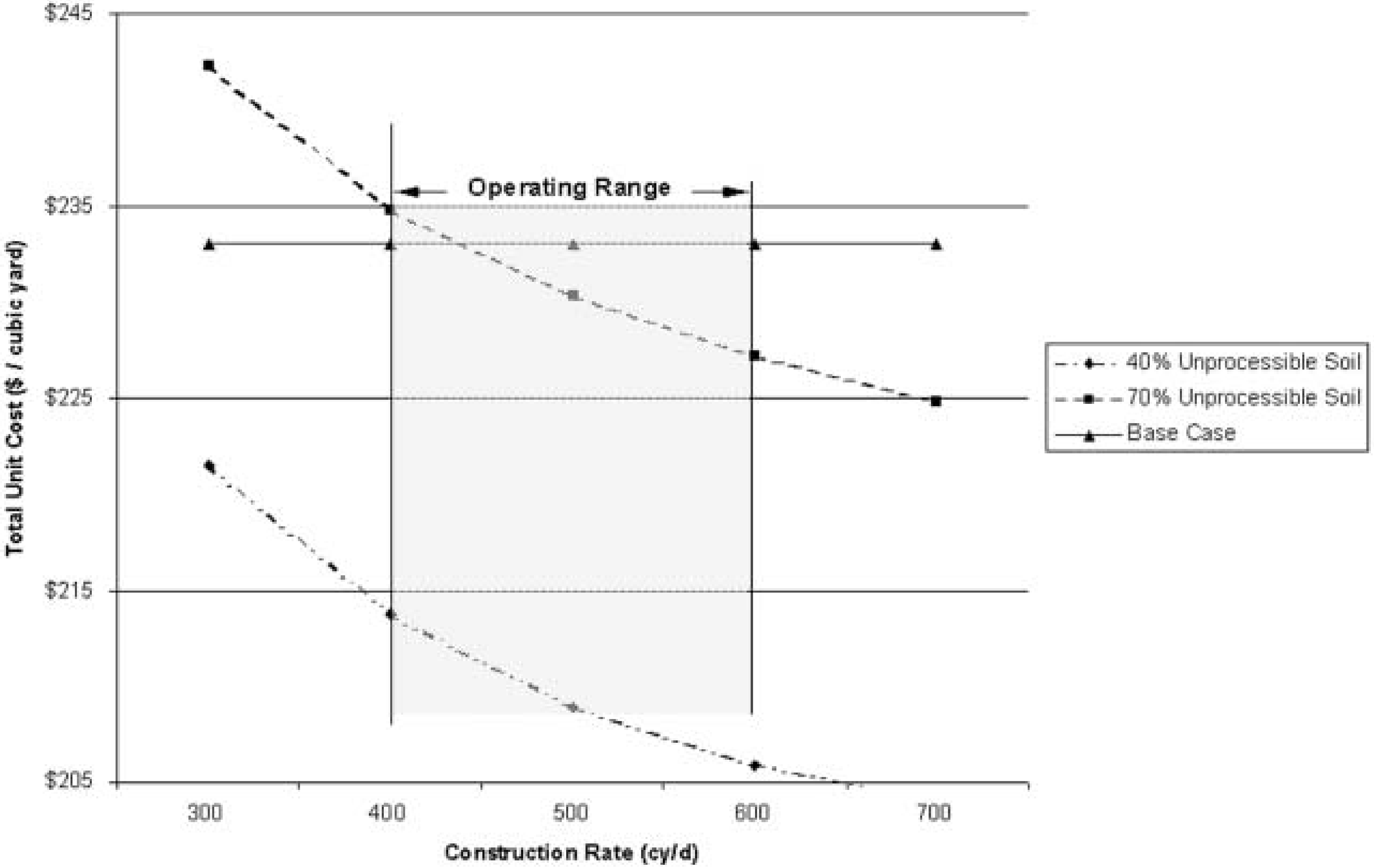


Exhibit 9 – Unit Cost Analysis – GSS Processing Construction Constrained – 400 cy/d

Given: GSS Processing
750 cy/day system capacity
50,000 cy/season max
400 construction rate

Assume:

V =	345,896 cy	Fixed for all cases		
P =		dependant on construction duration and soil throughput see sample calc		
D_r =	$233 per cy	Fixed		
D_a =	$203 per cy	Fixed		
B_c =	$1.02 per cy	Fixed		
R =	15%	Fixed	Coarse Fraction =	15% by volume
			Fines Fraction =	0%

a % Unprocessible	r % Reuse	P	Process Factor	Rad Disposal	Alt Disposal	Backfill Credit	Unit Cost	Base
30%	100%	$33	$ 7,990,195	$ 72,133,904	$ -	$ 37,099	$ 232	$ 233
40%	100%	$38	$ 7,886,426	$ 73,342,852	$ -	$ 31,799	$ 235	$ 233
50%	100%	$46	$ 7,955,605	$ 74,551,800	$ -	$ 26,499	$ 238	$ 233
60%	100%	$57	$ 7,886,426	$ 75,760,748	$ -	$ 21,199	$ 242	$ 233
70%	100%	$76	$ 7,886,426	$ 76,969,696	$ -	$ 15,899	$ 245	$ 233
30%	50%	$33	$ 7,990,195	$ 72,133,904	$ 3,686,532	$ 18,549	$ 242	$ 233
40%	50%	$38	$ 7,886,426	$ 73,342,852	$ 3,159,885	$ 15,899	$ 244	$ 233
50%	50%	$46	$ 7,955,605	$ 74,551,800	$ 2,633,237	$ 13,250	$ 246	$ 233
60%	50%	$57	$ 7,886,426	$ 75,760,748	$ 2,106,590	$ 10,600	$ 248	$ 233
70%	50%	$76	$ 7,886,426	$ 76,969,696	$ 1,579,942	$ 7,950	$ 250	$ 233

V = total construction volume
P = process cost per cy
D_r = disposal cost per cy for radiologically-contaminated soil
D_a = disposal cost per cy for non-radiologically-contaminated soil
B_c = credit per cy on backfill for volume of soil reused onsite
R = percent of soil recovered as below criteria

Exhibit 10 – Unit Cost Analysis – GSS Processing Only
Construction Constrained – 400 cy/d
15% Coarse Fraction Volume

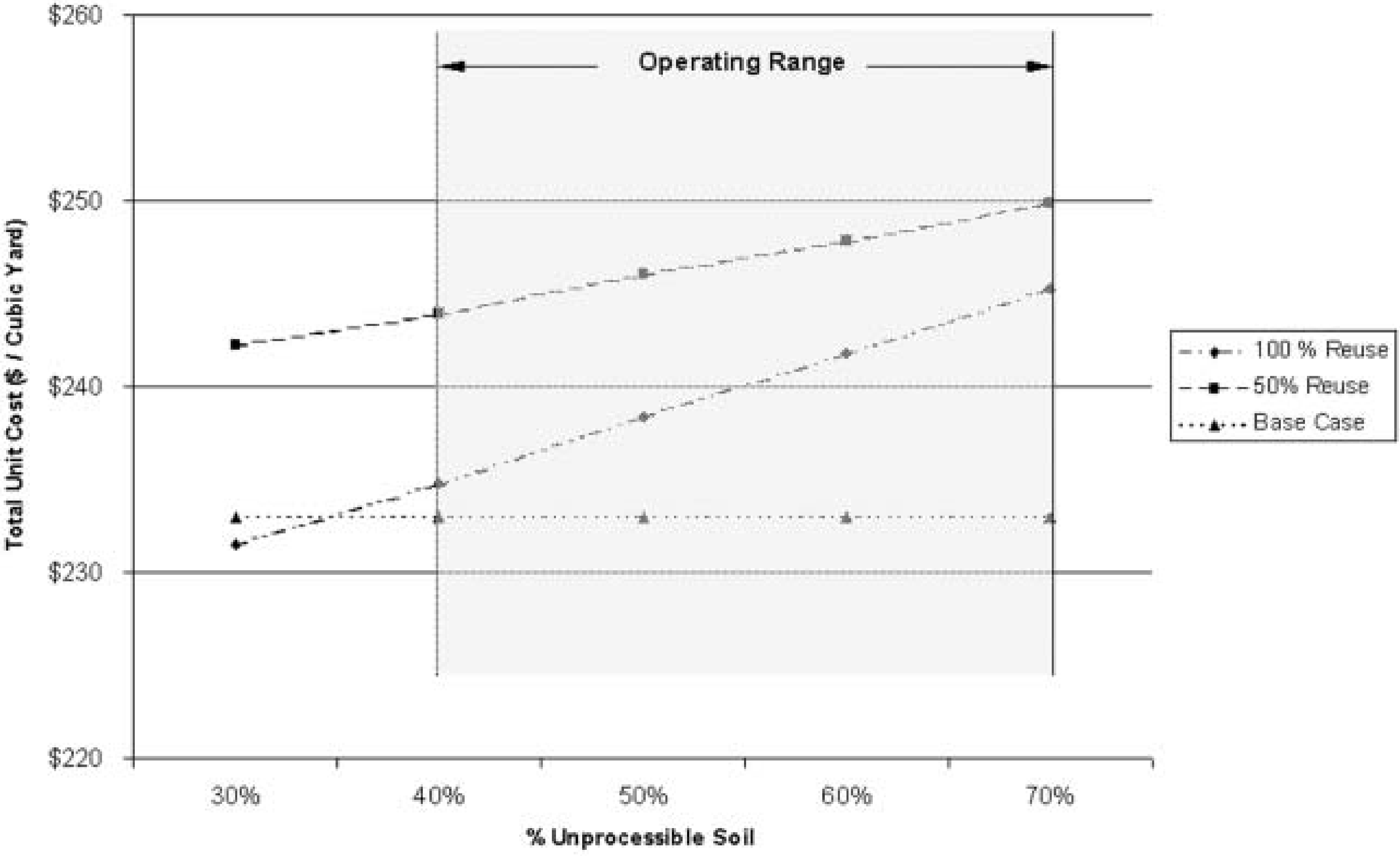


Exhibit 11 – Unit Cost Sensitivity – GSS Processing – Varying Construction Rate

Given: GSS Processing
750 cy/day system capacity
50,000 cy/season max
100 Reuse

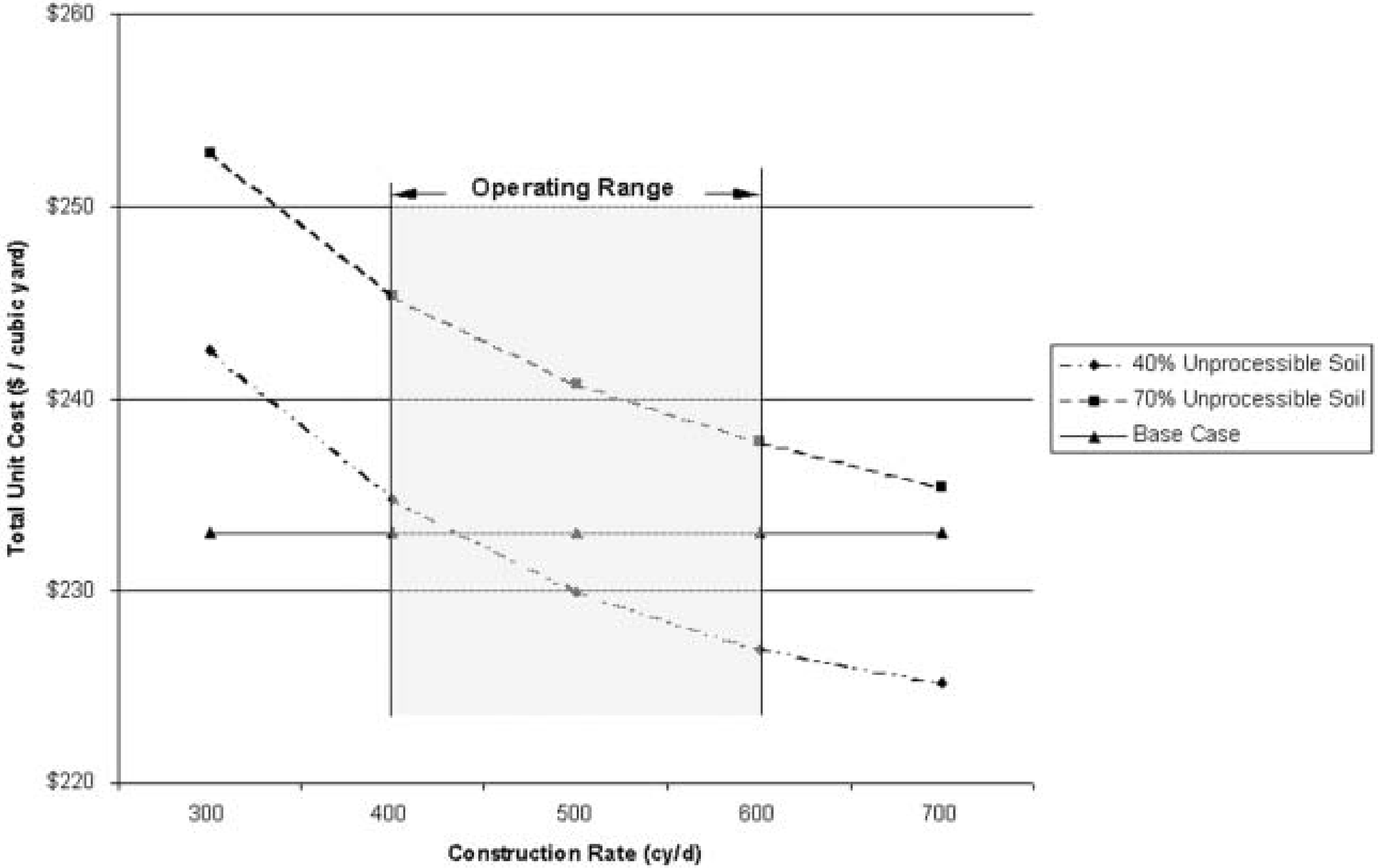
Assume:

V = 345,896 cy Fixed for all cases
P = dependant on construction duration and soil throughput see sample calc
D_r = $233 per cy Fixed
D_a = $203 per cy Fixed
B_c = $1.02 per cy Fixed
R = 15% Fixed Coarse Fraction = 15% by volume
r = 100% Fines Fraction = 0%

a % Unprocessible	Construction Rate	P	Process Factor	Rad Disposal	Alt Disposal	Backfill Credit	Unit Cost	Base
40%	300	$51	$ 10,584,414	$ 73,342,852	$ -	$ 31,799	$ 243	$ 233
40%	400	$38	$ 7,886,426	$ 73,342,852	$ -	$ 31,799	$ 235	$ 233
40%	500	$30	$ 6,226,126	$ 73,342,852	$ -	$ 31,799	$ 230	$ 233
40%	600	$25	$ 5,188,438	$ 73,342,852	$ -	$ 31,799	$ 227	$ 233
40%	700	$22	$ 4,565,826	$ 73,342,852	$ -	$ 31,799	$ 225	$ 233
70%	300	$101	$ 10,480,645	$ 76,969,696	$ -	$ 15,899	$ 253	$ 233
70%	400	$76	$ 7,886,426	$ 76,969,696	$ -	$ 15,899	$ 245	$ 233
70%	500	$61	$ 6,329,895	$ 76,969,696	$ -	$ 15,899	$ 241	$ 233
70%	600	$51	$ 5,292,207	$ 76,969,696	$ -	$ 15,899	$ 238	$ 233
70%	700	$43	$ 4,462,057	$ 76,969,696	$ -	$ 15,899	$ 235	$ 233

V = total construction volume
P = process cost per cy
D_r = disposal cost per cy for radiologically-contaminated soil
D_a = disposal cost per cy for non-radiologically-contaminated soil
B_c = credit per cy on backfill for volume of soil reused onsite
R = percent of soil recovered as below criteria
r = percent of recovered soil that can be reused onsite

Exhibit 12 – Unit Cost Sensitivity – GSS Only
(100% Reuse; 15% Coarse Fraction Volume)



7.0 CONCLUSIONS AND RECOMMENDATIONS

7.1 CONCLUSIONS

7.1.1 Radiological Soil Sorting

The RSS was designed to separate soil containing ROC activity in excess of selected setpoint criteria (rejected soil) from soil containing ROC activity below the selected setpoint criteria (accepted soil). Although construction methods and material handling techniques were varied, no method was discovered that did not result in the significant homogenization of the soils. The mixing of above and below criteria soil prior to the RSS reduces the effectiveness of the RSS. The RSS experienced a 34% acceptance error rate (above criteria material diverted to the below criteria pile) especially at lower setpoint values.

The utility of the U-238 detection and quantitation system on the RSS could not be effectively evaluated, because it was not operational during most of the Pilot Demonstration.

7.1.2 Particle Size Separation

Separation of the excavated soil into different size fractions is a proven mature technology that may provide substantial benefits in reducing the volume of soils requiring off-site disposal. Simple separation at the +3/8-inch size fraction produced an oversize product stream with lower gross activity than the feed soil. An even cleaner break may be achievable with a slightly larger top size, such as +1/2-inch or +3/4-inch. The unrinsed +3/8-inch oversize material met the current criteria of less than 15 pCi/g above background of Ra-226 + Th-232, and less than 50 pCi/g above background of U-238 in 20 out of 24 batches (**Table 14**). Operation of the rinse unit produced a significantly less radioactive oversize material product stream (**Table 15**). This was not surprising, since the radioactivity at the Maywood Site is primarily associated with the finer material.

The oversize product stream may be suitable for non-cohesive backfill for onsite or even off-site applications. In order to meet the geotechnical characteristics for permeability, blending the coarse fraction with finer grain material would be required and would increase process costs slightly.

7.1.3 Chemical Characteristics

In situ soil and processed material from various stockpiles was analyzed to determine if chemical constituents were preferentially concentrated in particular process streams or size fractions. No clear trends were observed. Chemicals were distributed fairly evenly over the various size fractions and process streams. Consistent or significant concentration was not observed in any size fraction or process stream. None of the material analyzed for chemical characteristics constituted a hazardous waste or other waste category requiring special handling or management.

7.1.4 Cost Performance

The cost performance of processing soil is measured in relation to the “base case.” The “base case” involves the cost to load railcars, rail transportation costs, and disposal fees at a licensed disposal facility. Current costs for the base case are in the range of $233 per cy. This number would be expected to drop based on competitive bidding of transportation and disposal services and operation efficiencies of loading under a full-scale construction program. The “process” scenario is considered to have a favorable cost performance if the unit cost for processing the soil is less than the “base case” of $233 per cy.

The cost performance evaluation of the combined RSS/GSS system is problematic given the high rate of acceptance errors of the RSS. Assuming a volume recovery of 30% coarse (+3/8-inch) and a 33% recovery of the fines from the RSS, construction operations that generate at least 423 cy per day would yield favorable cost performance only if all resulting material could be reused onsite and when more than 50% of the excavated soils are suitable for processing. Cost performance improves as the construction rate increases when all other variables remain the same until the equipment is processing material at its optimum capacity. Factors that limit the construction rate include property access and interference's with property owner operations, constraints caused by existing infrastructure, and potential annual funding limits.

Cost performance is sensitive to the volume of excavated material that can or would be processed. Material that clearly exceeds the radiological limits would not be processed by the RSS. Similarly, fine silty-sands and clay deposits from the wetland areas and stream channels might not warrant processing by the GSS due to the low percentage of material greater than 3/8 inch. Some of the material found on the Maywood Site could not be processed. Process waste found in the settling basins on the MISS and Stepan properties could not be processed based on physical characteristics. This material alone could account for over 75,000 cy of the total volume. The fraction of excavated material that would not or could not be processed reduces the cost performance of the overall system since it results in under utilization of the process equipment.

The GSS is a proven and relatively simple technology and the cost performance of operating the GSS alone was evaluated. Factors affecting the "GSS Only" scenario are similar to the GSS/RSS operation. Assuming a 30% volume recovery from +3/8-inch material and 100% reuse of the material onsite, the GSS-only scenario generally shows favorable cost performance. Cost performance of the GSS-only scenario is not cost effective under any condition analyzed if the volume of the coarse fraction equals 15% as estimated in the Engineering Test Pit Study for Maywood Soils. The GSS-only operation is not cost effective under the broader site soil characteristics (15% gravel), the expected percentage of unprocessible soil, and the anticipated daily construction rate.

7.2 RECOMMENDATIONS

7.2.1 Radiological Soil Sorter

The RSS did not demonstrate consistently reliable performance separating above-criteria from below-criteria soil. The RSS technology may be fundamentally unsuited to the type of material present at Maywood and the degree of physical processing required to prepare a feed material to the RSS.

Pending substantial further development and refinement of the existing RSS technology, this approach to volume reduction for the Maywood facility should not receive further consideration.

7.2.2 Gravel Separator

The GSS system can effectively separate coarse material from the finer radiologically-impacted material to a restricted use level (15 pCi/g Ra-226 + Th-232). It is likely that the gravel rinse system could achieve a product that is acceptable for an unrestricted use level (5 pCi/g Ra-226 + Th-232).

The cost performance of the GSS is favorable when the coarse fraction in the excavated material exceeds 30%. Cost performance would be negatively impacted if the percentage of coarse fraction is reduced and/or if the material could not be used onsite. Uncertainty exists in whether the coarse fraction experienced during the Pilot Demonstration Project are representative of the larger population of soils that would be encountered during remediation. The course fraction found from test pits on other areas of the

MISS was only 15% and soil excavated during subsequent remediation on vicinity properties appeared more consistent with the 15% course fraction as well. Additional uncertainty exists in the assumption over the acceptability of the material for reuse. One factor affecting the ability to reuse the material is the potential for chemical contamination that might be coincident with radiological contamination. Stockpiling of material and with intermittent GSS operations would increase cost performance of this technology but has public acceptability and site operability constraints. Based upon the operational problems / limitations of the system on the MISS, the uncertainties associated with water treatment and percent course fraction of the soil, and the cost analysis of the operating the system, it appears the potential benefits offered by the system are minimal. Therefore, it is recommended that the GSS-only scenario not be considered for use during remedial action at the FMSS site.

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TABLES

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Table 1a
Fractionation Tank Radiological Water Sample Results Summary

Process Date	S&W Full Sample ID	Batch ID	Analyte	Analytic Result	Units of Measure	MDA	Uncertainty	MAT_DESC	Lift ID
10/05/2000	12b-PT1-HN-FRC-SW-0-035388	TEST 2	GAlpha	126.98	pCi/L	0.94	4.76777	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035388	TEST 2	GBeta	58.42	pCi/L	1.33	2.22013	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035388	TEST 2	Ra-226	6.62	pCi/L	0.64	1.398	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035388	TEST 2	Ra-228	13.68	pCi/L	1.90	2.27062	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035388	TEST 2	Tot-U	6.91	µg/L	0.03	0.13870	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035388	TEST 2	Tot-U	4.68	PCi/L	0.02	0.09390	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	GAlpha	43.71	PCi/L	1.19	2.73720	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	GAlpha	41.10	PCi/L	2.55	4.63	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	GAlpha	41.10	PCi/L	2.55	4.63	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	GBeta	22.15	PCi/L	2.00	2.17	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	GBeta	22.15	PCi/L	2.00	2.17	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	GBeta	21.96	PCi/L	0.99	1.35440	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	Ra-226	2.08	PCi/L	0.18	0.3905	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	Ra-228	4.97	PCi/L	0.46	0.59546	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	Tot-U	3.46	µg/L	0.03	0.07068	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035389	TEST 2	Tot-U	2.35	PCi/L	0.02	0.04785	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035390	TEST 2	GAlpha	49.16	pCi/L	1.11	2.83574	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035390	TEST 2	GBeta	23.83	pCi/L	0.93	1.32106	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035390	TEST 2	Ra-226	2.14	pCi/L	0.10	0.4	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035390	TEST 2	Ra-228	5.48	pCi/L	0.41	0.56069	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035390	TEST 2	Tot-U	3.83	µg/L	0.03	0.10664	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035390	TEST 2	Tot-U	2.60	pCi/L	0.02	0.07219	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035391	TEST 2	GAlpha	1483.70	pCi/L	7.05	39.87752	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035391	TEST 2	GBeta	599.17	pCi/L	7.46	15.17721	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035391	TEST 2	Ra-226	44.78	pCi/L	0.82	5.369	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035391	TEST 2	Ra-228	158.83	pCi/L	2.39	5.61406	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035391	TEST 2	Tot-U	40.39	µg/L	0.03	4.97996	U	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035391	TEST 2	Tot-U	27.34	pCi/L	0.02	3.37143	U	2

Table 1a
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Process Date	S&W Full Sample ID	Batch ID	Analyte	Analytic Result	Units of Measure	MDA	Uncertainty	MAT_DESC	Lift ID
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	GAlpha	1140.73	pCi/L	6.20	28.14	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	GAlpha	1140.73	pCi/L	6.20	28.14	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	GAlpha	1124.84	pCi/L	2.98	23.56023	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	GBeta	572.25	pCi/L	5.32	12.16	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	GBeta	572.25	pCi/L	5.32	12.16	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	GBeta	541.54	pCi/L	3.67	9.15736	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	Ra-226	33.24	pCi/L	0.17	3.331	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	Ra-228	164.30	pCi/L	0.59	2.67745	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	Tot-U	8.90	µg/L	0.03	1.87427	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035392	TEST 2	Tot-U	6.02	pCi/L	0.02	1.26888	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035393	TEST 2	GAlpha	135.18	pCi/L	0.82	4.58998	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035393	TEST 2	GBeta	60.37	pCi/L	0.88	1.74823	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035393	TEST 2	Ra-226	9.26	pCi/L	0.24	1.347	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035393	TEST 2	Ra-228	18.14	pCi/L	0.42	0.84890	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035393	TEST 2	Tot-U	11.85	µg/L	0.03	0.26496	F	2
10/05/2000	12b-PT1-HN-FRC-SW-0-035393	TEST 2	Tot-U	8.03	pCi/L	0.02	0.17938	F	2
10/06/2000	12b-PT1-HN-FRC-SW-0-035401	7-1	GAlpha	12624.82	pCi/L	90.52	369.8766	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035401	7-1	GBeta	5799.55	pCi/L	78.27	161.6395	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035401	7-1	Ra-226	19.75	pCi/L	0.31	2.63	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035401	7-1	Ra-228	-1.40	pCi/L	2.25	1.15302	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035401	7-1	Tot-U	0.46	µg/L	0.03	0.02853	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035401	7-1	Tot-U	0.31	pCi/L	0.02	0.01931	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	GAlpha	2222.81	pCi/L	10.68	51.39	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	GAlpha	2222.81	pCi/L	10.68	51.39	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	GAlpha	1989.53	pCi/L	10.53	49.71667	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	GBeta	934.66	pCi/L	8.58	19.71	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	GBeta	934.66	pCi/L	8.58	19.71	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	GBeta	931.65	pCi/L	7.97	19.76536	F	1

Table 1a
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Process Date	S&W Full Sample ID	Batch ID	Analyte	Analytic Result	Units of Measure	MDA	Uncertainty	MAT_DESC	Lift ID
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	Ra-226	149.50	pCi/L	0.20	14.69	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	Ra-228	221.19	pCi/L	0.58	3.32299	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	Tot-U	0.26	µg/L	0.03	0.01657	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035402	7-1	Tot-U	0.18	pCi/L	0.02	0.01122	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035403	7-1	GAlpha	566.00	pCi/L	1.81	10.90346	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035403	7-1	GBeta	396.99	pCi/L	1.37	5.09054	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035403	7-1	Ra-226	5.19	pCi/L	0.86	1.442	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035403	7-1	Ra-228	92.39	pCi/L	5.32	7.35820	U	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035403	7-1	Tot-U	71.55	µg/L	0.03	2.57956	F	1
10/06/2000	12b-PT1-HN-FRC-SW-0-035403	7-1	Tot-U	48.44	pCi/L	0.02	1.74636	F	1
10/10/2000	12b-PT1-HN-FRC-SW-0-035415	8-3	GAlpha	53.13	pCi/L	1.82	4.14	U	1
10/10/2000	12b-PT1-HN-FRC-SW-0-035415	8-3	GBeta	27.04	pCi/L	1.52	2.04	U	1
10/10/2000	12b-PT1-HN-FRC-SW-0-035415	8-3	Tot-U	19.80	µg/L	0.03	0.92	U	1
10/10/2000	12b-PT1-HN-FRC-SW-0-035415	8-3	Tot-U	13.40	pCi/L	0.02	0.62	U	1
10/19/2000	12b-PT1-HN-FRC-SW-0-035614	7-4	GAlpha	39.63	pCi/L	4.82	6.84589	U	2
10/19/2000	12b-PT1-HN-FRC-SW-0-035614	7-4	GBeta	25.98	pCi/L	2.99	3.04078	U	2
10/19/2000	12b-PT1-HN-FRC-SW-0-035614	7-4	Ra-226	2.78	pCi/L	0.15	0.5186	U	2
10/19/2000	12b-PT1-HN-FRC-SW-0-035614	7-4	Ra-228	5.40	pCi/L	0.55	0.66450	U	2
10/19/2000	12b-PT1-HN-FRC-SW-0-035614	7-4	Tot-U	18.99	µg/L	0.03	1.26759	U	2
10/19/2000	12b-PT1-HN-FRC-SW-0-035614	7-4	Tot-U	12.86	pCi/L	0.02	0.85816	U	2
10/23/2000	12b-PT1-HN-FRC-SW-0-035628	6-3	GAlpha	43.05	pCi/L	2.75	4.64348	U	2
10/23/2000	12b-PT1-HN-FRC-SW-0-035628	6-3	GBeta	28.69	pCi/L	2.80	3.30390	U	2
10/23/2000	12b-PT1-HN-FRC-SW-0-035628	6-3	Ra-226	13.84	pCi/L	1.79	3.134	U	2
10/23/2000	12b-PT1-HN-FRC-SW-0-035628	6-3	Ra-228	12.62	pCi/L	2.09	2.27297	U	2
10/23/2000	12b-PT1-HN-FRC-SW-0-035628	6-3	Tot-U	9.70	µg/L	0.03	0.579	U	2
10/23/2000	12b-PT1-HN-FRC-SW-0-035628	6-3	Tot-U	6.57	pCi/L	0.02	0.39224	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035654	6-3	GAlpha	18.09	pCi/L	1.82	2.77633	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035654	6-3	GBeta	19.71	pCi/L	1.74	2.12450	U	2

Table 1a
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Process Date	S&W Full Sample ID	Batch ID	Analyte	Analytic Result	Units of Measure	MDA	Uncertainty	MAT_DESC	Lift ID
10/24/2000	12b-PT1-HN-FRC-SW-0-035654	6-3	Ra-226	1.11	pCi/L	0.19	0.3191	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035654	6-3	Ra-228	2.41	pCi/L	0.38	0.42189	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035654	6-3	Tot-U	8.00	µg/L	0.03	0.401	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035654	6-3	Tot-U	5.41	pCi/L	0.02	0.27133	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035690	6-3	GAlpha	549.68	pCi/L	4.27	16.09583	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035690	6-3	GBeta	222.02	pCi/L	3.54	6.31743	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035690	6-3	Ra-226	29.57	pCi/L	0.78	3.865	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035690	6-3	Ra-228	36.91	pCi/L	1.08	1.83137	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035690	6-3	Tot-U	16.20	µg/L	0.03	1.72	U	2
10/24/2000	12b-PT1-HN-FRC-SW-0-035690	6-3	Tot-U	10.99	pCi/L	0.02	1.16505	U	2
10/25/2000	12b-PT1-HN-FRC-SW-0-035711	7-4	GAlpha	303.62	pCi/L	4.55	14.47113	U	2
10/25/2000	12b-PT1-HN-FRC-SW-0-035711	7-4	GBeta	123.12	pCi/L	2.63	4.77528	U	2
10/25/2000	12b-PT1-HN-FRC-SW-0-035711	7-4	Ra-226	102.40	pCi/L	2.39	12.64	U	2
10/25/2000	12b-PT1-HN-FRC-SW-0-035711	7-4	Ra-228	115.02	pCi/L	3.19	5.58226	U	2
10/25/2000	12b-PT1-HN-FRC-SW-0-035711	7-4	Tot-U	10.80	µg/L	0.03	1.09	U	2
10/25/2000	12b-PT1-HN-FRC-SW-0-035711	7-4	Tot-U	7.32	pCi/L	0.02	0.73681	U	2
10/31/2000	12b-PT1-HN-FRC-SW-0-035755	6-6	GAlpha	19.30	pCi/L	1.96	2.91918	U	2
10/31/2000	12b-PT1-HN-FRC-SW-0-035755	6-6	GBeta	21.24	pCi/L	1.22	1.62192	U	2
10/31/2000	12b-PT1-HN-FRC-SW-0-035755	6-6	Ra-226	1.72	pCi/L	0.16	0.3927	U	2
10/31/2000	12b-PT1-HN-FRC-SW-0-035755	6-6	Ra-228	3.94	pCi/L	0.38	0.46737	U	2
10/31/2000	12b-PT1-HN-FRC-SW-0-035755	6-6	Tot-U	11.56	µg/L	0.03	1.02482	U	2
10/31/2000	12b-PT1-HN-FRC-SW-0-035755	6-6	Tot-U	7.83	pCi/L	0.02	0.694	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035770	6-6	GAlpha	43.18	pCi/L	2.36	4.45396	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035770	6-6	GBeta	27.31	pCi/L	2.01	2.50359	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035770	6-6	Ra-226	2.67	pCi/L	0.23	0.5718	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035770	6-6	Ra-228	4.08	pCi/L	0.57	0.63712	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035770	6-6	Tot-U	10.40	µg/L	0.03	0.55	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035770	6-6	Tot-U	7.05	pCi/L	0.02	0.37203	U	2

Table 1a
Fractionation Tank Radiological Water Sample Results Summary

Process Date	S&W Full Sample ID	Batch ID	Analyte	Analytic Result	Units of Measure	MDA	Uncertainty	MAT_DESC	Lift ID
11/01/2000	12b-PT1-HN-FRC-SW-0-035775	6-6	GAlpha	2912.73	pCi/L	69.22	158.7391	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035775	6-6	GBeta	1449.66	pCi/L	37.00	58.80529	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035775	6-6	Ra-226	67.25	pCi/L	0.71	7.733	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035775	6-6	Ra-228	68.45	pCi/L	1.02	2.30091	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035775	6-6	Tot-U	11.80	µg/L	0.03	1.27	U	2
11/01/2000	12b-PT1-HN-FRC-SW-0-035775	6-6	Tot-U	7.99	pCi/L	0.02	0.86048	U	2
11/02/2000	12b-PT1-HN-FRC-SW-0-035789	FCR #1	GAlpha	48.54	pCi/L	5.07	7.14011	U	NA
11/02/2000	12b-PT1-HN-FRC-SW-0-035789	FCR #1	GBeta	33.51	pCi/L	3.42	4.09021	U	NA
11/02/2000	12b-PT1-HN-FRC-SW-0-035789	FCR #1	Ra-226	3.71	pCi/L	0.28	0.7212	U	NA
11/02/2000	12b-PT1-HN-FRC-SW-0-035789	FCR #1	Ra-228	5.13	pCi/L	0.49	0.60648	U	NA
11/02/2000	12b-PT1-HN-FRC-SW-0-035789	FCR #1	Tot-U	15.84	µg/L	0.03	1.08821	U	NA
11/02/2000	12b-PT1-HN-FRC-SW-0-035789	FCR #1	Tot-U	10.70	pCi/L	0.02	0.737	U	NA

Notes:
pCi/L = picocuries per liter
µg/L = Micrograms per liter
MAT_DESC = Material description
U = Unfiltered
F = Filtered
Lift ID = Identified excavation layer number for the Soil Acquisition Area

Table 1b
Fractional Tank Chemical Water Sample Results Summary

Date of Sample Collection	S&W Full Sample ID	Analysis Name	Analytic Result	Result Qualifier	Units	IDL	Dilution	Batch ID	Analyte Group
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Methoxychlor		U	µg/L	0.5	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Aroclor-1242		U	µg/L	1	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Aroclor-1232		U	µg/L	1	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Aroclor-1221		U	µg/L	2	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Aroclor-1016		U	µg/L	1	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Toxaphene		U	µg/L	2.5	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	gamma-Chlordane	0.02	J	µg/L	0.05	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	alpha-Chlordane		U	µg/L	0.05	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Aluminum, Total	497.00		µg/L	200	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Endrin Ketone		U	µg/L	0.1	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Aroclor-1260		U	µg/L	1	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4,4'-DDT		U	µg/L	0.1	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Endosulfan Sulfate		U	µg/L	0.1	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4,4'-DDD	0.05	J	µg/L	0.1	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Endosulfan II		U	µg/L	0.1	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Endrin		U	µg/L	0.1	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4,4'-DDE	0.03	J	µg/L	0.1	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Dieldrin		U	µg/L	0.1	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Endrin Aldehyde		U	µg/L	0.1	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Bis(2-Chloroisopropyl) ether		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2,4-Dichlorophenol		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Bis(2-Chloroethoxy) methane		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2,4-Dimethylphenol		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2-Nitrophenol		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Isophorone		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Nitrobenzene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Hexachloroethane		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Aroclor-1248		U	µg/L	1	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4-Methylphenol		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Aroclor-1254		U	µg/L	1	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2-Methylphenol		U	µg/L	10	1	FCR #3	SVOC

Table 1b
Fractional Tank Chemical Water Sample Results Summary

Date of Sample Collection	S&W Full Sample ID	Analysis Name	Analytic Result	Result Qualifier	Units	IDL	Dilution	Batch ID	Analyte Group
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,2-Dichlorobenzene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,4-Dichlorobenzene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,3-Dichlorobenzene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2-Chlorophenol		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Bis(2-Chloroethyl) ether		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Phenol		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Aldrin	0.19		µg/L	0.05	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	N-Nitroso-di-n-propylamine		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Copper, Total	20.50	B	µg/L	25	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Endosulfan I		U	µg/L	0.05	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Potassium, Total	26500.00		µg/L	5000	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Nickel, Total	5.10	B	µg/L	40	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Molybdenum, Total	11.30	B	µg/L	20	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Mercury, Total	0.10	U	µg/L	0.2	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Manganese, Total	1390.00		µg/L	15	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Magnesium, Total	25000.00		µg/L	5000	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Silver, Total	1.00	U	µg/L	10	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Iron, Total	2020.00		µg/L	100	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Sodium, Total	33900.00		µg/L	5000	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Cobalt, Total	1.90	B	µg/L	50	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Chromium, Total	27.00		µg/L	10	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Calcium, Total	334000.00		µg/L	5000	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Cadmium, Total	0.50	U	µg/L	5	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Beryllium, Total	0.50	U	µg/L	5	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Barium, Total	51.70	B	µg/L	200	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Arsenic, Total	5.00	U	µg/L	10	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Antimony, Total	5.00	U	µg/L	60	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Lead, Total	20.40		µg/L	3	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Reactivity	0.00			0	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4-Chloroaniline		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Heptachlor	0.14		µg/L	0.05	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	gamma-BHC (Lindane)		U	µg/L	0.05	1	FCR #3	Pesticides

Table 1b
Fractional Tank Chemical Water Sample Results Summary

Date of Sample Collection	S&W Full Sample ID	Analysis Name	Analytic Result	Result Qualifier	Units	IDL	Dilution	Batch ID	Analyte Group
11/15/00	12b-PT1-HN-FRC-ID-0-035868	delta-BHC	0.04	J	µg/L	0.05	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	beta-BHC	0.06		µg/L	0.05	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	alpha-BHC	0.01	J	µg/L	0.05	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Corrosivity by pH	7.41		S.U.	0	1	FCR #3	Char
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Selenium, Total	5.00	U	µg/L	5	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Sulfide, Reactive	10.00	U	mg/kg	10	1	FCR #3	Char
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Heptachlor Epoxide		U	µg/L	0.05	1	FCR #3	Pesticides
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Petroleum Hydrocarbons	1.00	U	mg/L	1	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Oil and Grease	2.90		mg/L	1	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Cyanide, Reactive	0.50	U	mg/kg	0.5	1	FCR #3	Char
11/15/00	12b-PT1-HN-FRC-ID-0-035868	BOD5	2.00	U	mg/L	2	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Ammonia	3.99		mg/L	0.04	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Zinc, Total	186.00		µg/L	20	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Vanadium, Total	5.20	B	µg/L	50	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Thallium, Total	7.00	U	µg/L	10	1	FCR #3	Metals
11/15/00	12b-PT1-HN-FRC-ID-0-035868	TSS	5.00	U	mg/L	5	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Methylene Chloride	0.40	J	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Benzo(k)fluoranthene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Chloroform	0.70	J	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,2-Dichloroethene (trans)		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,2-Dichloroethene (cis)		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,1-Dichloroethane		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,1-Dichloroethene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Vinyl Acetate		U	µg/L	10	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2-Butanone	4.00	J	µg/L	10	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Acetone	9.00	J	µg/L	10	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,1,1-Trichloroethane		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Chloroethane		U	µg/L	10	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Vinyl Chloride		U	µg/L	10	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Bromomethane		U	µg/L	10	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Chloromethane		U	µg/L	10	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Benzo(g,h,i)perylene		U	µg/L	10	1	FCR #3	SVOC

Table 1b
Fractional Tank Chemical Water Sample Results Summary

Date of Sample Collection	S&W Full Sample ID	Analysis Name	Analytic Result	Result Qualifier	Units	IDL	Dilution	Batch ID	Analyte Group
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Dibenzo(a,h)anthracene		U	µg/L	10	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Indeno(1,2,3-cd)pyrene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,2,4-Trichlorobenzene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Carbon Disulfide		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Trans-1,3-Dichloropropene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Styrene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Ethylbenzene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Chlorobenzene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,1,2,2-Tetrachloroethane		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Toluene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Tetrachloroethene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2-Hexanone		U	µg/L	10	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,2-Dichloroethane		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Bromoform		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Benzo(b)fluoranthene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Benzene	0.20	J	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,1,2-Trichloroethane		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Dibromochloromethane		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Trichloroethene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	cis-1,3-Dichloropropene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	1,2-Dichloropropane		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Bromodichloromethane		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Carbon Tetrachloride		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4-Methyl-2-Pentanone		U	µg/L	10	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2-Nitroaniline		U	µg/L	50	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Benzo(a)pyrene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Dibenzofuran		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4-Nitrophenol		U	µg/L	50	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2,4-Dinitrophenol		U	µg/L	50	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Acenaphthene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	3-Nitroaniline		U	µg/L	50	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2,6-Dinitrotoluene		U	µg/L	10	1	FCR #3	SVOC

Table 1b
Fractional Tank Chemical Water Sample Results Summary

Date of Sample Collection	S&W Full Sample ID	Analysis Name	Analytic Result	Result Qualifier	Units	IDL	Dilution	Batch ID	Analyte Group
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Diethylphthalate		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Dimethylphthalate		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4-Chlorophenyl-phenyl ether		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2-Chloronaphthalene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2,4,5-Trichlorophenol		U	µg/L	50	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2,4,6-Trichlorophenol		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Hexachlorocyclopentadiene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2-Methylnaphthalene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4-Chloro-3-methylphenol		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Hexachlorobutadiene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Total Xylene		U	µg/L	5	1	FCR #3	VOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Acenaphthylene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Anthracene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Di-n-octylphthalate		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	bis(2-Ethylhexyl)phthalate		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Chrysene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Benzo(a)anthracene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	3,3'-Dichlorobenzidine		U	µg/L	20	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Butyl benzyl phthalate		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Pyrene	0.30	J	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	2,4-Dinitrotoluene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Di-n-butylphthalate		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Naphthalene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Phenanthrene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Pentachlorophenol		U	µg/L	50	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Hexachlorobenzene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4-Bromophenyl-phenyl ether		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	N-nitroso diphenylamine	1.00	J	µg/L	10	1	FCR #3	
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4,6-Dinitro-2-methylphenol		U	µg/L	50	1	FCR #3	SVOC

Table 1b
Fractional Tank Chemical Water Sample Results Summary

Date of Sample Collection	S&W Full Sample ID	Analysis Name	Analytic Result	Result Qualifier	Units	IDL	Dilution	Batch ID	Analyte Group
11/15/00	12b-PT1-HN-FRC-ID-0-035868	4-Nitroaniline		U	µg/L	50	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Fluorene		U	µg/L	10	1	FCR #3	SVOC
11/15/00	12b-PT1-HN-FRC-ID-0-035868	Fluoranthene		U	µg/L	10	1	FCR #3	SVOC

Notes:
U - Non-detected
J – Estimated Result Value
B – Blank Contamination
µg/L – microgram per liter
mg/kg – milligram per kilogram

Tab
Radiological Samp

Sample Location	Testing Location	Sample Type / Media	Fre
In situ – Prior to Excavation (Screen/Sample Location 1)(2)	Field Screening	Scan / Soil	Entire li
	Onsite Laboratory	Grab / Soil	One sample per
Test Run Material	Field Screening	Scan / Soil	Entire stocl
	Offsite Laboratory	Grab / Soil	Or
Material Not Processed (Screen/Sample Location 2) (2)	Field Screening	Scan / Bulk (Oversize construction debris and trash)	Entire stocl
	Onsite Laboratory	Wipe / Bulk (Oversize construction debris)	One sample per batch or 5
	Onsite Laboratory	Grab / Soil	One sample per 50 cubic y below criteria soil, based
Output from Gravel Separation *Oversize and Debris (> 6 inches)* (Screen/Sample Location 3) (2)	Field Screening	Scan / Bulk	100% scan of each slug st
	Onsite Laboratory	Wipe / Bulk (Oversize construction debris)	One sample per batch or 5
Output from Gravel Separation (prior to rinse) *Coarse Material (3/8 – 6 inches)* (Screen/Sample Location 4) (2)	Onsite Laboratory	Grab / Soil	4-5 samples over
Output from Gravel Rinse *Filter Cake* (Screen/Sample Location 5) (2)	Onsite Laboratory	Grab / Sludge	One samp
Output from Gravel Rinse *Coarse Material (3/8 – 6 inches)* (Screen/Sample Location 6) (2)	Field Screening	Scan / Soil	100% scan of each slug st
	Onsite Laboratory	Grab / Soil	One sample for each batch c
Output from Gravel Separation and Rinse/ Input to Radiological Soil Sorting (< 3/8 inch) (Screen/Sample Location 7) (2)	Onsite Laboratory	Composite / Soil	4-5 samples over
	Onsite Laboratory	Grab / Soil	Three sa
Output from Radiological Soil Sorting *Above Criteria* (Screen/Sample Location 8) (2)	Field Screening	Scan / Soil	100% scan of
	Onsite Laboratory	Grab / Soil	Three samples for each slug 50 cubic yarc
Output from Radiological Soil Sorting *Below Criteria* (Screen/Sample Location 9) (2)	Field Screening	Scan / Soil	100% scan of
	Onsite Laboratory	Grab / Soil	Three samples for each slug 50 cubic yarc
Final Status Survey – Refer to Soil Acquisition Plan in Volume 2	Offsite Laboratory	Grab / Soil	To be su
Excavation Water (if not used for dust control)	Offsite Laboratory	Grab / Water	One samp
Process Wastewater	Offsite Laboratory	Grab / Water	One samp
Decontamination Wastewater (if not used for dust control)	Offsite Laboratory	Grab / Water	One sar

Notes:

1. A batch consists of a pre-determined quantity of soil with characteristics which satisfy a specific objective. Each slug (consisting of 8 – 10 cubic yards within the batch) will undergo detailed sampling to facilitate activity tracking. Slugs will be processed one per batch initially, and less frequently as the objectives are realized. In addition, QA/QC samples will be collected at a frequency of ten percent each for all samples.
2. Refer to Figure 3 for Screen/Sample Locations

Tab
Chemical & Geotechnical

Sample Location	Testing Location	Sample Type / Media	Frequ
In situ Prior to Excavation (Sample location 1) (3)	Offsite Laboratory	Grab / Soil	Approximately one sample per 1
Test Run Material	Offsite Laboratory	Grab / Soil	One sa
Material Not Processed (Screen/Sample Location 2) (3)	Offsite Laboratory	Grab / Soil	One sample per 50 cubic yards below criteria soil, based
	Offsite Laboratory	Wipe / Bulk (Oversize construction debris)	One sample per batch or 50 c
Output from Gravel Separation *Oversize and Debris (> 6 inches)* (Screen/Sample Location 3) (3)	Offsite Laboratory	Wipe / Bulk (Oversize construction debris)	One sample per batch or 50 c
Output from Gravel Rinse *Filter Cake* (Sample Location 5) (3)	Offsite Laboratory	Grab / Sludge	One sample f
Output from Gravel Rinse *Coarse Material (3/8 – 6 inches)* (Sample Location 6) (3)	Offsite Laboratory	Grab / Soil	One sample per batch or 50 c
Output from Gravel Separation and Rinse Input to Radiological Soil Sorting (< 3/8 inch) (Sample Location 7) (3)	Offsite Laboratory	Composite / Soil	4-5 samples over cou
Output from Radiological Soil Sorting *Above Criteria* (Sample Location 8) (3)	Offsite Laboratory	Grab / Soil	One sample per batch or 50 c
Output from Radiological Soil Sorting *Below Criteria* (Sample Location 9) (3)	Offsite Laboratory	Grab / Soil	One sample per batch or 50 c
Excavation Water (if not used for dust control)	Offsite Laboratory	Grab / Water	One sample
Process Wastewater	Offsite Laboratory	Grab / Water	One sample
Decontamination Wastewater (if not used for dust control)	Offsite Laboratory	Grab / Water	One sampl

Notes:

1. A batch consists of a pre-determined quantity of soil with characteristics which satisfy a specific objective. Each slug (consisting of 8 – 10 cubic
   batch) will undergo detailed sampling to facilitate mass and activity tracking. Slugs will be processed one per batch initially, and less frequently a
   objectives are realized. In addition, QA/QC samples will be collected at a frequency of ten percent each for all samples.
2. Waste Characteristics consist of pH, TCLP, Total Organic Halides, Paint Filter Liquid Test, Flashpoint, Reactive Cyanide, and Reactive Sulfide.
   water analyses listed are provided as example only. Disposal analyses to be performed in accordance with the permit for the selected receiving fa
3. Refer to Figure 3 for Screen/Sample Locations

Table 4
Percent Oversize Removal

Batch ID	Total Mass (tons)	Oversize Mass (tons)	Percent (%) Oversize, >3/8-inch to <6-inch
1	38.685	10.420	26.90%
2	56.130	14.355	25.60%
3	142.840	31.180	21.80%
4	58.565	13.950	23.80%
5	101.745	28.800	28.30%
7	170.815	59.315	34.70%
8	142.630	44.840	31.40%
9	108.840	38.485	35.40%
1-1	741.020	287.660	38.80%
8-1	271.570	68.025	25.00%
8-2	300.890	52.370	17.40%
6-1	267.000	57.050	21.40%
1-3	127.000	48.400	38.10%
1-5	174.495	48.325	27.70%
Batch Test #2	26.200	9.200	35.10%
7-1	259.200	94.200	36.30%
8-3	354.620	99.780	28.10%
Sequence #5	15.940	3.900	24.50%
7-4	115.230	44.240	38.40%
7-5	196.960	77.165	39.20%
7-6	227.500	108.800	47.80%
6-6	191.700	62.800	32.80%
6-7	371.000	121.100	32.60%
8-5	205.400	67.200	32.70%
Recycled Water Test	17.700	4.200	23.70%
Full Capacity Run #1	504.400	117.410	23.30%
Full Capacity Run #2	138.900	36.300	26.10%
Full Capacity Run #3	476.800	130.200	27.30%
Full Capacity Run #4	749.500	332.500	44.40%
		Total Average	31.85%

Table 5
Gravel Separation System Production Rates

Date	GSS Production Hours	Weight (tons)	GSS Production (tons/hr)
08/17/2000	3.00	7.92	2.64
08/18/2000	2.50	38.69	15.47
08/21/2000	5.00	56.13	11.23
08/22/2000	5.33	142.84	26.80
08/23/2000	3.16	58.57	18.53
08/24/2000	4.00	101.75	25.44
08/28/2000	5.49	170.82	31.11
08/29/2000	3.75	142.63	38.03
08/30/2000	3.08	108.84	35.34
08/31/2000	4.96	147.68	29.77
09/01/2000	4.08	128.00	31.37
09/05/2000	2.75	88.13	32.05
09/06/2000	4.83	205.08	42.46
09/07/2000	2.88	182.27	63.29
09/08/2000	4.08	132.91	32.57
09/11/2000	2.83	99.03	34.99
09/13/2000	5.91	118.80	20.10
09/14/2000	5.83	221.52	38.00
09/21/2000	7.33	105.47	14.39
09/26/2000	3.33	79.52	23.88
09/27/2000	1.50	127.00	84.67
10/02/2000	4.37	52.32	11.97
10/03/2000	4.16	174.50	41.95
10/04/2000	3.16	42.50	13.45
10/05/2000	3.25	46.10	14.18
10/06/2000	2.91	84.70	29.11
10/09/2000	7.16	174.50	24.37
10/10/2000	4.16	172.60	41.49
10/11/2000	6.66	119.10	17.88
10/12/2000	4.16	68.50	16.47
10/13/2000	2.24	30.90	13.79
10/16/2000	4.16	163.72	39.35
10/17/2000	6.33	41.10	6.49
10/18/2000	2.16	28.70	13.29
10/19/2000	4.04	84.90	21.01
10/20/2000	2.49	30.84	12.39
10/23/2000	4.66	47.04	10.09
10/24/2000	4.91	126.23	25.71
10/25/2000	4.66	115.23	24.73
10/26/2000	2.58	196.96	76.34
10/27/2000	4.66	227.50	48.82
10/30/2000	4.50	253.00	56.22
10/31/2000	5.16	383.40	74.30
11/01/2000	3.33	87.60	26.31
11/02/2000	5.16	371.00	71.90
11/03/2000	3.16	98.70	31.23
11/07/2000	3.16	205.40	65.00
11/08/2000	4.66	51.50	11.05
11/13/2000	5.41	504.40	93.23
11/14/2000	1.16	138.90	119.74
11/15/2000	4.66	476.80	102.32
11/16/2000	4.66	749.50	160.84
	213.52 Total Production Hours		37.83 Average
			160.84 Maximum
			2.64 Minimum

Table 6
Radiological Separation System Production Rates

Date	RSS Production Hours	Weight (tons)	RSS Production (tons/hour)
8/17/00	1.5	5.65	3.77
8/18/00	2.5	22.835	9.13
8/21/00	5	42.425	8.49
8/22/00	6.08	97.34	16.01
8/23/00	2.64	45.43	17.21
8/24/00	6.25	55.825	8.93
8/28/00	5.4	128.93	23.88
8/29/00	4.88	102	20.90
8/30/00	4.5	70.265	15.61
8/31/00	5.72	96.37	16.85
9/1/00	4.08	92.165	22.59
9/5/00	3.08	54.03	17.54
9/6/00	6	136.965	22.83
9/7/00	4.88	123.225	25.25
9/8/00	4.66	89.805	19.27
9/11/00	6.33	56.44	8.92
9/12/00	2.55	29.04	11.39
9/13/00	4.11	78.29	19.05
9/14/00	5.83	110.24	18.91
9/18/00	7.33	14.43	1.97
9/19/00	5.28	91.15	17.26
9/20/00	4.05	36.845	9.10
9/21/00	6.33	64.815	10.24
9/26/00	3.33	34.875	10.47
9/27/00	5.5	70	12.73
9/29/00	7.33	8.5	1.16
10/2/00	5.45	39.195	7.19
10/3/00	4.88	117.835	24.15
10/4/00	4.16	29.6	7.12
10/5/00	3.33	28.3	8.50
10/6/00	4.91	59.9	12.20
10/9/00	5.66	115.2	20.35
10/10/00	5.41	108.2	20.00
10/11/00	3.99	81	20.30
10/12/00	1.99	43	21.61
10/13/00	2.74	20.6	7.52
10/16/00	4.99	107.13	21.47
10/17/00	4.49	23.9	5.32
10/18/00	2.16	17.2	7.96
10/19/00	4.37	56.6	12.95
10/20/00	3.49	16.07	4.60
10/23/00	4.66	22.905	4.92
10/24/00	5.41	65.62	12.13
10/25/00	4.91	72.235	14.71
10/26/00	4.91	110.27	22.46
10/27/00	4.66	107.67	23.11
10/30/00	4.48	108.975	24.32
10/31/00	7.16	180.89	25.26
11/1/00	3.33	12.87	3.86
11/2/00	5.66	140.08	24.75
11/7/00	5.66	137.475	24.29
11/8/00	4.16	26.6	6.39
	242.16 Total Production Hours		14.56 Average
			25.26 Maximum
			1.16 Minimum

Table 7
NaI Detector Arrays

	Array 1 (Thick)	**Array 2 (Thin)**
Detector Dimensions	2” x 4” x 4”	0.16” x 4” x 4”
Number of Detectors in Array	8	8
Nuclide(s) of Interest	Th-232 and Ra-226	U-238
Energy Window Setting	480keV – 750keV	40keV – 110keV
Calibration	Th-232	U-238

Table 8
LLDs for the Pilot Demonstration RSS

Radionuclide	Sample Type	LLD (pCi/g)
U-238	Batch	19.6
	Segment	25.9
Th-232	Batch	1.5
	Segment	2.4

Table 9
Background Levels of Radionuclides for the Pilot Demonstration

Radionuclide	Grab Sample Activity (pCi/g)	MDAs (pCi/g)	Uncertainty (pCi/g)	RSS Background Activity
U-238	-0.23 (1)	0.74	0.84	1.13
Th-232	0.16 (2)	+/- 0.27 (3)	0.20 (3)	0.08 (4)
Ra-226	0.28 (2)	+/- 0.14 (3)	0.24 (3)	

Notes:

1. U-238 result from sample ID 12B-35032 only. Sample 12B-35031 was rejected because the absolute value of the U-238 result was larger than the associated 2-sigma uncertainty. This is indicative of improper method blank subtraction at the analytical laboratory.
2. Grab sample activity value equal to average result from samples 12B-35031, 12B-35031DUP, and 12B-35032.
3. The highest single sample value reported.
4. The RSS assumed that all material in the Th-232/Ra-226 energy window was Th-232 during the Pilot Demonstration.

Table 10
Radiological Characteristics of Particle Size Fractions

Parent Sample ID	Date	Size Fraction Sample ID	Description (size fraction)	Th-232 (pCi/g)	Uncertainty (pCi/g)	Ra-226 (pCi/g)	Uncertainty (pCi/g)
12b-035860	9/14/00	12b-035876	- #100 to + #200	9.02E-01	3.15E-01	3.56E-03	9.34E-02
		12b-035877	- #60 to + #100	4.36E-01	2.00E-01	3.00E-02	6.74E-02
		12b-035878	- #40 to + #60	7.88E-01	2.93E-01	1.12E-01	9.44E-02
		12b-035879	- #20 to + #40	4.94E-01	2.06E-01	2.76E-01	1.31E-01
		12b-035880	- #10 to + #20	7.47E-01	2.69E-01	3.60E-02	7.49E-02
		12b-035881	- #4 to + #10	5.04E-01	1.09E-01	2.31E-01	1.39E-01
		12b-035882	- 3/8" to + #4	4.20E-01	1.89E-01	-2.78E-02	3.68E-02
		12b-035883	- 3/4" to 3/8"	4.00E-01	1.86E-01	4.40E-02	5.87E-02
12b-035861	10/2/00	12b-035891	- #100 to + #200	1.78E+01	3.27E+00	9.71E-01	2.88E-02
		12b-035892	- #60 to + #100	4.96E+00	9.75E-01	5.43E-01	1.94E-01
		12b-035893	- #40 to + #60	5.38E+00	1.11E+00	5.54E-01	1.95E-01
		12b-035894	- #20 to + #40	4.89E+00	1.03E+00	3.63E-01	1.63E-01
		12b-035895	- #10 to + #20	1.88E+00	5.08E-01	7.58E-01	2.60E-01
		12b-035896	- #4 to + #10	1.12E+00	3.97E-01	4.02E-01	1.79E-01
		12b-035898	- 3/8" to + #4	7.21E-01	2.53E-01	5.06E-01	2.08E-01
		12b-035899	- 3/4" to 3/8"	7.28E-01	3.74E-01	1.38E-01	1.93E-01
12b-035862	10/6/00	12b-035884	- #100 to + #200	1.38E+01	2.76E+00	3.75E-01	1.67E-01
		12b-035885	- #60 to + #100	4.92E+00	1.08E+00	4.18E-01	1.65E-01
		12b-035886	- #40 to + #60	2.15E+00	5.38E-01	1.42E-01	1.06E-01
		12b-035887	- #20 to + #40	4.27E+00	9.38E-01	5.07E-01	2.03E-01
		12b-035888	- #10 to + #20	2.08E+00	5.42E-01	4.63E-01	1.95E-01
		12b-035889	- 3/8" to + #4	5.65E-01	2.21E-01	3.92E-01	1.64E-01
		12b-035890	- #4 to + #10	1.35E+00	3.82E-01	9.91E-01	2.92E-01
12b-035863	10/27/00	12b-035900	- #100 to + #200	8.49E+00	1.82E+00	4.02E-01	1.78E-01
		12b-035901	- #60 to + #100	2.99E+00	6.95E-01	2.75E-01	1.47E-01
		12b-035902	- #40 to + #60	1.76E+00	4.93E-01	1.21E-01	9.65E-02
		12b-035903	- #20 to + #40	1.13E+00	3.31E-01	2.08E-01	1.20E-01
		12b-035904	- #10 to + #20	2.11E+00	5.30E-01	8.47E-01	2.67E-01
		12b-035905	- #4 to + #10	1.51E+00	4.43E-01	8.49E-01	2.79E-01
		12b-035906	- 3/8" to + #4	7.43E-01	2.77E-01	4.20E-01	2.15E-01

Table 11a
On-site Slug Radiological Characteristics
Ra + Th Setpoint 15 pCi/g
Uranium Setpoint 50 pCi/g

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U- (pC
In situ	Bucket 1-1	12b-035044	1.83	0.29	0.08828	9.13	0.24	0.18604	3.6
In situ	Bucket 1-2	12b-035045	3.20	0.40	0.10552	6.88	0.38	0.14223	0.0
In situ	Bucket 1-3	12b-035046	2.15	0.38	0.09755	10.05	0.26	0.19264	0.0
In situ	Bucket 2-1	12b-035047	1.89	0.36	0.09021	10.16	0.24	0.19702	6.4
In situ	Bucket 2-2	12b-035048	2.24	0.33	0.09398	10.23	0.25	0.19470	5.4
In situ	Bucket 2-3	12b-035049	2.14	0.40	0.09703	10.99	0.25	0.20759	3.8
In situ	Bucket 3-1	12b-035050	1.50	0.29	0.08218	8.80	0.26	0.18409	3.7
In situ	Bucket 3-2	12b-035051	1.94	0.33	0.09155	11.08	0.25	0.20598	3.8
In situ	Bucket 3-3	12b-035052	1.93	0.31	0.08761	9.22	0.25	0.18516	1.3
Point #7(1)	NA(3)	12b-035056	2.24	0.38	0.10057	10.50	0.28	0.20583	0.0
Point #7(1)	NA(3)	12b-035058	2.34	0.38	0.10258	10.67	0.29	0.20396	3.2
Point #7(1)	NA(3)	12b-035060	2.14	0.35	0.09184	10.06	0.25	0.19069	7.1
G(2)	NA(3)	12b-035061	2.17	0.32	0.08716	9.80	0.24	0.18497	1.2
G(2)	NA(3)	12b-035062	2.21	0.28	0.07669	7.18	0.28	0.13838	7.1
G(2)	NA(3)	12b-035063	2.02	0.25	0.08186	9.51	0.24	0.17787	1.4

Notes:
1. Entrance to the RSS
2. Above-criteria Stockpile
3. NA = Not Applicable

Table 11b
Slug 6-1 Radiological Characteristics
Ra + Th Setpoint 5 pCi/g
Uranium Setpoint 50 pCi/g

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-2 (pC
In situ	G7	12b-035238	2.16	0.27	0.09803	4.25	0.18	0.10987	5.7
In situ	G8	12b-035239	4.88	0.45	0.17070	13.14	0.31	0.24534	6.3
In situ	G9	12b-035240	5.27	0.48	0.18484	12.61	0.34	0.2535	9.5
In situ	H7	12b-035241	3.35	0.38	0.13594	14.04	0.28	0.24701	1.7
In situ	H8	12b-035242	4.52	0.46	0.16864	18.05	0.32	0.31182	8.6
In situ	H9	12b-035243	38.43	1.13	0.72675	114.62	0.81	1.45912	20.2
In situ	I7	12b-035244	9.66	0.81	0.30308	59.00	0.57	0.81464	8.0
In situ	I8	12b-035245	8.08	0.89	0.30259	75.65	0.61	1.00705	17.2
In situ	I9	12b-035246	5.82	0.64	0.21399	38.99	0.44	0.55923	10.6
Point #7[1]	NA[3]	12b-035250	17.68	0.78	0.41212	44.86	0.54	0.66407	10.5
Point #7[1]	NA[3]	12b-035253	11.09	0.51	0.27433	17.92	0.37	0.32214	6.7
Point #7[1]	NA[3]	12b-035254	4.73	0.40	0.15935	12.76	0.29	0.23945	5.9
G[2]	NA[3]	12b-035255	19.63	0.74	0.42420	44.76	0.55	0.65261	3.4
G[2]	NA[3]	12b-035256	18.83	0.60	0.38287	26.09	0.45	0.41768	10.0
G[2]	NA[3]	12b-035257	5.33	0.40	0.16842	14.29	0.30	0.2534	2.7

Notes:
1. Entrance to the RSS
2. Above-Criteria Stockpile
3. NA = Not Applicable

Table 11c
Slug 6-2 Radiological Characteristics
Ra + Th Setpoint 24 pCi/g
Uranium Setpoint Not Applicable

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-238 (pCi/g)
In situ	EE15	12b-035341	4.29	0.51	0.14532	23.99	0.38	0.36827	3.65 J
In situ	EE16	12b-035342	4.74	0.41	0.13664	22.48	0.44	0.32261	1.33 J
In situ	EE17	12b-035343	4.85	0.49	0.14864	23.71	0.35	0.37186	4.07 J
In situ	FF15	12b-035344	4.54	0.48	0.14462	22.34	0.35	0.35411	11.79 J
In situ	FF16	12b-035345	4.96	0.49	0.14376	19.36	0.45	0.30658	5.39 J
In situ	FF17	12b-035346	4.35	0.38	0.12741	22.22	0.35	0.34222	3.03 J
In situ	GG15	12b-035347	4.66	0.48	0.14416	24.08	0.35	0.37337	10.15 J
In situ	GG16	12b-035348	3.85	0.48	0.13113	23.30	0.35	0.35676	7.8 J
In situ	GG17	12b-035349	4.28	0.49	0.13667	21.73	0.35	0.34265	5.53 J
Point #7(1)	NA(4)	12b-035378	4.22	0.45	0.12670	20.86	0.35	0.31621	0.00 U
Point #7(1)	NA(4)	12b-035379	3.23	0.42	0.13558	20.41	0.30	0.32101	8.35 J
Point #7(1)	NA(4)	12b-035380	4.11	0.39	0.13112	24.25	0.35	0.37673	1.95 UJ
G(2)	NA(4)	12b-035383	3.92	0.38	0.12412	21.06	0.31	0.32695	5.52 J
G(2)	NA(4)	12b-035384	3.96	0.40	0.12762	22.58	0.36	0.35064	3.84 J
G(2)	NA(4)	12b-035385	4.39	0.47	0.13457	22.78	0.34	0.34815	9.24 J
G(2)	NA(4)	12b-035386	3.54	0.43	0.13614	19.77	0.29	0.30679	0.00 U
H(3)	NA(4)	12b-035387	3.81	0.37	0.11990	20.95	0.33	0.32443	2.93 J

Notes:
1. Entrance to the RSS
2. Above-criteria Stockpile
3. Below-criteria Stockpile
4. NA = Not Applicable

Table 11d
Slug 6-3 Radiological Characteristics
Ra + Th Setpoint 5 pCi/g
Uranium Setpoint 50 pCi/g

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-23 (pCi/
In situ	DD5	12b-035617	2.12	0.30	0.08511	4.91	0.21	0.11616	0.9
In situ	DD6	12b-035618	1.68	0.25	0.08159	4.28	0.21	0.11476	3.0
In situ	DD7	12b-035619	2.31	0.34	0.10339	5.99	0.24	0.14877	1.7
In situ	EE5	12b-035620	3.22	0.54	0.15209	9.10	0.37	0.23118	18.3
In situ	EE6	12b-035621	2.70	0.30	0.10679	6.29	0.25	0.13731	0.5
In situ	EE7	12b-035622	2.01	0.29	0.08821	4.07	0.20	0.10882	5.2
In situ	FF5	12b-035623	1.92	0.23	0.08031	4.30	0.19	0.10661	0.0
In situ	FF6	12b-035624	3.08	0.37	0.11881	6.37	0.26	0.15535	3.5
In situ	FF7	12b-035625	2.21	0.24	0.09064	3.56	0.19	0.10072	3.3
Point #7[1]	NA[3]	12b-035629	2.95	0.33	0.11055	7.67	0.24	0.16798	2.2
Point #7[1]	NA[3]	12b-035630	2.33	0.34	0.11685	7.60	0.23	0.16641	0.8
Point #7[1]	NA[3]	12b-035631	3.07	0.27	0.11393	6.29	0.25	0.15550	0.5
G[2]	NA[3]	12b-035635	2.75	0.30	0.10235	6.70	0.23	0.14632	1.0
G[2]	NA[3]	12b-035636	2.50	0.25	0.09986	6.35	0.23	0.14755	0.0
G[2]	NA[3]	12b-035637	1.90	0.32	0.09861	5.27	0.20	0.13041	5.9
G[2]	NA[3]	12b-035638	2.78	0.35	0.10562	7.96	0.24	0.16815	0.4
G[2]	NA[3]	12b-035639	3.01	0.36	0.11371	8.23	0.25	0.17319	10.0

Notes:
1. Entrance to the RSS
2. Above-criteria Stockpile
3. NA = Not Applicable

Table 11e
Slug 7-1 Radiological Characteristics
Ra + Th Setpoint 10 pCi/g
Uranium Setpoint Not Applicable

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-2 (pC
In situ	HH28	12b-035316	3.44	0.37	0.12002	18.60	0.33	0.30600	5.8
In situ	HH29	12b-035317	3.80	0.36	0.12670	20.17	0.34	0.33052	7.8
In situ	HH30	12b-035318	4.69	0.45	0.15381	23.58	0.38	0.38539	7.3
In situ	II28	12b-035319	3.79	0.38	0.12242	20.47	0.33	0.32040	8.4
In situ	II29	12b-035320	5.51	0.52	0.16203	26.24	0.38	0.40228	6.1
In situ	II30	12b-035321	4.59	0.47	0.14176	20.78	0.33	0.33016	8.9
In situ	JJ28	12b-035322	3.42	0.44	0.12043	19.24	0.31	0.30292	10.2
In situ	JJ29	12b-035323	5.10	0.47	0.15199	24.82	0.37	0.37921	0.0
In situ	JJ30	12b-035324	4.83	0.37	0.14248	21.91	0.34	0.33346	1.1
Point #7(1)	NA(3)	12b-035353	6.77	0.44	0.16487	21.77	0.45	0.32766	13.7
Point #7(1)	NA(3)	12b-035354	4.64	0.46	0.15813	22.89	0.31	0.35409	5.7
Point #7(1)	NA(3)	12b-035355	5.80	0.39	0.15895	26.66	0.37	0.4	9.2
Point #7(1)	NA(3)	12b-035356	6.21	0.42	0.17059	27.79	0.41	0.40535	0.0
G(2)	NA(3)	12b-035358	5.79	0.45	0.15925	25.63	0.38	0.38519	5.9
G(2)	NA(3)	12b-035359	5.15	0.45	0.14569	22.25	0.35	0.33571	3.7
G(2)	NA(3)	12b-035360	4.99	0.45	0.14180	22.59	0.34	0.33582	7.3
G(2)	NA(3)	12b-035362	5.60	0.40	0.14763	21.69	0.42	0.32484	4.8

Notes:
1. Entrance to the RSS
2. Above-criteria Stockpile
3. NA = Not Applicable

Table 11f
Slug 7-2 Radiological Characteristics
Ra + Th Setpoint 5 pCi/g
Uranium Setpoint Not Applicable

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-23 (pCi/
In situ	P8	12b-035421				1.05	0.11	0.04367	1.24 J
In situ	P9	12b-035422	1.11	0.18	0.05162	1.20	0.12	0.03998	1.66 J
In situ	P10	12b-035423	0.87	0.17	0.05240	1.14	0.11	0.04384	2.31 U
In situ	Q8	12b-035424	0.76	0.15	0.05215	1.05	0.10	0.04314	0.13 J
In situ	Q9	12b-035425	0.75	0.18	0.05341	1.01	0.11	0.04401	3.26 U
In situ	Q10	12b-035426	0.95	0.17	0.04932	1.15	0.11	0.03947	3.21 I
In situ	R8	12b-035427	1.61	0.27	0.08512	6.05	0.18	0.12891	0.78 U
In situ	R9	12b-035428	0.92	0.17	0.05759	1.33	0.12	0.04963	0.91 J
In situ	R10	12b-035429	0.86	0.14	0.05257	1.18	0.10	0.04708	0.35 J
Point #7(1)	NA(3)	12b-035434	1.10	0.17	0.04970	1.68	0.12	0.04798	0.04 U
Point #7(1)	NA(3)	12b-035435	1.17	0.16	0.06116	1.71	0.12	0.05842	7.25 J
Point #7(1)	NA(3)	12b-035436	1.12	0.18	0.06119	1.95	0.12	0.06148	0.31 J
Point #7(1)	NA(3)	12b-035437	0.98	0.19	0.06186	2.03	0.13	0.06417	1.17 J
H(2)	NA(3)	12b-035440	1.06	0.08	0.06327	2.03	0.12	0.06611	0.58 J
H(2)	NA(3)	12b-035441	0.98	0.19	0.05959	1.65	0.12	0.05688	2.48 J
H(2)	NA(3)	12b-035442	0.99	0.21	0.06184	2.18	0.13	0.06690	2.19 J
H(2)	NA(3)	12b-035443	1.14	0.17	0.06536	1.72	0.13	0.06129	2.51 J

Notes:
1. Entrance to the RSS
2. Below-criteria Stockpile
3. NA = Not Applicable

Table 11g
Slug 7-3 Radiological Characteristics
Ra + Th Setpoint 5 pCi/g
Uranium Setpoint 50 pCi/g

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-238 (pCi/g)
In situ	T5	12b-035496	1.19	0.23	0.07638	1.45	0.15	0.06370	0.79 J
In situ	T6	12b-035497	1.16	0.24	0.06500	2.14	0.14	0.06635	2.31 J
In situ	T7	12b-035498	1.89	0.57	0.18558	2.88	0.41	0.15832	1.70 J
In situ	U5	12b-035499	0.92	0.20	0.06142	1.41	0.13	0.05468	3.41 J
In situ	U6	12b-035500	0.91	0.21	0.06305	1.23	0.13	0.05210	0.73 J
In situ	U7	12b-035501	1.46	0.28	0.09965	2.09	0.19	0.08644	7.52
In situ	V5	12b-035502	1.05	0.18	0.05872	1.37	0.12	0.04737	1.90 J
In situ	V6	12b-035503	0.96	0.23	0.06813	1.79	0.15	0.06441	2.70 J
In situ	V7	12b-035504	1.25	0.32	0.09815	1.66	0.19	0.07864	0.72 J
Point #7(1)	NA(3)	12b-035508	3.96	0.48	0.16735	13.44	0.33	0.26095	6.69 J
Point #7(1)	NA(3)	12b-035509	1.09	0.21	0.06671	2.30	0.13	0.06940	2.86 J
Point #7(1)	NA(3)	12b-035510	1.06	0.18	0.06310	1.61	0.13	0.05774	2.71 J
Point #7(1)	NA(3)	12b-035518	0.88	0.18	0.05953	1.44	0.13	0.05515	2.83 J
H(2)	NA(3)	12b-035513	2.31	0.33	0.10146	5.45	0.23	0.12833	5.12 J
H(2)	NA(3)	12b-035514	1.17	0.22	0.06996	2.88	0.15	0.08228	1.58 J
H(2)	NA(3)	12b-035515	1.24	0.23	0.07223	2.72	0.14	0.07910	3.94 J
H(2)	NA(3)	12b-035516	1.12	0.21	0.06495	2.24	0.14	0.06676	5.47 J
H(2)	NA(3)	12b-035517	1.15	0.24	0.07289	2.67	0.13	0.08013	2.16 J

Notes:
1. Entrance to the RSS
2. Below-criteria Stockpile
3. NA = Not Applicable

Table 11h
Slug 7-4 Radiological Characteristics
Ra + Th Setpoint 5 pCi/g – Uranium Setpoint 50 pCi/g

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-23 (pCi/
In situ	T11	12b-035531	1.45	0.24	0.08070	***	0.17	0.10271	3.33
In situ	T12	12b-035532	1.21	0.30	0.08460	2.51	0.17	0.08449	0.00
In situ	T13	12b-035533	0.86	0.20	0.06010	1.78	0.12	0.06349	3.65
In situ	U11	12b-035534	1.33	0.24	0.07744	3.85	0.18	0.09984	2.64
In situ	U12	12b-035535	1.11	0.19	0.06515	1.52	0.13	0.05504	2.31
In situ	U13	12b-035536	2.47	0.36	0.10811	11.23	0.25	0.20728	2.00
In situ	V11	12b-035537	1.45	0.29	0.09125	3.95	0.19	0.11072	8.86
In situ	V12	12b-035538	1.09	0.17	0.06522	1.96	0.13	0.06518	2.75
In situ	V13	12b-035539	1.04	0.17	0.06057	1.62	0.12	0.05844	1.92
Point #7(1)	NA(4)	12b-035552	3.02	0.27	0.10331	***	***	***	2.55
Point #7(1)	NA(4)	12b-035553	2.68	0.34	0.10081	7.10	0.24	0.15245	1.64
Point #7(1)	NA(4)	12b-035554	2.09	0.31	0.08965	5.82	0.22	0.13342	3.06
H(2)	NA(4)	12b-035557	2.08	0.27	0.08619	5.59	0.21	0.13004	0.74
H(2)	NA(4)	12b-035558	2.62	0.33	0.10332	6.05	0.23	0.13946	4.82
H(2)	NA(4)	12b-035559	2.28	0.24	0.08799	5.55	0.21	0.13030	2.54
H(2)	NA(4)	12b-035560	2.60	0.31	0.09821	6.73	0.24	0.14767	2.38
H(2)	NA(4)	12b-035561	2.27	0.25	0.08571	5.88	0.21	0.12945	2.89
H(2)	NA(4)	12b-035562	2.32	0.32	0.09589	6.52	0.22	0.14589	0.73
H(2)	NA(4)	12b-035563	2.35	0.29	0.09569	6.16	0.23	0.13931	5.17
H(2)	NA(4)	12b-035564	2.69	0.34	0.10511	6.59	0.23	0.14493	5.56
G(3)	NA(4)	12b-035565	1.78	0.26	0.09565	4.63	0.20	0.11571	5.04
G(3)	NA(4)	12b-035566	1.78	0.28	0.09429	5.47	0.20	0.12778	6.26
G(3)	NA(4)	12b-035567	2.31	0.25	0.09591	5.92	0.20	0.13195	1.86
G(3)	NA(4)	12b-035568	2.02	0.24	0.09220	5.30	0.19	0.12399	5.59
G(3)	NA(4)	12b-035569	2.04	0.30	0.09754	5.81	0.19	0.13140	4.37
G(3)	NA(4)	12b-035570	1.90	0.25	0.08918	5.27	0.19	0.11944	2.51

1. Entrance to the RSS
2. Below-criteria Stockpile
3. Above-criteria Stockpile
4. NA = Not Applicable

Table 11i
Slug 8-1 Radiological Characteristics
Ra + Th Setpoint 5.68 pCi/g
Uranium Setpoint Not Applicable

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-2 (pC
In situ	N19	12b-035162	1.17	0.21	0.06852	4.55	0.15	0.10662	0.7
In situ	N20	12b-035163	2.22	0.33	0.10740	9.93	0.22	0.18778	8.9
In situ	N21	12b-035164	9.84	1.50	0.47866	248.38	1.06	2.91295	17.6
In situ	O19	12b-035165	1.64	0.27	0.07917	5.76	0.17	0.12204	2.2
In situ	O20	12b-035166	2.37	0.35	0.10886	10.09	0.23	0.18869	3.2
In situ	O21	12b-035167	14.90	0.85	0.37559	83.57	0.62	1.07014	18.
In situ	P19	12b-035168	1.13	0.18	0.06318	1.94	0.12	0.06265	1.22
In situ	P20	12b-035169	1.65	0.28	0.09102	7.61	0.18	0.15250	2.1
In situ	P21	12b-035170	12.84	0.72	0.32114	58.89	0.53	0.78273	16.9
Point #7(1)	NA(3)	12b-035173	5.26	0.69	0.21882	54.51	0.48	0.72989	5.5
Point #7(1)	NA(3)	12b-035176	5.85	0.78	0.24833	73.29	0.59	0.95299	24.8
Point #7(1)	NA(3)	12b-035177	7.49	0.77	0.26392	64.39	0.55	0.85458	8.9
G(2)	NA(3)	12b-035178	6.71	0.63	0.22308	47.31	0.46	0.64556	8.2
G(2)	NA(3)	12b-035179	5.93	0.77	0.27679	94.13	0.66	1.15431	12.0
G(2)	NA(3)	12b-035180	6.70	0.70	0.24329	59.61	0.51	0.78826	1.0

Notes:
1. Entrance to the RSS
2. Above-criteria Stockpile
3. NA = Not Applicable

Table 11j
Slug 8-2 Radiological Characteristics
Ra + Th Setpoint 5.68 pCi/g
Uranium Setpoint Not Applicable

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-2 (pC
In situ	C4	12b-035200	2.85	0.33	0.12281	4.88	0.22	0.13088	4.7
In situ	C5	12b-035201	5.34	0.46	0.17370	12.82	0.31	0.24180	2.9
In situ	C6	12b-035202	3.20	0.43	0.14672	5.90	0.27	0.15780	9.5
In situ	D4	12b-035203	2.64	0.40	0.12493	6.88	0.24	0.16298	4.9
In situ	D5	12b-035204	3.19	0.37	0.13294	9.66	0.25	0.19546	3.3
In situ	D6	12b-035205	3.37	0.37	0.13850	7.10	0.23	0.15967	2.5
In situ	E4	12b-035206	5.89	0.74	0.27076	15.15	0.49	0.35023	19.4
In situ	E5	12b-035207	2.94	0.34	0.13537	5.17	0.24	0.14379	7.3
In situ	E6	12b-035208	1.98	0.34	0.10024	3.83	0.26	0.10919	4.4
Point #7(1)	NA(3)	12b-035215	3.04	0.36	0.13550	6.50	0.23	0.15835	6.3
Point #7(1)	NA(3)	12b-035216	3.81	0.37	0.14569	7.87	0.27	0.17581	7.4
Point #7(1)	NA(3)	12b-035217	3.98	0.40	0.14708	7.13	0.26	0.16636	3.6
G(2)	NA(3)	12b-035220	4.04	0.34	0.14784	8.36	0.25	0.18332	4.9
G(2)	NA(3)	12b-035221	3.61	0.33	0.13140	6.74	0.24	0.15190	2.2
G(2)	NA(3)	12b-035222	3.17	0.35	0.13031	6.81	0.23	0.15676	9.4

Notes:
1. Entrance to the RSS
2. Above-criteria Stockpile
3. NA = Not Applicable

Table 11k
Slug 8-3 Radiological Characteristics
Ra + /Th Setpoint 24 pCi/g
Uranium Setpoint Not Applicable

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-2 (pCi
In situ	DD21	12b-035327	4.00	0.38	0.12493	18.25	0.46	0.29447	3.1
In situ	DD22	12b-035328	1.75	0.26	0.08358	7.50	0.26	0.16205	0.7
In situ	DD23	12b-035329	4.39	0.51	0.14380	23.77	0.35	0.36492	4.3
In situ	EE21	12b-035333	3.86	0.46	0.13166	18.99	0.41	0.29828	5.8
In situ	EE22	12b-035334	3.65	0.37	0.12578	21.15	0.36	0.33503	4.2
In situ	EE23	12b-035335	4.28	0.55	0.15523	23.32	0.41	0.38594	9.5
In situ	FF21	12b-035336	3.29	0.43	0.11877	19.37	0.32	0.31177	9.5
In situ	FF22	12b-035337	3.94	0.40	0.13097	23.08	0.35	0.35821	7.1
In situ	FF23	12b-035338	3.97	0.37	0.12870	22.50	0.36	0.35840	0.0
Point #7(1)	NA(3)	12b-035364	3.26	0.38	0.11233	17.77	0.31	0.28071	6.7
Point #7(1)	NA(3)	12b-035365	3.15	0.40	0.13198	17.54	0.27	0.28680	3.9
Point #7(1)	NA(3)	12b-035366	3.67	0.39	0.12623	21.35	0.36	0.34109	8.3
Point #7(1)	NA(3)	12b-035372	3.20	0.41	0.13774	17.66	0.27	0.28839	3.0
H(2)	NA(3)	12b-035368	4.07	0.46	0.13278	21.13	0.35	0.32747	7.4
H(2)	NA(3)	12b-035369	3.95	0.32	0.11531	17.86	0.36	0.28379	10.7
H(2)	NA(3)	12b-035370	3.01	0.36	0.11492	14.85	0.26	0.24204	4.2
H(2)	NA(3)	12b-035371	3.59	0.42	0.12071	19.09	0.33	0.29223	5.1
H(2)	NA(3)	12b-035373	2.85	0.42	0.12868	16.70	0.28	0.27386	4.0
H(2)	NA(3)	12b-035374	4.19	0.35	0.12154	17.67	0.41	0.28042	6.5

Notes:
1. Entrance to the RSS
2. Below-criteria Stockpile
3. NA = Not Applicable

Table 11l
Slug 8-4 Radiological Characteristics
Ra + Th Setpoint 5 pCi/g
Uranium Setpoint 50 pCi/g

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-23 (pCi/
In situ	T8	12b-035520	1.32	0.21	0.07781	2.48	0.15	0.08005	1.12
In situ	T9	12b-035521	1.50	0.32	0.09074	3.97	0.18	0.10655	6.53
In situ	T10	12b-035522	1.46	0.57	0.15978	3.02	0.35	0.15657	8.50
In situ	U8	12b-035523	1.33	0.31	0.07538	1.54	0.19	0.05488	5.39
In situ	U9	12b-035524	3.26	0.32	0.10573	8.30	0.22	0.16798	2.81
In situ	U10	12b-035525	1.29	0.19	0.07089	2.40	0.14	0.07611	1.90
In situ	V8	12b-035526	1.75	0.33	0.10515	3.50	0.20	0.10924	3.10
In situ	V9	12b-035527	2.44	0.33	0.09611	6.33	0.21	0.14004	4.67
In situ	V10	12b-035528	1.72	0.33	0.10668	4.76	0.22	0.13978	1.70
Point #7 (1)	NA(3)	12b-035542	1.41	0.22	0.06223	2.21	0.14	0.06242	1.50
Point #7 (1)	NA(3)	12b-035543	1.21	0.28	0.07337	2.45	0.14	0.07705	2.14
Point #7 (1)	NA(3)	12b-035544	1.30	0.18	0.07262	2.21	0.15	0.07252	3.61
H (2)	NA(3)	12b-035547	1.62	0.21	0.07714	3.79	0.16	0.09616	1.83
H (2)	NA(3)	12b-035548	1.01	0.21	0.06430	2.16	0.14	0.06662	4.33
H (2)	NA(3)	12b-035549	1.27	0.20	0.07140	3.34	0.15	0.08957	1.70
H (2)	NA(3)	12b-035550	1.39	0.24	0.07522	2.21	0.14	0.07096	2.26
H (2)	NA(3)	12b-035551	1.55	0.18	0.07478	2.31	0.13	0.07137	5.25

Notes:
1. Entrance to the RSS
2. Below-criteria Stockpile
3. NA = Not Applicable

Table 11m
Engineering Slug #1 Radiological Characteristics
Ra + Th Setpoint 13.75 pCi/g
Uranium Setpoint Not Applicable

Process Stockpile ID	Grid Cell ID	Sample ID	Ra-226 (pCi/g)	MDA	Uncertainty	Th-232 (pCi/g)	MDA	Uncertainty	U-23 (pCi
In situ	SAND 1	12b-035464	0.41	0.15	0.04168	1.67	0.10	0.05283	2.55
In situ	SAND 2	12b-035465	0.47	0.17	0.04615	1.32	0.10	0.04975	1.98
In situ	SAND 3	12b-035466	0.51	0.20	0.04969	1.53	0.12	0.05618	2.75
In situ	G1	12b-035469	6.00	0.61	0.21097	34.54	0.40	0.51219	10.09
In situ	G2	12b-035470	6.82	0.57	0.20007	30.82	0.39	0.45984	8.27
In situ	G3	12b-035471	5.60	0.57	0.19654	29.70	0.38	0.45528	12.07
Point #7[1]	NA[4]	12b-035474	5.33	0.48	0.18257	25.40	0.35	0.39691	12.06
Point #7[1]	NA[4]	12b-035475	1.53	0.30	0.08938	7.01	0.21	0.14612	3.31
Point #7[1]	NA[4]	12b-035476	2.66	0.39	0.11901	12.88	0.24	0.22743	2.31
Point #7[1]	NA[4]	12b-035477	4.72	0.51	0.17428	26.02	0.35	0.40247	7.43
G[2]	NA[4]	12b-035479	4.45	0.44	0.14890	21.22	0.30	0.33120	5.82
G[2]	NA[4]	12b-035480	4.16	0.42	0.15078	18.15	0.31	0.29697	3.93
G[2]	NA[4]	12b-035483	2.93	0.38	0.12690	14.44	0.26	0.25322	9.32
G[2]	NA[4]	12b-035485	4.01	0.47	0.16262	20.07	0.33	0.32178	7.09
H[3]	NA[4]	12b-035481	2.82	0.34	0.11992	13.79	0.27	0.23811	5.11
H[3]	NA[4]	12b-035481	2.59	0.36	0.11610	12.92	0.25	0.20355	0.68
H[3]	NA[4]	12b-035482	2.25	0.34	0.10918	11.06	0.24	0.20477	3.83
H[3]	NA[4]	12b-035484	2.66	0.39	0.12230	13.45	0.26	0.23192	3.86

Notes:
1. Entrance to the RSS
2. Above-criteria Stockpile
3. Below-criteria Stockpile
4. NA = Not Applicable

Table 12
Slug Weight Separations

GSS						RSS		Total Oversize (tons)	% Total Oversize
Slug	**Total Weight (tons)**	**+6" (tons)**	**% +6"**	**+3/8" to 6" (tons)**	**% 3/8" to 6"**	**-3/8" (tons)**	**% -3/8"**		
On-Site	7.92	0.54	6.82	1.52	19.19	5.9	73.99	2.1	26.01
Engineered	16.3	0	0.00	0	0.00	16.3	100.00	0.0	0.00
6-1	30.11	2.56	8.50	12.65	42.01	14.9	49.49	15.2	50.51
6-2	19.9	0.6	3.02	7.8	39.20	11.5	57.79	8.4	42.21
6-3	30.84	0.54	1.75	9.63	31.23	20.7	67.02	10.2	32.98
7-1	20.9	0.3	1.44	5.6	26.79	15.0	71.77	5.9	28.23
7-2	23.3	0.6	2.58	8.9	38.20	13.8	59.23	9.5	40.77
7-3	27.9	0.4	1.43	13	46.59	14.5	51.97	13.4	48.03
7-4	30.6	0.6	1.96	10.5	34.31	19.5	63.73	11.1	36.27
8-1	10.15	0	0.00	3.04	29.95	7.1	70.05	3.0	29.95
8-2	9.32	0	0.00	2.03	21.78	7.3	78.22	2.0	21.78
8-3	21.6	0.4	1.85	11.1	51.39	10.1	46.76	11.5	53.24
8-4	28.7	1.2	4.18	11	38.33	16.5	57.49	12.2	42.51
Totals	**277.5**	**7.7**	**2.79**	**96.8**	**34.87**	**173.0**	**62.34**	**104.5**	**37.66**

Table 13
Batch Weight Separation

GSS						RSS		Total Oversize (tons)	% Total Oversize (tons)
Batch	**Total Weight**	**+6" (tons)**	**% +6"**	**+3/8 to 6" (tons)**	**% +3/8 to 6”**	**-3/8"**	**% -3/8"**		
1	38.7	1.2	3.05	10.4	26.94	27.1	70.01	11.6	29.99
1-1	147.7	0.0	0.00	48.7	32.94	99.0	67.06	48.7	32.94
	128.0	0.0	0.00	40.5	31.67	87.5	68.33	40.5	31.67
	172.1	0.0	0.00	56.4	32.74	115.8	67.26	56.4	32.74
	88.1	4.5	5.07	29.7	33.75	53.9	61.18	34.2	38.82
	205.1	0.0	0.00	70.7	34.47	134.4	65.53	70.7	34.47
1-2	79.5	1.9	2.33	41.7	52.43	36.0	45.24	43.5	54.76
1-3	127.0	0.0	0.00	48.4	38.11	78.6	61.89	48.4	38.11
1-4	52.3	0.0	0.00	15.9	30.39	36.4	69.61	15.9	30.39
1-5	174.5	0.2	0.09	48.3	27.69	126.0	72.21	48.5	27.79
2	56.1	0.6	1.06	14.4	25.57	41.2	73.37	15.0	26.63
3	142.8	0.6	0.42	31.2	21.83	111.1	77.75	31.8	22.25
4	58.6	0.0	0.00	14.0	23.82	44.6	76.18	14.0	23.82
5	101.7	0.0	0.00	28.8	28.31	72.9	71.69	28.8	28.31
6-1	119.6	5.0	4.18	21.1	17.63	93.5	78.19	26.1	21.81
	41.9	1.6	3.92	8.9	21.10	31.4	74.97	10.5	25.03
	105.5	15.0	14.17	27.1	25.71	63.4	60.12	42.1	39.88
6-5	253.0	10.9	4.31	69.1	27.31	173.0	68.38	80.0	31.62
6-6	191.7	1.9	0.99	62.8	32.76	127.0	66.25	64.7	33.75
7	170.8	0.0	0.00	59.3	34.72	111.5	65.28	59.3	34.72
7-1	84.7	0.7	0.83	27.3	32.23	56.7	66.94	28.0	33.06
	174.5	2.3	1.32	66.9	38.34	105.3	60.34	69.2	39.66
7-4	115.2	3.1	2.65	44.2	38.39	67.9	58.96	47.3	41.04
7-5	197.0	1.5	0.74	77.2	39.18	118.3	60.08	78.6	39.92
7-6	227.5	12.5	5.49	108.8	47.82	106.2	46.68	121.3	53.32
8	142.6	0.0	0.00	44.8	31.44	97.8	68.56	44.8	31.44
8-1	132.9	0.0	0.00	35.2	26.51	97.7	73.49	35.2	26.51
	99.0	0.0	0.00	25.3	25.52	73.8	74.48	25.3	25.52
	39.6	0.0	0.00	7.5	18.98	32.1	81.02	7.5	18.98
8-2	109.5	1.0	0.88	39.7	36.28	68.8	62.84	40.7	37.16
	191.4	45.5	23.77	12.7	6.61	133.3	69.62	58.2	30.38
8-3	95.1	3.3	3.47	27.0	28.39	64.8	68.14	30.3	31.86
	95.8	0.0	0.00	28.3	29.54	67.5	70.46	28.3	29.54
	163.7	1.9	1.15	44.5	27.17	117.4	71.68	46.4	28.32
8-5	205.4	5.3	2.58	67.2	32.72	132.9	64.70	72.5	35.30
9	108.8	0.0	0.00	38.5	35.36	70.4	64.64	38.5	35.36
FCR#1	504.4	10.3	2.04	117.4	23.28	376.7	74.68	127.7	25.32
FCR#2	138.9	3.4	2.45	36.3	26.13	99.2	71.42	39.7	28.58
FCR#3	476.8	11.4	2.39	130.1	27.29	335.3	70.32	141.5	29.68
FCR#4	749.5	14.7	1.96	332.5	44.36	402.3	53.68	347.2	46.32
Fresh Water	16.4	0.0	0.00	2.5	15.24	13.9	84.76	2.5	15.24
Recycled	17.7	0.3	1.69	4.2	23.73	13.2	74.58	4.5	25.42
Sequence #1	68.5	0.9	1.31	20.1	29.34	47.5	69.34	21.0	30.66
Sequence #2	54.3	0.0	0.00	13.0	23.94	41.3	76.06	13.0	23.94
Sequence #3	47.0	4.1	8.73	15.1	32.14	27.8	59.14	19.2	40.86
Sequence #4	110.3	2.6	2.38	50.8	46.06	56.9	51.56	53.4	48.44
Sequence #5	15.9	0.0	0.00	3.9	24.47	12.0	75.53	3.9	24.47
Batch Test #2	26.2	0.2	0.76	9.2	35.11	16.8	64.12	9.4	35.88
Total	**6863.6**	**168.1**	**2.45**	**2177.5**	**31.73**	**4518.0**	**65.83**	**2345.6**	**34.17**

Table 14
Gravel Separator Performance Evaluation Data[1]

Batch	Total Mass (tons)	Oversize[2] Mass (tons)	% Oversize	Th-232 Activity Oversize (pCi/g)	Th-232 Activity Oversize (pCi)	Th-232 Activity Total (pCi/g)	Th-232 Activity Total (pCi)	% Th-232 Oversize	Ra-226 Activity Oversize (pCi/g)	Ra-226 Activity Oversize (pCi)	Ra-226 Activity Total (pCi/g)	Ra-226 Activity Total (pCi)	% Ra-226 Oversize	U-238 Activity Oversize (pCi/g)
1	38.685	10.42	26.9	9.05	8.56E+07	7.86	2.76E+08	31.0	2.25	2.13E+07	1.85	6.49E+07	32.8	3.36
2	56.13	14.355	25.6	8.45	1.10E+08	7.30	3.72E+08	29.6	2.21	2.88E+07	0.96	4.89E+07	58.9	0.37
3	142.84	31.18	21.8	8.31	2.35E+08	6.65	8.63E+08	27.3	2.18	6.17E+07	1.88	2.44E+08	25.3	3.81
4	58.565	13.95	23.8	2.64	3.34E+07	6.36	3.38E+08	9.9	2.06	2.61E+07	2.07	1.10E+08	23.7	7.87
5	101.745	28.8	28.3	1.71	4.47E+07	3.44	3.18E+08	14.1	1.09	2.85E+07	1.40	1.29E+08	22.1	2.02
7	170.815	59.315	34.7	2.09	1.13E+08	6.38	9.90E+08	11.4	1.32	7.11E+07	1.93	2.99E+08	23.8	2.14
8	142.63	44.84	31.4	1.82	7.41E+07	4.12	5.34E+08	13.9	1.04	4.23E+07	1.49	1.93E+08	21.9	4.78
9	108.84	38.485	35.4	2.13	7.44E+07	10.32	1.02E+09	7.3	1.77	6.19E+07	1.60	1.58E+08	39.1	0.36
1-1	741.02	287.66	38.8	0.88	2.30E+08	1.72	1.16E+09	19.8	0.66	1.72E+08	0.45	3.02E+08	57.1	1.59
8-1	271.57	68.025	25.0	2.51	1.55E+08	3.77	9.29E+08	16.7	1.39	8.59E+07	1.63	4.02E+08	21.4	0.16
8-2	300.89	52.37	17.4	2.41	1.15E+08	4.83	1.32E+09	8.7	1.22	5.80E+07	0.90	2.45E+08	23.7	3.57
6-1	267	57.05	21.4	4.54	2.35E+08	7.71	1.87E+09	12.6	2.32	1.20E+08	2.57	6.24E+08	19.3	2.29
1-3	127	48.4	38.1	19.8	8.70E+08	28.88	3.33E+09	26.1	4.57	2.01E+08	6.54	7.54E+08	26.6	3.87
1-5	174.495	48.325	27.7	20.9	9.17E+08	23.04	3.65E+09	25.1	5.12	2.25E+08	5.60	8.88E+08	25.3	9.48
Batch Test #2	26.2	9.2	35.1	6.89	5.76E+07	11.94	2.84E+08	20.3	1.91	1.60E+07	2.71	6.45E+07	24.7	0.00
7-1	259.2	94.2	36.3	10.2	8.72E+08	19.16	4.51E+09	19.3	2.10	1.80E+08	4.17	9.81E+08	18.3	3.56
8-3	354.62	99.78	28.1	21.05	1.91E+09	30.06	9.68E+09	19.7	0.00	0.00E+00	0.00			0.00
Batch Sequence 5	15.94	3.9	24.5	24.4	8.64E+07	31.16	4.51E+08	19.2	4.72	1.67E+07	6.18	8.94E+07	18.7	4.24
7-4	115.23	44.24	38.4	1.64	6.59E+07	3.32	3.47E+08	19.0	1.01	4.06E+07	1.30	1.36E+08	29.8	0.63
7-5	196.96	77.165	39.2	1.68	1.18E+08	2.75	4.91E+08	24.0	1.07	7.50E+07	1.21	2.16E+08	34.7	2.60
7-6	227.5	108.8	47.8	2.89	2.86E+08	3.64	7.52E+08	38.0	1.89	1.87E+08	1.61	3.32E+08	56.2	2.69
6-6	191.7	62.8	32.8	3.44	1.96E+08	9.19	1.60E+09	12.3	1.25	7.13E+07	2.40	4.18E+08	17.1	5.13
6-7	371	121.1	32.6	5.6	6.16E+08	9.26	3.12E+09	19.7	1.83	2.01E+08	2.30	7.74E+08	26.0	4.24
8-5	205.4	67.2	32.7	5.77	3.52E+08	20.96	3.91E+09	9.0	2.50	1.53E+08	6.06	1.13E+09	13.5	3.13
Recycled Water	17.7	4.2	23.7	13.81	5.27E+07	54.07	8.69E+08	6.1	1.31	5.00E+06	12.01	1.93E+08	2.6	2.26
TOTAL	**4683.675**	**1495.76**	**31.9**		**7.90E+09**		**4.30E+10**	**18.4**		**2.15E+09**		**8.80E+09**	**24.4**	

Notes:
1. Data analysis performed only on those batches with complete radiochemical data for oversize fraction plus accepted and rejected material from RSS.
2. Oversize consists of material >3/8" and <6" based on weight of Stockpile J.

Table 15
Rinse Unit Performance Evaluation Data

Batch	Date	Th-232 Before Rinse (pCi/g)	Th-232 After Rinse (pCi/g)	% Reduction	Ra-226 Before Rinse (pCi/g)	Ra-226 After Rinse (pCi/g)	% Reduction	U-238 Before Rinse (pCi/g)	U-238 After Rinse (pCi/g)	% Reduction
6-6	10/31/00	3.44	1.48	56.98	1.25	0.7	44.00	5.13	2.95	42.50
6-7	11/3/00	4.31	3.17	26.45	1.53	1.75	-14.38	4.54	3.77	16.96
Recycled	11/8/00	13.81	2.1	84.79	3.95	1.54	61.01	3.13	1.34	57.19
Recycled	11/8/00	4.07	2.4	41.03	2.3	1.98	13.91	2.02	2.02	0.00
Fresh	11/8/00	10.9	2.9	73.39	3.29	1.38	58.05	8.36	1.46	82.54
5	10/24/00	24.4	12.47	48.89	4.72	3.07	34.96	4.24	3.85	9.20

Table 16
Slug Summary, Radiological Characteristics

Slug	Date	Source	Ra + Th Setpoint (pCi/g)	U Setpoint (pCi/g)	Total Mass (g)	Mass Rejected (g)	% Rejected	Th-232 Rejected (pCi/g)	Ra-226 Rejected (pCi/g)	U-238 Rejected (pCi/g)	Mass Accepted (g)	% Accepte
On Site	8/17/00	Stockpile	15	50	5.14E+06	5.14E+06	100.0	8.83	2.13	3.27	0.00E+00	0.0
Engineered		Fabricated	13.75	>	1.18E+07	5.64E+06	47.8	18.47	3.89	6.51	6.18E+06	52.3
6-1	9/14/00	G7-I9	5	50	1.03E+07	1.03E+07	100.0	28.38	14.6	5.4	0.00E+00	0.0
6-2	10/05/00	EE15-GG17	24	>	1.81E+07	1.06E+07	58.6	21.55	3.95	4.65	4.54E+05	2.5
6-3	10/20/00	DD5-FF7	5	50	1.46E+07	1.46E+07	100.0	6.9	2.59	3.5	0.00E+00	0.0
7-1	10/4/00	HH28-JJ30	10	>	6.23E+06	6.23E+06	100.0	23.04	5.39	5.47	0.00E+00	0.0
7-2	10/11/00	P8-R10	5	>	1.25E+07	8.18E+05	6.5				1.17E+07	93.6
7-3	10/17/00	T5-V7	5	50	1.19E+07	0.00E+00	0.0				1.19E+07	100.0
7-4	10/19/00	T11-V13	5	50	1.55E+07	1.08E+07	69.7	5.4	1.97	4.27	4.34E+06	28.0
8-1	9/7/00	N19-P21	5.68	>	6.37E+06	6.37E+06	100.0	67.02	6.44	7.12	0.00E+00	0.0
8-2	9/13/00	C4-E6	5.68	>	5.04E+06	4.83E+06	95.8	7.3	3.61	5.52	2.09E+05	4.1
8-3	10/4/00	DD21-FF23	24	>	1.45E+07	0.00E+00	0.0				1.46E+07	100.7
8-4	10/18/00	T8-V10	5	50	1.56E+07	1.36E+06	8.7				1.43E+07	91.7

Note: Mass values obtained from weighed stockpiles (G, H, and G+H) after processing. Radiological data from on-site laboratory analysis.

Table 17
Batch Summary, Radiological Characteristics

Batch	Date	Ra + Th Setpoint (pCi/g)	U Setpoint (pCi/g)	Total Mass (kg)	Mass Rejected (kg)	% Rejected	Ra-226 Rejected (pCi/g)	Th-232 Rejected (pCi/g)	U-238 Rejected (pCi/g)	Mass Accepted (kg)	% Accepted
1	8/18/00	15	50	20759	1863.63	9.0	1.81	7.6	2.12	18895.45	91.0
2	8/21/00	15	>	38568	3695	9.6				34873	90.4
3	8/22/00	15	>	88491	4377	4.9				84114	95.1
4	8/23/00	15	>	41300	2409	5.8	2.06	6.67	2.47	38891	94.2
5	8/24/00	15	>	50750	28559	56.3	2.13	5.09	3.21	22191	43.7
7	8/28/00	5.68	>	117209	95523	81.5	2	7.68	1.7	21686	18.5
8	8/29/00	5.68	>	92727	48955	52.8	1.66	5	1.97	43774	47.2
9	8/30/00	5.68	>	63877	46918	73.5	1.34	3.66	2.18	16909	26.5
1-1 (partial)	8/31/00	5.68	>	87609	6445	7.4				81164	92.6
1-1 (partial)	9/1/00	5.68	>	83786	4973	5.9				78814	94.1
1-1 (partial)	9/5/00	5.68	>	49118	3686	7.5				45432	92.5
1-1 (partial)	9/6/00	5.68	>	124514	6677	5.4	1.32	2.71	5.29	117836	94.6
1-1 (partial)	9/7/00	5.68	>	105650	5591	5.3				100059	94.7
8-1 (partial)	9/8/00	5.68	>	81641	34609	42.4	2.4	4.51	0.96	47032	57.6
8-1 (partial)	9/11/00	5.68	>	51309	21545	42.0				29764	58.0
8-1 (partial)	9/12/00	5.68	>	26400	1495	5.7				24905	94.3
8-2 (partial)	9/13/00	5.68	>	66136	18855	28.5	3.08	6.8	4.14	47282	71.5
8-2 (partial)	9/14/00	5.68	>	89955	49941	55.5	2.04	15.2	1.19	40014	44.5
6-1 (partial)	9/19/00	5.68	>	82864	81636	98.5	15.1	49.9	12	1227	1.5
6-1 (partial)	9/20/00	5.68	>	33495	31636	94.4	9.86	39.7	8.83	1859	5.6
6-1 (partial)	9/21/00	15	>	58923	29636	50.3				29286	49.7
1-2	9/26/00	5.68	>	31705	31705	100.0				0	0.0
1-3	9/27/00	15	>	63636	63636	100.0	8.68	38.7	5.47	0	0.0
1-4	10/2/00	15	>	35632	35632	100.0	8.58	31.9	4.45	0	0.0
1-5	10/3/00	15	>	107123	107123	100.0	6.19	25.6	6.65	0	0.0
Batch Test #2	10/5/00	17	>	14636	14636	100.0	3.32	15.5	8.5	0	0.0
7-1 (partial)	10/6/00	20	>	54455	15909	29.2	5.78	24	5.32	38545	70.8
7-1 (partial)	10/9/00	32	>	104727	6545	6.2	4.28	20.7	3.67	98182	93.8
8-3 (partial	10/10/00	32	>	77365	22455	29.0		29.1		54909	71.0
8-3 (partial)	10/11/00	32	>	61091	20000	32.7		26.4		41091	67.3
Seq. Batch #1	10/12/00	5	>	39091	15636	40.0	2.72	8.11	1.68	23455	60.0
8-3 (partial)	10/16/00	15	>	97391	97391	100.0		44.1		0	0.0
Seq. Batch #2	10/19/00	5	50	36000	15091	41.9	3.54	9.14	4.22	20909	58.1

Batch	Date	Ra + Th Setpoint (pCi/g)	U Setpoint (pCi/g)	Total Mass (kg)	Mass Rejected (kg)	% Rejected	Ra-226 Rejected (pCi/g)	Th-232 Rejected (pCi/g)	U-238 Rejected (pCi/g)	Mass Accepted (kg)	% Accepted
Seq. Batch #3	10/23/00	5	50	20823	1177	5.7				19645	94.3
Seq. Batch #4	10/24/00	5	50	48709	9259	19.0	2.11	6.37	3.84	39450	81.0
Seq. Batch #5	10/24/00	5	50	14491	10945	75.5	33.51	6.69	7.09	0	0.0
7-4	10/25/00	5	50	65668	9932	15.1	1.36	5.06	2.21	55736	84.9
7-5	10/26/00	5	50	100245	10800	10.8	1.63	5.81	5.39	89445	89.2
7-6	10/27/00	5	50	97882	85968	87.8	1.48	4.81	0.79	11914	12.2
6-5	10/30/00	5	50	99068	99068	100.0				0	0.0
6-6 (partial)	10/31/00	5	50	69873	69873	100.0	4.28	16.9	6.77	0	0.0
6-6 (partial)	10/31/00	15	50	12350	6101	49.4	4.35	17.2	3.32	6249	50.6
6-7	11/2/00	15	50	127345	123877	97.3	4.62	20.1	7.43	3815	3.0
6-7 (oversize)	11/3/00	5	50	11610	8374	72.1	4.49	20.1	8.07	3236	27.9
8-5	11/7/00	15	50	124977	122877	98.3	7.81	28.6	6.06	2100	1.7

Note: Mass values obtained from weighed stockpiles (G, H, and G+H) after processing. Radiological data from on-site laboratory analysis.

Table 18
Slug Performance Summary

Slug	Ra+Th Setpoint (pCi/g)	Total Mass (tons)	Rejected Mass (tons)	Reject Error (tons)	Accepted Mass (tons)	Accepted Error (tons)
2-6	24	12.2	11.7	0.0	0.5	0.5
3-8	24	15.9	0.0	0.0	15.9	0.0
Engineered	15	13.0	6.2	0.0	6.8	6.8
On-site	13.75	5.7	5.7	0.0	0.0	0.0
1-7	10	13.7	13.7	0.0	0.0	0.0
1-6	5	11.3	11.3	0.0	0.0	0.0
3-6	5	16.1	16.1	0.0	0.0	0.0
2-7	5	13.8	0.9	NA	12.9	0.0
3-7	5	13.1	0.0	0.0	13.1	0.0
4-7	5	17.0	11.9	0.0	5.1	5.1
1-8	5.68	7.0	7.0	0.0	0.0	0.0
2-8	5.68	5.5	5.3	0.0	0.2	NA
4-8	5	17.2	1.5	NA	15.7	0.0
Totals		**161.4**	**91.2**	**0.0**	**70.2**	**12.9**
Error %				**0.0**		**18.4**

Note:
NA – Not Applicable

Table 19
Batch Performance Summary

Batch	Ra+Th Setpoint (pCi/g)	Total Mass (tons)	Rejected Mass (tons)	Reject Error (tons)	Accepted Mass (tons)	Accepted Error (tons)
1	15	22.8	2.1	2.1	20.8	
1-1	5.68	495.8	30.1	NA	465.7	
1-3	5.68	70.0	70.0		0.0	
1-4	5.68	39.2	39.2		0.0	
1-5	15	117.8	117.8		0.0	
2	15	42.4	4.1	NA	38.4	
3	15	97.3	4.8	NA	92.5	
4	15	45.4	2.7	2.7	42.8	
5	15	55.8	31.4	31.4	24.4	
6-1	5.68	64.8	32.6		32.2	32.2
6-6	5.68	90.4	90.4		0.0	
6-7	15	140.1	136.3		3.8	NA
7	5.68	128.9	105.1		23.9	23.9
7-1	20	59.9	17.5	17.5	42.4	
7-1	32	115.2	7.2	7.2	108.0	
7-4	5	72.2	10.9		61.3	61.3
7-5	5	110.3	11.9		98.4	
7-6	5	107.7	94.6		13.1	13.1
8	5.68	102.0	53.9		48.2	48.2
8-1	5.68	175.3	63.4		108.9	108.9
8-2	5.68	171.7	75.7		96.0	96.0
8-3	32	152.3	46.7	-1.0	105.6	105.6
8-3	15	107.1	107.1		0.0	
8-5	16	137.5	135.2		2.3	2.3
9	5.68	69.8	51.7	51.7	18.6	18.6
Recycled	25	26.6	26.6		0.0	
Sequence 1	5	40.0	17.2		25.8	
Sequence 2	5	39.6	16.6		23.0	23.0
Sequence 3	5	22.9	1.3	NA	21.6	21.6
Sequence 4	5	53.6	10.2		43.4	43.4
Sequence 5	5	12.0	12.0		0.0	
Batch Test 2	17	16.1	16.1		0.0	
Total		**3002.8**	**1442.2**	**111.5**	**1561.0**	**492.5**
Error %				**7.73**		**31.55**

Note:
NA – Not Applicable

Table 20
Range of Daytime L_{90} and L_{eq} Ambient Sound Levels, With and Without Screening Process in Operation

Location	**L_{90}**(1)		**L_{eq}**(2)	
	High(3)	**Low**	**High**	**Low**
1(4)	58 (55)		65 (61)	
2	61 (56)	56 (52)	73 (69)	71 (62)
3	61 (57)	58 (56)	72 (71)	70 (68)
4(4)	63 (61)		72 (68)	

Notes:
1. The L90 is the sound level in dBA exceeded 90% of the time.
2. The Leq, or equivalent sound level, is the energy average level.
3. (parenthesis) values are the ambient levles without the screening process operating.
4. Only one survey conducted rather than two.

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)	C In (
F	1	1	100	Char	Sulfide, Reactive	38.800	mg/kg	---	38.80		
G	50	2	4	Char	Sulfide, Reactive	44.800	mg/kg	40.87	44.80		
H	53	5	9.4339623	Char	Sulfide, Reactive	23.820	mg/kg	11.12	23.82		
In situ	8	7	87.50	Char	Sulfide, Reactive	10.857	mg/kg	2.27	10.86		
J	51	2	3.9215686	Char	Sulfide, Reactive	15.950	mg/kg	0.07	15.95		
F	8	8	100	Metals	Aluminum, Total	6520.000	mg/kg	411.79	6520.00		
G	56	1	1.7857143	Metals	Aluminum, Total	7617.679	mg/kg	1795.70	7617.68		
H	56	56	100	Metals	Aluminum, Total	7484.107	mg/kg	1635.01	7484.11		
I	4	3	75	Metals	Aluminum, Total	3840	mg/kg	377.49	3840.00		
In situ	17	17	100.00	Metals	Aluminum, Total	27118.235	mg/kg	35562.55	27118.24		
J	54	54	100	Metals	Aluminum, Total	7089.630	mg/kg	1598.58	7089.63		
F	8	8	100	Metals	Antimony, Total	1.075	mg/kg	0.07	1.08	14	
G	56	56	100	Metals	Antimony, Total	0.912	mg/kg	0.33	0.91	14	
H	56	56	100	Metals	Antimony, Total	0.673	mg/kg	0.30	0.67	14	
I	4	4	100	Metals	Antimony, Total	1.25	mg/kg	0.13	1.25	14	
In situ	17	17	100.00	Metals	Antimony, Total	0.834	mg/kg	0.60	0.83	14	
J	54	54	100	Metals	Antimony, Total	0.742	mg/kg	0.31	0.74	14	
F	8	8	100	Metals	Arsenic, Total	12.825	mg/kg	3.28	12.83	20	
G	56	56	100	Metals	Arsenic, Total	13.568	mg/kg	7.51	13.57	20	
H	56	56	100	Metals	Arsenic, Total	8.048	mg/kg	4.20	8.05	20	
I	4	4	100	Metals	Arsenic, Total	10.875	mg/kg	13.08	10.88	20	
In situ	17	17	100.00	Metals	Arsenic, Total	15.059	mg/kg	11.23	15.06	20	
J	54	54	100	Metals	Arsenic, Total	8.852	mg/kg	5.63	8.85	20	
F	8	8	100	Metals	Barium, Total	67.713	mg/kg	10.97	67.71	700	
G	56	56	100	Metals	Barium, Total	77.946	mg/kg	32.40	77.95	700	
H	56	56	100	Metals	Barium, Total	56.073	mg/kg	21.10	56.07	700	
I	4	4	100	Metals	Barium, Total	33.175	mg/kg	2.36	33.18	700	
In situ	17	17	100.00	Metals	Barium, Total	72.994	mg/kg	35.99	72.99	700	
J	54	53	98.148148	Metals	Barium, Total	60.730	mg/kg	23.45	60.73	700	
F	8	8	100	Metals	Beryllium, Total	0.474	mg/kg	0.03	0.47	2	
G	56	56	100	Metals	Beryllium, Total	0.525	mg/kg	0.13	0.52	2	
H	56	56	100	Metals	Beryllium, Total	0.430	mg/kg	0.11	0.43	2	

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)
I	4	4	100	Metals	Beryllium, Total	0.3475	mg/kg	0.06	0.35	2
In situ	17	17	100.00	Metals	Beryllium, Total	1.242	mg/kg	1.26	1.24	2
J	54	54	100	Metals	Beryllium, Total	0.441	mg/kg	0.12	0.44	2
F	8	8	100	Metals	Cadmium, Total	0.108	mg/kg	0.01	0.11	39
G	56	56	100	Metals	Cadmium, Total	0.142	mg/kg	0.08	0.14	39
H	56	56	100	Metals	Cadmium, Total	0.148	mg/kg	0.10	0.15	39
I	4	4	100	Metals	Cadmium, Total	0.125	mg/kg	0.01	0.13	39
In situ	17	17	100.00	Metals	Cadmium, Total	0.325	mg/kg	0.29	0.33	39
J	54	54	100	Metals	Cadmium, Total	0.124	mg/kg	0.08	0.12	39
F	8	8	100	Metals	Calcium, Total	10056.250	mg/kg	3535.02	10056.25	
G	56	56	100	Metals	Calcium, Total	8036.429	mg/kg	2391.97	8036.43	
H	56	56	100	Metals	Calcium, Total	7534.107	mg/kg	3268.96	7534.11	
I	4	4	100	Metals	Calcium, Total	6310	mg/kg	821.91	6310.00	
In situ	17	17	100.00	Metals	Calcium, Total	17171.176	mg/kg	13472.53	17171.18	
J	54	54	100	Metals	Calcium, Total	7214.352	mg/kg	4024.59	7214.35	
F	8	8	100	Metals	Chromium, Total	112.938	mg/kg	45.01	112.94	
G	56	56	100	Metals	Chromium, Total	88.511	mg/kg	50.21	88.51	
H	56	56	100	Metals	Chromium, Total	81.213	mg/kg	64.92	81.21	
I	4	4	100	Metals	Chromium, Total	21.35	mg/kg	2.99	21.35	
In situ	17	17	100.00	Metals	Chromium, Total	73.094	mg/kg	183.43	73.09	
J	54	54	100	Metals	Chromium, Total	75.478	mg/kg	56.45	75.48	
F	8	8	100	Metals	Cobalt, Total	3.963	mg/kg	0.36	3.96	
G	56	56	100	Metals	Cobalt, Total	4.616	mg/kg	1.02	4.62	
H	56	56	100	Metals	Cobalt, Total	5.379	mg/kg	1.61	5.38	
I	4	4	100	Metals	Cobalt, Total	3.525	mg/kg	0.64	3.53	
In situ	17	17	100.00	Metals	Cobalt, Total	3.958	mg/kg	2.27	3.96	
J	54	54	100	Metals	Cobalt, Total	4.994	mg/kg	1.53	4.99	
F	8	8	100	Metals	Copper, Total	35.000	mg/kg	5.08	35.00	600
G	56	56	100	Metals	Copper, Total	85.546	mg/kg	361.49	85.55	600
H	56	56	100	Metals	Copper, Total	36.696	mg/kg	19.87	36.70	600
I	4	4	100	Metals	Copper, Total	69.15	mg/kg	83.23	69.15	600
In situ	17	17	100.00	Metals	Copper, Total	61.965	mg/kg	60.55	61.96	600

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)	C In (
J	54	54	100	Metals	Copper, Total	32.622	mg/kg	20.58	32.62	600	
F	8	8	100	Metals	Iron, Total	11311.250	mg/kg	2550.14	11311.25		
G	56	56	100	Metals	Iron, Total	12499.464	mg/kg	2955.99	12499.46		
H	56	56	100	Metals	Iron, Total	13052.321	mg/kg	2679.92	13052.32		
I	4	4	100	Metals	Iron, Total	12502.5	mg/kg	5886.10	12502.50		
In situ	17	17	100.00	Metals	Iron, Total	11302.353	mg/kg	7065.89	11302.35		
J	54	54	100	Metals	Iron, Total	12608.333	mg/kg	3535.04	12608.33		
F	8	8	100	Metals	Lead, Total	77.213	mg/kg	8.93	77.21	400	
G	56	56	100	Metals	Lead, Total	126.743	mg/kg	240.27	126.74	400	
H	56	56	100	Metals	Lead, Total	80.998	mg/kg	58.33	81.00	400	
I	4	4	100	Metals	Lead, Total	25.175	mg/kg	4.20	25.18	400	
In situ	17	17	100.00	Metals	Lead, Total	107.576	mg/kg	136.03	107.58	400	
J	54	54	100	Metals	Lead, Total	65.924	mg/kg	48.84	65.92	400	
F	8	8	100	Metals	Magnesium, Total	1556.250	mg/kg	152.59	1556.25		
H	56	56	100	Metals	Magnesium, Total	2850.768	mg/kg	1758.81	2850.77		
I	4	4	100	Metals	Magnesium, Total	1378	mg/kg	439.73	1378.00		
In situ	17	17	100.00	Metals	Magnesium, Total	1858.941	mg/kg	1462.03	1858.94		
J	54	54	100	Metals	Magnesium, Total	2353.944	mg/kg	1449.87	2353.94		
F	8	8	100	Metals	Manganese, Total	261.875	mg/kg	110.42	261.88		
G	56	56	100	Metals	Manganese, Total	252.446	mg/kg	60.00	252.45		
H	56	56	100	Metals	Manganese, Total	235.268	mg/kg	47.38	235.27		
I	4	4	100	Metals	Manganese, Total	327	mg/kg	214.68	327.00		
In situ	17	17	100.00	Metals	Manganese, Total	258.600	mg/kg	183.15	258.60		
J	54	54	100	Metals	Manganese, Total	262.463	mg/kg	72.18	262.46		
F	8	8	100	Metals	Mercury, Total	0.480	mg/kg	0.43	0.48	14	
G	56	56	100	Metals	Mercury, Total	0.347	mg/kg	0.27	0.35	14	
H	56	56	100	Metals	Mercury, Total	0.241	mg/kg	0.18	0.24	14	
I	4	4	100	Metals	Mercury, Total	0.10775	mg/kg	0.09	0.11	14	
In situ	17	17	100.00	Metals	Mercury, Total	1.459	mg/kg	4.51	1.46	14	
J	54	54	100	Metals	Mercury, Total	0.233	mg/kg	0.18	0.23	14	
F	8	8	100	Metals	Molybdenum, Total	0.971	mg/kg	0.58	0.97		
G	56	56	100	Metals	Molybdenum, Total	0.951	mg/kg	0.45	0.95		

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)	C In (
H	56	56	100	Metals	Molybdenum, Total	0.717	mg/kg	0.31	0.72		
I	4	4	100	Metals	Molybdenum, Total	1.2275	mg/kg	1.05	1.23		
J	54	54	100	Metals	Molybdenum, Total	0.694	mg/kg	0.33	0.69		
F	8	8	100	Metals	Nickel, Total	11.088	mg/kg	3.01	11.09	250	
G	56	56	100	Metals	Nickel, Total	12.466	mg/kg	4.79	12.47	250	
H	56	56	100	Metals	Nickel, Total	12.355	mg/kg	2.81	12.36	250	
I	4	4	100	Metals	Nickel, Total	7.7	mg/kg	1.95	7.70	250	
In situ	17	17	100.00	Metals	Nickel, Total	13.141	mg/kg	8.19	13.14	250	
J	54	54	100	Metals	Nickel, Total	11.283	mg/kg	2.87	11.28	250	
F	8	8	100	Metals	Potassium, Total	706.750	mg/kg	59.31	706.75		
G	56	55	98.214286	Metals	Potassium, Total	769.927	mg/kg	241.95	769.93		
H	56	55	98.214286	Metals	Potassium, Total	714.509	mg/kg	212.09	714.51		
I	4	4	100	Metals	Potassium, Total	520	mg/kg	27.02	520.00		
In situ	17	17	100.00	Metals	Potassium, Total	728.588	mg/kg	246.52	728.59		
J	54	54	100	Metals	Potassium, Total	715.574	mg/kg	220.25	715.57		
G	56	30	53.571429	Metals	Selenium, Total	1.021	mg/kg	0.35	1.02	63	
H	56	44	78.571429	Metals	Selenium, Total	0.939	mg/kg	0.31	0.94	63	
In situ	17	17	100.00	Metals	Selenium, Total	0.898	mg/kg	0.45	0.90	63	
J	54	35	64.814815	Metals	Selenium, Total	1.023	mg/kg	0.40	1.02	63	
F	8	8	100	Metals	Silver, Total	0.218	mg/kg	0.01	0.22	110	
G	56	56	100	Metals	Silver, Total	0.247	mg/kg	0.46	0.25	110	
H	56	56	100	Metals	Silver, Total	0.183	mg/kg	0.06	0.18	110	
I	4	4	100	Metals	Silver, Total	0.245	mg/kg	0.03	0.25	110	
In situ	17	17	100.00	Metals	Silver, Total	0.141	mg/kg	0.09	0.14	110	
J	54	54	100	Metals	Silver, Total	0.173	mg/kg	0.06	0.17	110	
F	8	8	100	Metals	Sodium, Total	332.375	mg/kg	43.71	332.38		
G	56	56	100	Metals	Sodium, Total	398.696	mg/kg	181.08	398.70		
H	56	56	100	Metals	Sodium, Total	426.879	mg/kg	231.64	426.88		
I	4	4	100	Metals	Sodium, Total	163.5	mg/kg	26.64	163.50		
In situ	17	17	100.00	Metals	Sodium, Total	1284.647	mg/kg	1987.41	1284.65		
J	54	54	100	Metals	Sodium, Total	347.989	mg/kg	201.73	347.99		
F	8	8	100	Metals	Thallium, Total	1.350	mg/kg	0.16	1.35	2	

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Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)
G	56	54	96.428571	Metals	Thallium, Total	1.444	mg/kg	0.48	1.44	2
H	56	55	98.214286	Metals	Thallium, Total	1.089	mg/kg	0.34	1.09	2
I	4	4	100	Metals	Thallium, Total	1.925	mg/kg	0.57	1.93	2
In situ	17	17	100.00	Metals	Thallium, Total	0.743	mg/kg	0.25	0.74	2
J	54	53	98.148148	Metals	Thallium, Total	1.177	mg/kg	0.50	1.18	370
F	8	8	100	Metals	Vanadium, Total	13.663	mg/kg	1.56	13.66	370
G	56	56	100	Metals	Vanadium, Total	17.720	mg/kg	4.74	17.72	370
H	56	56	100	Metals	Vanadium, Total	20.386	mg/kg	7.05	20.39	370
I	4	3	75	Metals	Vanadium, Total	21.766667	mg/kg	16.40	21.77	370
In situ	17	17	100.00	Metals	Vanadium, Total	15.207	mg/kg	8.42	15.21	1500
J	54	54	100	Metals	Vanadium, Total	18.202	mg/kg	6.30	18.20	370
F	8	8	100	Metals	Zinc, Total	60.325	mg/kg	7.17	60.33	1500
G	56	56	100	Metals	Zinc, Total	73.184	mg/kg	37.05	73.18	1500
H	56	56	100	Metals	Zinc, Total	67.138	mg/kg	22.45	67.14	1500
I	4	4	100	Metals	Zinc, Total	627.275	mg/kg	1188.51	627.28	1500
In situ	17	17	100.00	Metals	Zinc, Total	100.376	mg/kg	70.95	100.38	1500
J	54	54	100	Metals	Zinc, Total	61.722	mg/kg	33.65	61.72	1500
F	8	8	100	Pesticides	4,4'-DDD	27.938	µg/kg	11.69	0.03	3
G	53	51	96.226415	Pesticides	4,4'-DDD	24.837	µg/kg	45.92	0.02	3
H	50	40	80	Pesticides	4,4'-DDD	31.700	µg/kg	64.93	0.03	3
In situ	8	8	100.00	Pesticides	4,4'-DDD	9.775	µg/kg	1.84	0.01	3
J	51	44	86.27451	Pesticides	4,4'-DDD	12.415	µg/kg	23.66	0.01	3
F	8	7	87.5	Pesticides	4,4'-DDE	10.600	µg/kg	3.78	0.01	2
G	53	37	69.811321	Pesticides	4,4'-DDE	11.978	µg/kg	5.70	0.01	2
H	50	19	38	Pesticides	4,4'-DDE	12.779	µg/kg	6.90	0.01	2
I	4	3	75	Pesticides	4,4'-DDE	27	µg/kg	9.85	0.03	2
In situ	8	8	100.00	Pesticides	4,4'-DDE	3.873	µg/kg	2.01	0.00	2
J	51	22	43.137255	Pesticides	4,4'-DDE	6.856	µg/kg	5.69	0.01	2
F	8	5	62.5	Pesticides	4,4'-DDT	7.080	µg/kg	2.06	0.01	2
G	53	44	83.018868	Pesticides	4,4'-DDT	6.793	µg/kg	5.18	0.01	2
H	50	37	74	Pesticides	4,4'-DDT	8.643	µg/kg	9.72	0.01	2
I	4	3	75	Pesticides	4,4'-DDT	10.266667	µg/kg	1.62	0.01	2

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)
In situ	8	8	100.00	Pesticides	4,4'-DDT	4.150	µg/kg	1.18	0.00	2
J	51	34	66.666667	Pesticides	4,4'-DDT	3.366	µg/kg	2.36	0.00	2
F	8	8	100	Pesticides	Aldrin	4.228	µg/kg	3.78	0.00	0.04
G	53	31	58.490566	Pesticides	Aldrin	5.402	µg/kg	4.00	0.01	0.04
H	50	18	36	Pesticides	Aldrin	5.087	µg/kg	10.62	0.01	0.04
I	4	3	75	Pesticides	Aldrin	4.1666667	µg/kg	1.53	0.00	0.04
In situ	8	8	100.00	Pesticides	Aldrin	4.440	µg/kg	6.47	0.00	0.04
J	51	16	31.372549	Pesticides	Aldrin	2.512	µg/kg	2.47	0.00	0.04
F	8	2	25	Pesticides	alpha-BHC	0.915	µg/kg	0.54	0.00	
G	53	5	9.4339623	Pesticides	alpha-BHC	2.094	µg/kg	1.25	0.00	
H	50	4	8	Pesticides	alpha-BHC	4.000	µg/kg	4.02	0.00	
I	4	3	75	Pesticides	alpha-BHC	8.6333333	µg/kg	1.95	0.01	
J	51	1	1.9607843	Pesticides	alpha-BHC	3.000	µg/kg	---	0.00	
F	8	8	100	Pesticides	alpha-Chlordane	26.588	µg/kg	42.32	0.03	
G	53	51	96.226415	Pesticides	alpha-Chlordane	16.640	µg/kg	12.60	0.02	
H	50	48	96	Pesticides	alpha-Chlordane	19.069	µg/kg	22.71	0.02	
I	4	4	100	Pesticides	alpha-Chlordane	6.475	µg/kg	2.51	0.01	
In situ	8	8	100.00	Pesticides	alpha-Chlordane	13.385	µg/kg	11.75	0.01	
J	51	44	86.27451	Pesticides	alpha-Chlordane	8.213	µg/kg	8.33	0.01	
F	8	4	50	Pesticides	beta-BHC	4.425	µg/kg	3.36	0.00	
G	53	10	18.867925	Pesticides	beta-BHC	3.660	µg/kg	1.88	0.00	
H	50	4	8	Pesticides	beta-BHC	3.128	µg/kg	3.80	0.00	
J	51	4	7.8431373	Pesticides	beta-BHC	1.678	µg/kg	0.95	0.00	
F	8	4	50	Pesticides	delta-BHC	7.355	µg/kg	7.84	0.01	
G	53	14	26.415094	Pesticides	delta-BHC	9.083	µg/kg	6.87	0.01	
H	50	5	10	Pesticides	delta-BHC	8.200	µg/kg	4.69	0.01	
I	4	2	50	Pesticides	delta-BHC	0.705	µg/kg	0.56	0.00	
J	51	8	15.686275	Pesticides	delta-BHC	2.111	µg/kg	2.66	0.00	
F	8	8	100	Pesticides	Dieldrin	3.600	µg/kg	1.72	0.00	0.042
G	53	34	64.150943	Pesticides	Dieldrin	5.135	µg/kg	3.73	0.01	0.042
H	50	22	44	Pesticides	Dieldrin	4.800	µg/kg	3.10	0.00	0.042
I	4	3	75	Pesticides	Dieldrin	1.8	µg/kg	0.17	0.00	0.042

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Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)
J	51	18	35.294118	Pesticides	Dieldrin	3.631	µg/kg	2.57	0.00	0.042
G	53	1	1.8867925	Pesticides	Endosulfan I	4.100	µg/kg	---	0.00	340
H	50	1	2	Pesticides	Endosulfan I	1.000	µg/kg	---	0.00	340
G	53	12	22.641509	Pesticides	Endosulfan II	4.125	µg/kg	4.98	0.00	340
H	50	14	28	Pesticides	Endosulfan II	4.362	µg/kg	8.85	0.00	340
J	51	10	19.607843	Pesticides	Endosulfan II	1.662	µg/kg	0.76	0.00	340
F	8	8	100	Pesticides	Endosulfan Sulfate	3.875	µg/kg	4.16	0.00	
G	53	36	67.924528	Pesticides	Endosulfan Sulfate	6.444	µg/kg	5.03	0.01	
H	50	25	50	Pesticides	Endosulfan Sulfate	7.641	µg/kg	12.39	0.01	
I	4	3	75	Pesticides	Endosulfan Sulfate	13.633333	µg/kg	4.99	0.01	
J	51	26	50.980392	Pesticides	Endosulfan Sulfate	3.074	µg/kg	1.90	0.00	
F	8	1	12.5	Pesticides	Endrin	8.300	µg/kg	---	0.01	17
G	53	3	5.6603774	Pesticides	Endrin	9.033	µg/kg	6.05	0.01	17
H	50	1	2	Pesticides	Endrin	100.000	µg/kg	---	0.10	17
I	4	2	50	Pesticides	Endrin	3	µg/kg	0.28	0.00	17
J	51	3	5.8823529	Pesticides	Endrin	13.100	µg/kg	12.94	0.01	17
G	53	3	5.6603774	Pesticides	Endrin aldehyde	13.667	µg/kg	13.32	0.01	
H	50	2	4	Pesticides	Endrin aldehyde	22.000	µg/kg	12.73	0.02	
J	51	1	1.9607843	Pesticides	Endrin aldehyde	31.000	µg/kg	---	0.03	
F	8	4	50	Pesticides	Endrin ketone	7.850	µg/kg	2.80	0.01	
G	53	10	18.867925	Pesticides	Endrin ketone	4.950	µg/kg	4.04	0.00	
H	50	9	18	Pesticides	Endrin ketone	4.667	µg/kg	3.82	0.00	
I	4	4	100	Pesticides	Endrin ketone	11.325	µg/kg	5.40	0.01	
J	51	8	15.686275	Pesticides	Endrin ketone	3.550	µg/kg	2.34	0.00	
F	8	2	25	Pesticides	gamma-BHC (Lindane)	0.980	µg/kg	0.17	0.00	0.52
G	53	12	22.641509	Pesticides	gamma-BHC (Lindane)	1.503	µg/kg	1.89	0.00	0.52
H	50	13	26	Pesticides	gamma-BHC (Lindane)	2.348	µg/kg	5.91	0.00	0.52
In situ	8	7	87.50	Pesticides	gamma-BHC (Lindane)	1.700	µg/kg	0.42	0.00	0.52
J	51	1	1.9607843	Pesticides	gamma-BHC (Lindane)	0.420	µg/kg	---	0.00	0.52
F	8	8	100	Pesticides	gamma-Chlordane	17.888	µg/kg	31.78	0.02	
G	53	49	92.45283	Pesticides	gamma-Chlordane	9.753	µg/kg	7.20	0.01	
H	50	50	100	Pesticides	gamma-Chlordane	13.190	µg/kg	20.69	0.01	

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I	4	4	100	Pesticides	gamma-Chlordane	4.725	µg/kg	0.81	0.00		
In situ	8	8	100.00	Pesticides	gamma-Chlordane	6.708	µg/kg	5.89	0.01		
J	51	44	86.27451	Pesticides	gamma-Chlordane	5.159	µg/kg	7.33	0.01		
F	8	1	12.5	Pesticides	Heptachlor	2.200	µg/kg	---	0.00	0.15	
G	53	4	7.5471698	Pesticides	Heptachlor	2.270	µg/kg	1.52	0.00	0.15	
H	50	18	36	Pesticides	Heptachlor	2.629	µg/kg	2.08	0.00	0.15	
J	51	9	17.647059	Pesticides	Heptachlor	1.906	µg/kg	2.13	0.00	0.15	
F	8	2	25	Pesticides	Heptachlor Epoxide	4.050	µg/kg	4.03	0.00		
G	53	9	16.981132	Pesticides	Heptachlor Epoxide	3.303	µg/kg	4.12	0.00		
H	50	9	18	Pesticides	Heptachlor Epoxide	3.238	µg/kg	2.41	0.00		
I	4	2	50	Pesticides	Heptachlor Epoxide	2.85	µg/kg	0.64	0.00		
In situ	8	8	100.00	Pesticides	Heptachlor Epoxide	13.950	µg/kg	16.78	0.01		
J	51	5	9.8039216	Pesticides	Heptachlor Epoxide	3.000	µg/kg	0.72	0.00		
F	8	6	75	Pesticides	Methoxychlor	11.850	µg/kg	5.08	0.01	280	
G	53	19	35.849057	Pesticides	Methoxychlor	15.858	µg/kg	8.24	0.02	280	
H	50	15	30	Pesticides	Methoxychlor	16.480	µg/kg	8.29	0.02	280	
I	4	4	100	Pesticides	Methoxychlor	33	µg/kg	8.98	0.03	280	
J	51	15	29.411765	Pesticides	Methoxychlor	11.213	µg/kg	6.83	0.01	280	
G	50	2	4	SVOC	2,4-Dimethylphenol	8.000	µg/kg	4.24	0.01	1100	
H	53	1	1.8867925	SVOC	2,4-Dimethylphenol	9.000	µg/kg	---	0.01	1100	
F	8	4	50	SVOC	2-Methylnaphthalene	33.750	µg/kg	32.21	0.03		
G	50	44	88	SVOC	2-Methylnaphthalene	69.545	µg/kg	136.66	0.07		
H	53	35	66.037736	SVOC	2-Methylnaphthalene	37.514	µg/kg	31.43	0.04		
I	4	2	50	SVOC	2-Methylnaphthalene	235	µg/kg	148.49	0.24		
In situ	8	8	100.00	SVOC	2-Methylnaphthalene	58.429	µg/kg	120.13	0.06		
J	51	23	45.098039	SVOC	2-Methylnaphthalene	49.739	µg/kg	95.28	0.05		
G	50	11	22	SVOC	2-Methylphenol	219.818	µg/kg	592.98	0.22	2800	
H	53	4	7.5471698	SVOC	2-Methylphenol	24.000	µg/kg	13.83	0.02	2800	
In situ	8	7	87.50	SVOC	2-Methylphenol	10.500	µg/kg	2.12	0.01	2800	
J	51	4	7.8431373	SVOC	2-Methylphenol	176.750	µg/kg	145.40	0.18	2800	
G	50	1	2	SVOC	4-Chloroaniline	11.000	µg/kg	---	0.01	230	
F	8	2	25	SVOC	4-Methylphenol	43.500	µg/kg	2.12	0.04	2800	

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G	50	22	44	SVOC	4-Methylphenol	43.818	µg/kg	26.76	0.04	2800
H	53	20	37.735849	SVOC	4-Methylphenol	68.050	µg/kg	45.94	0.07	2800
In situ	8	7	87.50	SVOC	4-Methylphenol	68.500	µg/kg	102.07	0.07	2800
In situ	8	7	87.50	SVOC	4-Methylphenol	1.100	µg/L	1.27		2800
J	51	9	17.647059	SVOC	4-Methylphenol	19.111	µg/kg	14.68	0.02	2800
F	8	3	37.5	SVOC	Acenaphthene	95.000	µg/kg	116.91	0.10	3400
G	50	43	86	SVOC	Acenaphthene	82.814	µg/kg	213.18	0.08	3400
H	53	38	71.698113	SVOC	Acenaphthene	63.947	µg/kg	55.61	0.06	3400
In situ	8	8	100.00	SVOC	Acenaphthene	82.167	µg/kg	101.31	0.08	3400
J	51	20	39.215686	SVOC	Acenaphthene	105.700	µg/kg	154.18	0.11	3400
F	8	7	87.5	SVOC	Acenaphthylene	53.714	µg/kg	28.22	0.05	
G	50	49	98	SVOC	Acenaphthylene	89.531	µg/kg	73.95	0.09	
H	53	53	100	SVOC	Acenaphthylene	98.566	µg/kg	89.06	0.10	
I	4	2	50	SVOC	Acenaphthylene	265	µg/kg	63.64	0.27	
In situ	8	8	100.00	SVOC	Acenaphthylene	198.000	µg/kg	446.05	0.20	10000
J	51	45	88.235294	SVOC	Acenaphthylene	124.111	µg/kg	360.61	0.12	
F	8	7	87.5	SVOC	Anthracene	143.857	µg/kg	141.94	0.14	10000
G	50	50	100	SVOC	Anthracene	227.200	µg/kg	570.72	0.23	10000
H	53	53	100	SVOC	Anthracene	189.906	µg/kg	161.95	0.19	10000
I	4	2	50	SVOC	Anthracene	520	µg/kg	56.57	0.52	10000
In situ	8	8	100.00	SVOC	Anthracene	268.000	µg/kg	543.15	0.27	0.9
J	51	48	94.117647	SVOC	Anthracene	226.000	µg/kg	582.71	0.23	10000
F	8	7	87.5	SVOC	Benzo(a)anthracene	254.286	µg/kg	217.63	0.25	0.9
G	50	49	98	SVOC	Benzo(a)anthracene	452.571	µg/kg	919.27	0.45	0.9
H	53	53	100	SVOC	Benzo(a)anthracene	426.434	µg/kg	350.62	0.43	0.9
I	4	2	50	SVOC	Benzo(a)anthracene	555	µg/kg	77.78	0.56	0.9
In situ	8	8	100.00	SVOC	Benzo(a)anthracene	524.500	µg/kg	855.58	0.52	0.66
J	51	50	98.039216	SVOC	Benzo(a)anthracene	350.020	µg/kg	934.96	0.35	0.9
F	8	7	87.5	SVOC	Benzo(a)pyrene	258.571	µg/kg	206.92	0.26	0.66
G	50	50	100	SVOC	Benzo(a)pyrene	384.700	µg/kg	590.95	0.38	0.66
H	53	52	98.113208	SVOC	Benzo(a)pyrene	371.769	µg/kg	257.81	0.37	0.66
In situ	8	8	100.00	SVOC	Benzo(a)pyrene	400.750	µg/kg	544.78	0.40	0.9

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)
J	51	46	90.196078	SVOC	Benzo(a)pyrene	338.826	µg/kg	813.61	0.34	0.66
F	8	7	87.5	SVOC	Benzo(b)fluoranthene	205.714	µg/kg	166.82	0.21	0.9
G	50	49	98	SVOC	Benzo(b)fluoranthene	316.469	µg/kg	450.86	0.32	0.9
H	53	52	98.113208	SVOC	Benzo(b)fluoranthene	317.712	µg/kg	221.94	0.32	0.9
I	4	2	50	SVOC	Benzo(b)fluoranthene	300	µg/kg	84.85	0.30	0.9
In situ	8	8	100.00	SVOC	Benzo(b)fluoranthene	288.125	µg/kg	344.67	0.29	
J	51	47	92.156863	SVOC	Benzo(b)fluoranthene	272.851	µg/kg	638.39	0.27	0.9
F	8	7	87.5	SVOC	Benzo(g,h,i)perylene	205.143	µg/kg	182.62	0.21	
G	50	48	96	SVOC	Benzo(g,h,i)perylene	318.958	µg/kg	285.38	0.32	
H	53	50	94.339623	SVOC	Benzo(g,h,i)perylene	338.300	µg/kg	209.81	0.34	
I	4	2	50	SVOC	Benzo(g,h,i)perylene	150	µg/kg	42.43	0.15	
In situ	8	8	100.00	SVOC	Benzo(g,h,i)perylene	307.250	µg/kg	347.41	0.31	0.9
J	51	40	78.431373	SVOC	Benzo(g,h,i)perylene	326.625	µg/kg	768.16	0.33	
F	8	7	87.5	SVOC	Benzo(k)fluoranthene	275.714	µg/kg	226.93	0.28	0.9
G	50	50	100	SVOC	Benzo(k)fluoranthene	371.160	µg/kg	520.18	0.37	0.9
H	53	52	98.113208	SVOC	Benzo(k)fluoranthene	365.000	µg/kg	246.36	0.37	0.9
In situ	8	8	100.00	SVOC	Benzo(k)fluoranthene	309.750	µg/kg	344.20	0.31	49
J	51	47	92.156863	SVOC	Benzo(k)fluoranthene	296.426	µg/kg	649.84	0.30	0.9
F	8	4	50	SVOC	bis(2-Ethylhexyl)phthalate	109.500	µg/kg	27.59	0.11	49
G	50	35	70	SVOC	bis(2-Ethylhexyl)phthalate	135.343	µg/kg	153.00	0.14	49
H	53	37	69.811321	SVOC	bis(2-Ethylhexyl)phthalate	172.514	µg/kg	149.46	0.17	49
I	4	2	50	SVOC	bis(2-Ethylhexyl)phthalate	33.5	µg/kg	16.26	0.03	49
In situ	8	8	100.00	SVOC	bis(2-Ethylhexyl)phthalate	75.625	µg/kg	14.26	0.08	
J	51	26	50.980392	SVOC	bis(2-Ethylhexyl)phthalate	125.885	µg/kg	146.41	0.13	49
H	53	1	1.8867925	SVOC	Butyl benzyl phthalate	44.000	µg/kg	---	0.04	1100
In situ	8	8	100.00	SVOC	Carbazole	49.625	µg/kg	85.94	0.05	9
F	8	7	87.5	SVOC	Chrysene	345.714	µg/kg	287.68	0.35	9
G	50	49	98	SVOC	Chrysene	562.755	µg/kg	954.96	0.56	9
H	53	53	100	SVOC	Chrysene	506.849	µg/kg	370.32	0.51	9
I	4	2	50	SVOC	Chrysene	660	µg/kg	98.99	0.66	9
In situ	8	8	100.00	SVOC	Chrysene	620.500	µg/kg	1019.00	0.62	5700
J	51	50	98.039216	SVOC	Chrysene	414.320	µg/kg	1063.31	0.41	9

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)	C In (
F	8	5	62.5	SVOC	Dibenzofuran	44.400	µg/kg	59.15	0.04		
G	50	44	88	SVOC	Dibenzofuran	56.909	µg/kg	117.88	0.06		
H	53	42	79.245283	SVOC	Dibenzofuran	41.167	µg/kg	41.03	0.04		
I	4	2	50	SVOC	Dibenzofuran	96	µg/kg	19.80	0.10		
In situ	8	8	100.00	SVOC	Dibenzofuran	47.714	µg/kg	79.83	0.05	2300	
J	51	24	47.058824	SVOC	Dibenzofuran	67.500	µg/kg	104.31	0.07		
G	50	5	10	SVOC	Diethylphthalate	15.400	µg/kg	3.29	0.02	10000	
H	53	3	5.6603774	SVOC	Diethylphthalate	226.333	µg/kg	375.57	0.23	10000	
J	51	7	13.72549	SVOC	Diethylphthalate	15.714	µg/kg	14.04	0.02	10000	
G	50	1	2	SVOC	Dimethylphthalate	86.000	µg/kg	---	0.09	10000	
G	50	15	30	SVOC	Di-n-butylphthalate	29.800	µg/kg	26.37	0.03	5700	
H	53	9	16.981132	SVOC	Di-n-butylphthalate	14.111	µg/kg	13.72	0.01	5700	
In situ	8	8	100.00	SVOC	Di-n-butylphthalate	7.400	µg/kg	2.51	0.01		
J	51	12	23.529412	SVOC	Di-n-butylphthalate	23.333	µg/kg	21.79	0.02	5700	
G	50	1	2	SVOC	Di-n-octylphthalate	18.000	µg/kg	---	0.02	1100	
J	51	1	1.9607843	SVOC	Di-n-octylphthalate	59.000	µg/kg	---	0.06	1100	
F	8	7	87.5	SVOC	Fluoranthene	421.429	µg/kg	392.19	0.42	2300	
G	50	50	100	SVOC	Fluoranthene	707.200	µg/kg	1114.25	0.71	2300	
H	53	53	100	SVOC	Fluoranthene	651.698	µg/kg	570.66	0.65	2300	
I	4	2	50	SVOC	Fluoranthene	940	µg/kg	84.85	0.94	2300	
In situ	8	8	100.00	SVOC	Fluoranthene	814.125	µg/kg	1320.39	0.81	2300	
J	51	51	100	SVOC	Fluoranthene	559.471	µg/kg	1263.09	0.56	2300	
F	8	7	87.5	SVOC	Fluorene	70.571	µg/kg	84.05	0.07	2300	
G	50	49	98	SVOC	Fluorene	100.796	µg/kg	219.75	0.10	2300	
H	53	46	86.792453	SVOC	Fluorene	75.522	µg/kg	81.96	0.08	2300	
I	4	2	50	SVOC	Fluorene	305	µg/kg	120.21	0.31	2300	
In situ	8	8	100.00	SVOC	Fluorene	199.333	µg/kg	394.44	0.20	0.9	
J	51	32	62.745098	SVOC	Fluorene	148.063	µg/kg	289.34	0.15	2300	
F	8	7	87.5	SVOC	Indeno(1,2,3-cd)pyrene	198.857	µg/kg	181.21	0.20	0.9	
G	50	49	98	SVOC	Indeno(1,2,3-cd)pyrene	314.857	µg/kg	344.28	0.31	0.9	
H	53	50	94.339623	SVOC	Indeno(1,2,3-cd)pyrene	313.380	µg/kg	207.07	0.31	0.9	
I	4	2	50	SVOC	Indeno(1,2,3-cd)pyrene	155	µg/kg	21.21	0.16	0.9	

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)
In situ	8	8	100.00	SVOC	Indeno(1,2,3-cd)pyrene	256.125	µg/kg	294.31	0.26	230
J	51	42	82.352941	SVOC	Indeno(1,2,3-cd)pyrene	270.024	µg/kg	603.41	0.27	0.9
G	50	6	12	SVOC	Isophorone	5.833	µg/kg	1.47	0.01	1100
H	53	4	7.5471698	SVOC	Isophorone	7.250	µg/kg	2.06	0.01	1100
J	51	6	11.764706	SVOC	Isophorone	4.000	µg/kg	0.00	0.00	1100
F	8	1	12.5	SVOC	Naphthalene	170.000	µg/kg	---	0.17	230
G	50	40	80	SVOC	Naphthalene	43.775	µg/kg	64.47	0.04	230
H	53	39	73.584906	SVOC	Naphthalene	32.641	µg/kg	25.28	0.03	230
I	4	2	50	SVOC	Naphthalene	124	µg/kg	50.91	0.12	230
In situ	8	8	100.00	SVOC	Naphthalene	30.625	µg/kg	56.72	0.03	
J	51	23	45.098039	SVOC	Naphthalene	31.609	µg/kg	42.11	0.03	230
J	51	1	1.9607843	SVOC	Nitrobenzene	13.000	µg/kg	---	0.01	28
F	8	7	87.5	SVOC	Phenanthrene	498.571	µg/kg	535.80	0.50	
G	50	49	98	SVOC	Phenanthrene	826.735	µg/kg	1930.24	0.83	
H	53	53	100	SVOC	Phenanthrene	545.585	µg/kg	531.74	0.55	
I	4	2	50	SVOC	Phenanthrene	1800	µg/kg	424.26	1.80	
In situ	8	8	100.00	SVOC	Phenanthrene	1096.500	µg/kg	2473.95	1.10	10000
J	51	51	100	SVOC	Phenanthrene	675.078	µg/kg	1697.10	0.68	
G	50	18	36	SVOC	Phenol	55.833	µg/kg	108.71	0.06	10000
H	53	17	32.075472	SVOC	Phenol	38.824	µg/kg	33.49	0.04	10000
In situ	8	8	100.00	SVOC	Phenol	12.000	µg/kg	11.65	0.01	1700
J	51	9	17.647059	SVOC	Phenol	18.556	µg/kg	27.96	0.02	10000
F	8	7	87.5	SVOC	Pyrene	650.000	µg/kg	431.35	0.65	1700
G	50	50	100	SVOC	Pyrene	957.000	µg/kg	1700.31	0.96	1700
H	53	51	96.226415	SVOC	Pyrene	900.196	µg/kg	688.24	0.90	1700
I	4	2	50	SVOC	Pyrene	1015	µg/kg	120.21	1.02	1700
In situ	8	8	100.00	SVOC	Pyrene	1282.875	µg/kg	2271.15	1.28	
J	51	51	100	SVOC	Pyrene	716.784	µg/kg	1716.76	0.72	1700
In situ	17	8	47.06	VOC	1,1,1-Trichloroethane	1062.500	µg/kg	606.93	1.06	34
G	56	17	30.357143	VOC	1,1,2,2-Tetrachloroethane	3.853	µg/kg	4.05	0.00	34
H	56	16	28.571429	VOC	1,1,2,2-Tetrachloroethane	3.994	µg/kg	6.60	0.00	34
In situ	17	8	47.06	VOC	1,1,2,2-Tetrachloroethane	1062.500	µg/kg	606.93	1.06	22

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)
G	56	2	3.5714286	VOC	1,1,2-Trichloroethane	7.000	µg/kg	7.07	0.01	22
H	56	5	8.9285714	VOC	1,1,2-Trichloroethane	6.200	µg/kg	6.26	0.01	22
In situ	17	8	47.06	VOC	1,1,2-Trichloroethane	1062.500	µg/kg	606.93	1.06	570
In situ	17	8	47.06	VOC	1,1-Dichloroethane	1062.500	µg/kg	606.93	1.06	8
G	56	2	3.5714286	VOC	1,1-Dichloroethene	2.000	µg/kg	0.00	0.00	8
H	56	1	1.7857143	VOC	1,1-Dichloroethene	2.000	µg/kg	---	0.00	8
In situ	17	8	47.06	VOC	1,1-Dichloroethene	1062.500	µg/kg	606.93	1.06	6
G	56	1	1.7857143	VOC	1,2-Dichloroethane	4.000	µg/kg	---	0.00	6
In situ	17	8	47.06	VOC	1,2-Dichloroethane	1062.500	µg/kg	606.93	1.06	79
G	56	14	25	VOC	1,2-Dichloroethene (cis)	1.636	µg/kg	2.32	0.00	79
H	56	8	14.285714	VOC	1,2-Dichloroethene (cis)	2.025	µg/kg	1.45	0.00	79
In situ	17	8	47.06	VOC	1,2-Dichloroethene (total)	1062.500	µg/kg	606.93	1.06	10
G	56	1	1.7857143	VOC	1,2-Dichloroethene (trans)	1.000	µg/kg	---	0.00	1000
In situ	17	8	47.06	VOC	1,2-Dichloropropane	1062.500	µg/kg	606.93	1.06	1000
G	56	25	44.642857	VOC	2-Butanone	6.520	µg/kg	4.06	0.01	1000
H	56	24	42.857143	VOC	2-Butanone	11.792	µg/kg	---	0.01	1000
In situ	17	8	47.06	VOC	2-Butanone	2125.000	µg/kg	1229.11	2.13	1000
In situ	17	7	41.18	VOC	2-Butanone	19.000	µg/L	8.49		
J	3	3	100	VOC	2-Butanone	8.667	µg/kg	2.08	0.01	1000
H	56	1	1.7857143	VOC	2-Hexanone	3.000	µg/kg		0.00	
In situ	17	8	47.06	VOC	2-Hexanone	2125.000	µg/kg	1229.11	2.13	1000
F	8	8	100	VOC	4-Methyl-2-Pentanone	3.613	µg/kg	3.08	0.00	1000
G	56	27	48.214286	VOC	4-Methyl-2-Pentanone	2.952	µg/kg	2.63	0.00	1000
H	56	25	44.642857	VOC	4-Methyl-2-Pentanone	4.228	µg/kg	3.03	0.00	1000
I	4	3	75	VOC	4-Methyl-2-Pentanone	1.9666667	µg/kg	1.05	0.00	1000
In situ	17	8	47.06	VOC	4-Methyl-2-pentanone	2125.000	µg/kg	1229.11	2.13	1000
J	3	3	100	VOC	4-Methyl-2-Pentanone	4.000	µg/kg	3.46	0.00	1000
F	8	7	87.5	VOC	Acetone	21.429	µg/kg	9.83	0.02	1000
G	56	49	87.5	VOC	Acetone	50.571	µg/kg	29.35	0.05	1000
H	56	55	98.214286	VOC	Acetone	63.364	µg/kg	37.39	0.06	1000
I	4	3	75	VOC	Acetone	40.666667	µg/kg	25.32	0.04	1000
In situ	17	9	52.94	VOC	Acetone	1516.667	µg/kg	1419.87	1.52	3

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)
J	3	3	100	VOC	Acetone	44.667	µg/kg	7.37	0.04	1000
F	8	7	87.5	VOC	Benzene	0.929	µg/kg	0.15	0.00	3
G	56	45	80.357143	VOC	Benzene	2.400	µg/kg	2.12	0.00	3
H	56	44	78.571429	VOC	Benzene	1.811	µg/kg	1.92	0.00	3
I	4	3	75	VOC	Benzene	0.7	µg/kg	0.26	0.00	3
In situ	17	8	47.06	VOC	Benzene	1062.500	µg/kg	606.93	1.06	11
J	3	2	66.666667	VOC	Benzene	3.500	µg/kg	0.71	0.00	3
In situ	17	8	47.06	VOC	Bromodichloromethane	1062.500	µg/kg	606.93	1.06	86
In situ	17	8	47.06	VOC	Bromoform	1062.500	µg/kg	606.93	1.06	79
In situ	17	8	47.06	VOC	Bromomethane	2125.000	µg/kg	1229.11	2.13	0.62
F	8	6	75	VOC	Carbon Disulfide	0.783	µg/kg	0.21	0.00	0.62
G	56	33	58.928571	VOC	Carbon Disulfide	1.309	µg/kg	0.60	0.00	0.62
H	56	32	57.142857	VOC	Carbon Disulfide	1.450	µg/kg	1.29	0.00	0.62
I	4	2	50	VOC	Carbon Disulfide	4.5	µg/kg	4.95	0.00	0.62
In situ	17	8	47.06	VOC	Carbon Disulfide	1062.500	µg/kg	606.93	1.06	2
J	3	2	66.666667	VOC	Carbon Disulfide	1.000	µg/kg	0.00	0.00	0.62
In situ	17	8	47.06	VOC	Carbon Tetrachloride	1062.500	µg/kg	606.93	1.06	37
H	56	1	1.7857143	VOC	Chlorobenzene	0.900	µg/kg	---	0.00	37
In situ	17	8	47.06	VOC	Chlorobenzene	1062.500	µg/kg	606.93	1.06	
In situ	17	8	47.06	VOC	Chloroethane	2125.000	µg/kg	1229.11	2.13	19
H	56	3	5.3571429	VOC	Chloroform	0.567	µg/kg	0.21	0.00	19
In situ	17	8	47.06	VOC	Chloroform	1062.500	µg/kg	606.93	1.06	19
In situ	17	8	47.06	VOC	Chloroform	1.286	µg/L	0.49		
In situ	17	8	47.06	VOC	Chloromethane	2125.000	µg/kg	1229.11	2.13	4
In situ	17	8	47.06	VOC	cis-1,3-Dichloropropene	1062.500	µg/kg	606.93	1.06	110
In situ	17	8	47.06	VOC	Dibromochloromethane	1062.500	µg/kg	606.93	1.06	1000
G	56	1	1.7857143	VOC	Ethylbenzene	0.900	µg/kg	---	0.00	1000
H	56	16	28.571429	VOC	Ethylbenzene	0.763	µg/kg	0.46	0.00	1000
In situ	17	8	47.06	VOC	Ethylbenzene	1062.500	µg/kg	606.93	1.06	49
F	8	8	100	VOC	Methylene Chloride	15.750	µg/kg	1.98	0.02	49
G	56	45	80.357143	VOC	Methylene Chloride	7.422	µg/kg	5.79	0.01	49
H	56	39	69.642857	VOC	Methylene Chloride	6.487	µg/kg	3.24	0.01	49

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I	4	3	75	VOC	Methylene Chloride	15	µg/kg	4.36	0.02	49
In situ	17	8	47.06	VOC	Methylene Chloride	1796.250	µg/kg	1074.14	1.80	23
J	3	2	66.666667	VOC	Methylene Chloride	6.500	µg/kg	0.71	0.01	49
G	56	4	7.1428571	VOC	Styrene	0.325	µg/kg	0.26	0.00	23
H	56	5	8.9285714	VOC	Styrene	1.040	µg/kg	0.58	0.00	23
In situ	17	8	47.06	VOC	Styrene	1062.500	µg/kg	606.93	1.06	4
G	56	7	12.5	VOC	Tetrachloroethene	3.571	µg/kg	2.57	0.00	4
H	56	6	10.714286	VOC	Tetrachloroethene	3.167	µg/kg	1.60	0.00	4
In situ	17	8	47.06	VOC	Tetrachloroethene	1062.500	µg/kg	606.93	1.06	1000
F	8	8	100	VOC	Toluene	1.500	µg/kg	0.93	0.00	1000
G	56	48	85.714286	VOC	Toluene	4.867	µg/kg	8.51	0.00	1000
H	56	51	91.071429	VOC	Toluene	4.990	µg/kg	5.38	0.00	1000
I	4	3	75	VOC	Toluene	2.3333333	µg/kg	0.58	0.00	1000
In situ	17	8	47.06	VOC	Toluene	1062.500	µg/kg	606.93	1.06	410
J	3	2	66.666667	VOC	Toluene	3.500	µg/kg	0.71	0.00	1000
G	56	25	44.642857	VOC	Total Xylene	1.092	µg/kg	0.63	0.00	410
H	56	38	67.857143	VOC	Total Xylene	1.561	µg/kg	1.55	0.00	410
In situ	17	9	52.94	VOC	Total Xylene	968.889	µg/kg	633.39	0.97	
In situ	17	8	47.06	VOC	Trans-1,3-Dichloropropene	1062.500	µg/kg	606.93	1.06	23
G	56	24	42.857143	VOC	Trichloroethene	1.133	µg/kg	0.72	0.00	23
H	56	13	23.214286	VOC	Trichloroethene	1.231	µg/kg	0.57	0.00	23
In situ	17	8	47.06	VOC	Trichloroethene	1062.500	µg/kg	606.93	1.06	2
J	3	1	33.333333	VOC	Trichloroethene	1.000	µg/kg	---	0.00	23
In situ	17	8	47.06	VOC	Vinyl Chloride	2125.000	µg/kg	1229.11	2.13	
G	50	2	4.00	PCBs	Aroclor-1242	17.50	µg/kg	3.54	0.02	0.49
H	53	3	5.66	PCBs	Aroclor-1242	36.67	µg/kg	8.08	0.04	0.49
F	7	2	28.57	PCBs	Aroclor-1248	70.00	µg/kg	7.07	0.07	0.49
G	50	14	28.00	PCBs	Aroclor-1248	85.07	µg/kg	43.46	0.09	0.49
J	51	3	5.88	PCBs	Aroclor-1248	74.67	µg/kg	54.52	0.07	0.49
G	50	22	44.00	PCBs	Aroclor-1254	41.09	µg/kg	31.08	0.04	0.49
H	53	40	75.47	PCBs	Aroclor-1254	65.16	µg/kg	169.74	0.07	0.49

Table 21
Chemical Sample Evaluation

Process Stockpile ID	Total Samples Collected	Count of Samples with Detected Results	% Samples with Detected Results	Analyte Group	Analysis Name	Average Result (units vary)	various units	Standard Deviation (results vary)	Average Result (mg/kg)	Direct Contact, Residential (mg/kg)
In situ	10	2	20.00	PCBs	Aroclor-1254	20.50	µg/kg	6.36	0.02	0.49
J	51	15	29.41	PCBs	Aroclor-1254	25.88	µg/kg	30.73	0.03	0.49
F	7	7	100.00	PCBs	Aroclor-1260	29.71	µg/kg	22.02	0.03	0.49
G	50	37	74.00	PCBs	Aroclor-1260	25.21	µg/kg	22.29	0.03	0.49
H	53	43	81.13	PCBs	Aroclor-1260	35.88	µg/kg	39.37	0.04	0.49
I	2	2	100.00	PCBs	Aroclor-1260	6.75	µg/kg	1.63	0.01	0.49
In situ	10	7	70.00	PCBs	Aroclor-1260	14.34	µg/kg	7.06	0.01	0.49
J	51	25	49.02	PCBs	Aroclor-1260	13.02	µg/kg	10.05	0.01	0.49

Notes:
mg/kg – milligram per kilogram
µg/kg – microgram per kilogram

FIGURES

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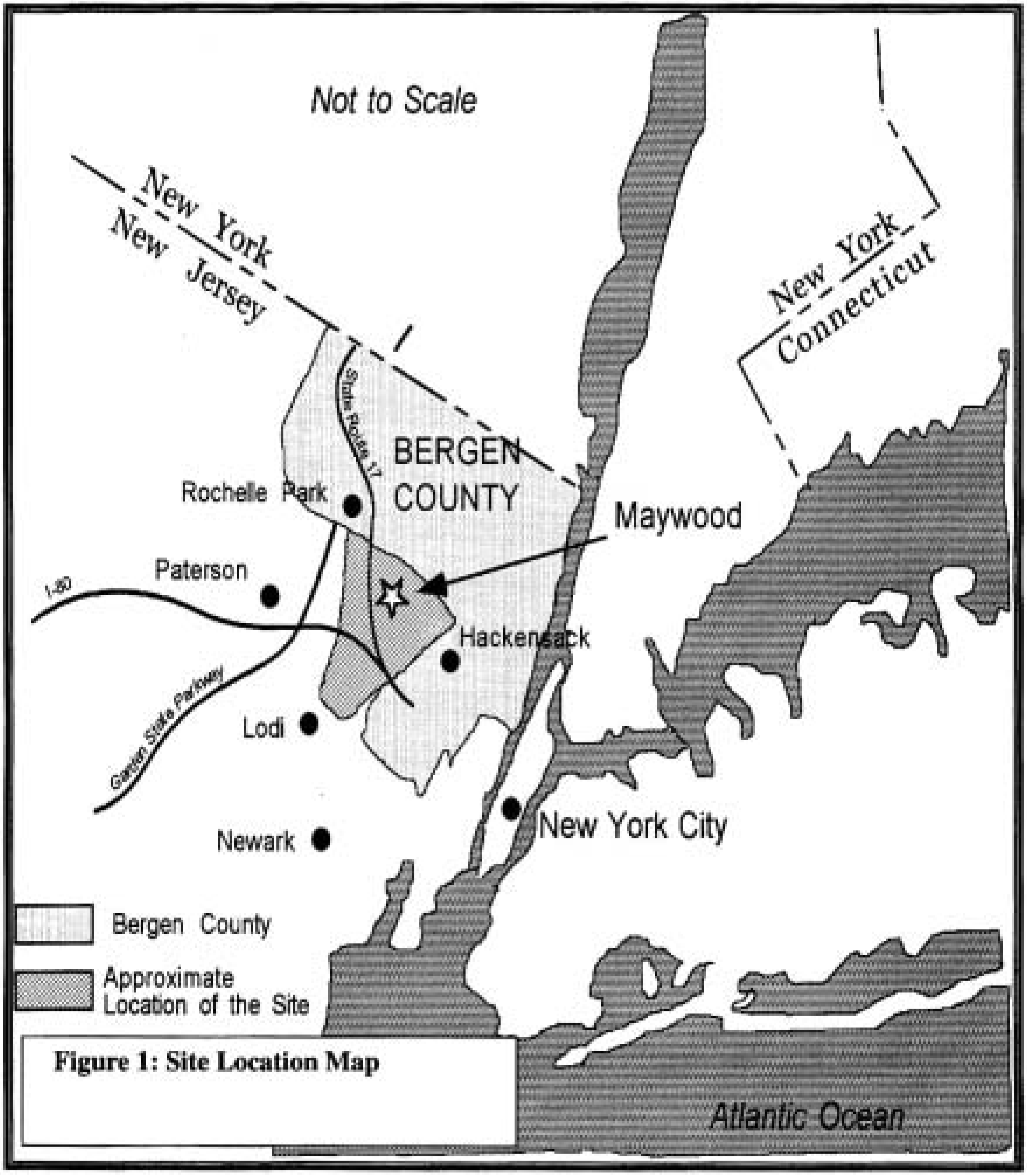

Figure 1
Site Location Map

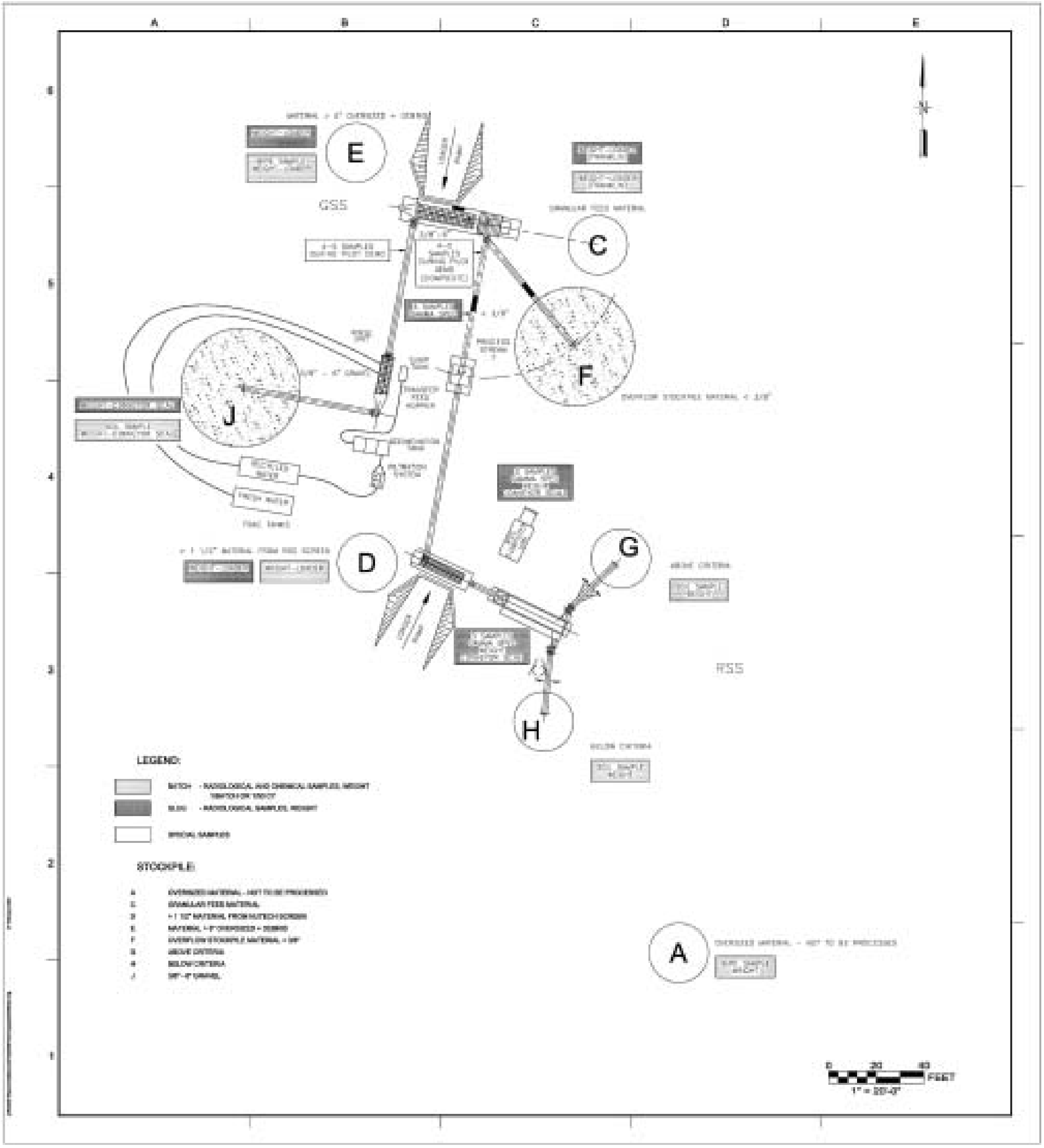

Figure 2
Pilot Plant Demonstration Systems Layout

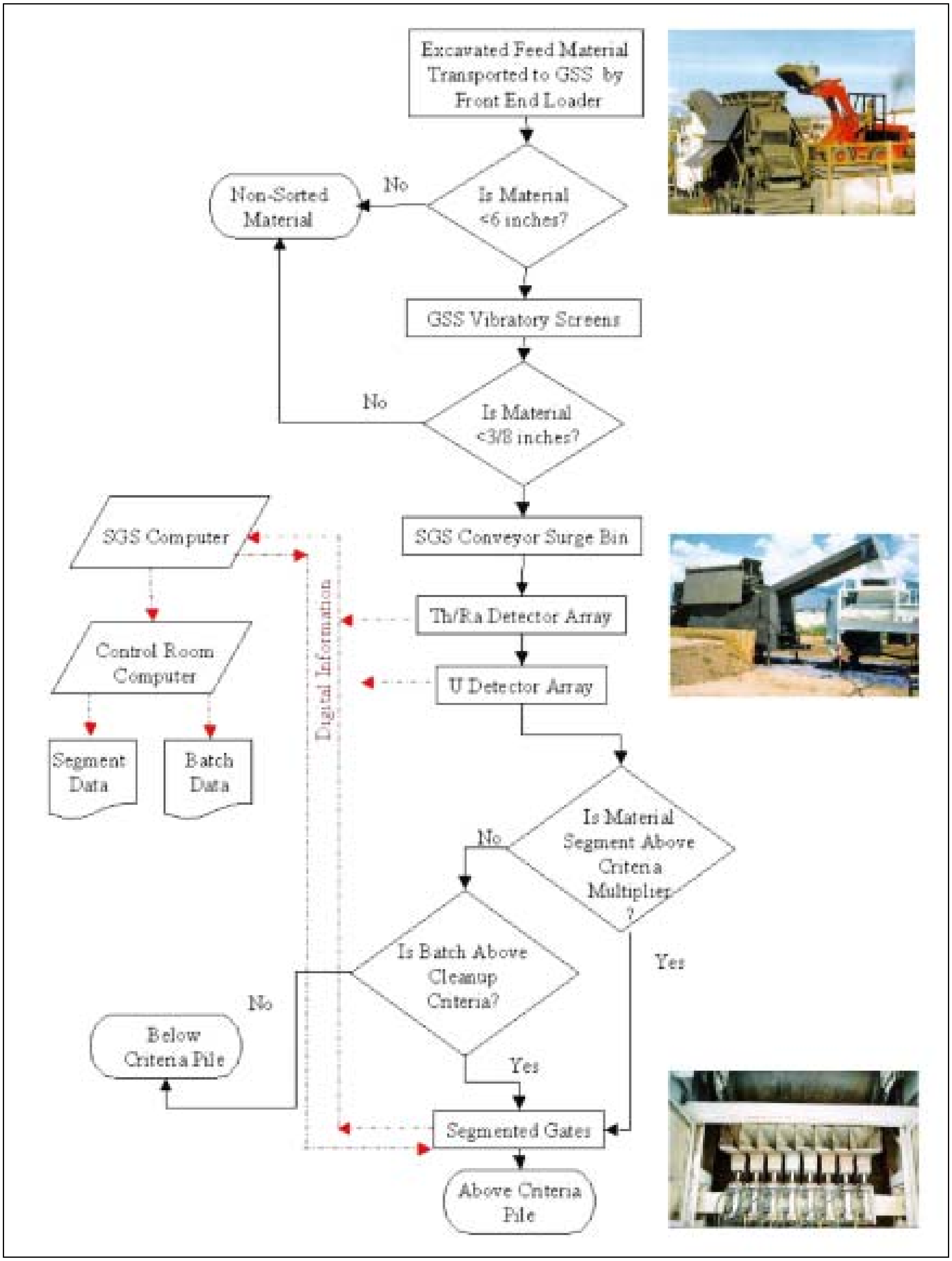

Figure 3
RSS Process Flow Schematic

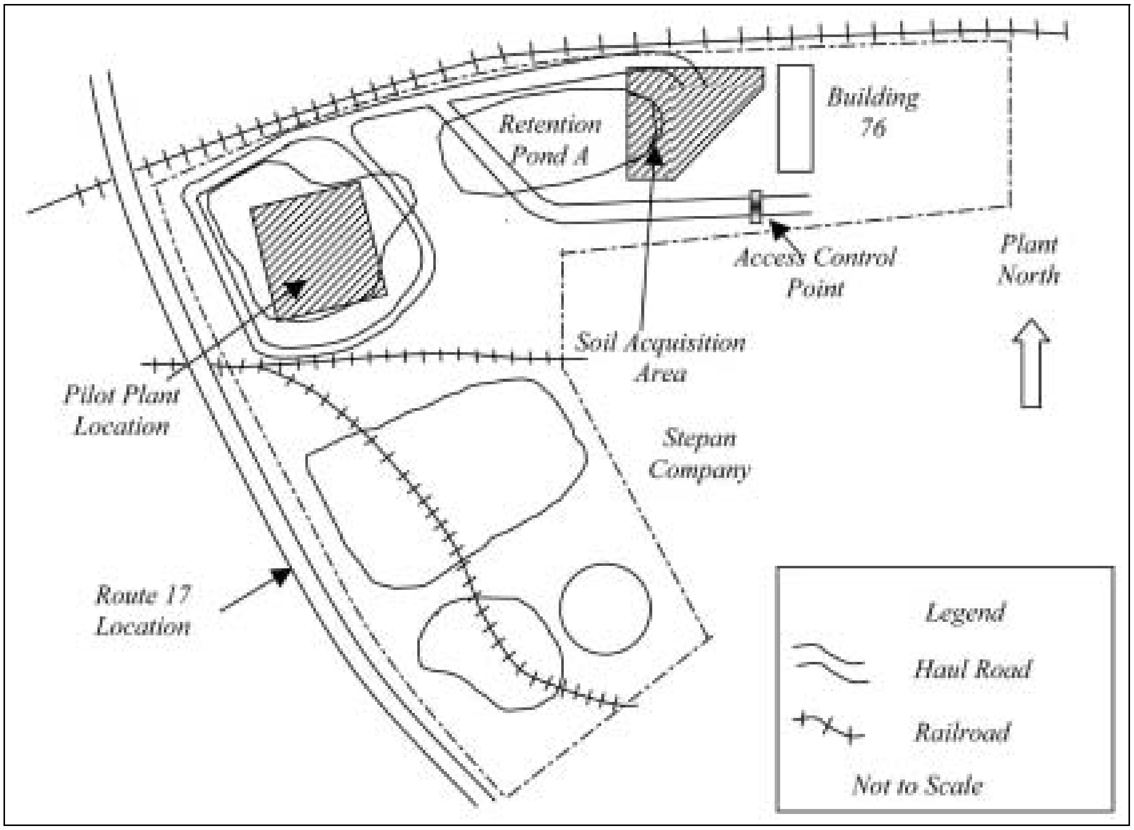

Figure 4
Project Layout

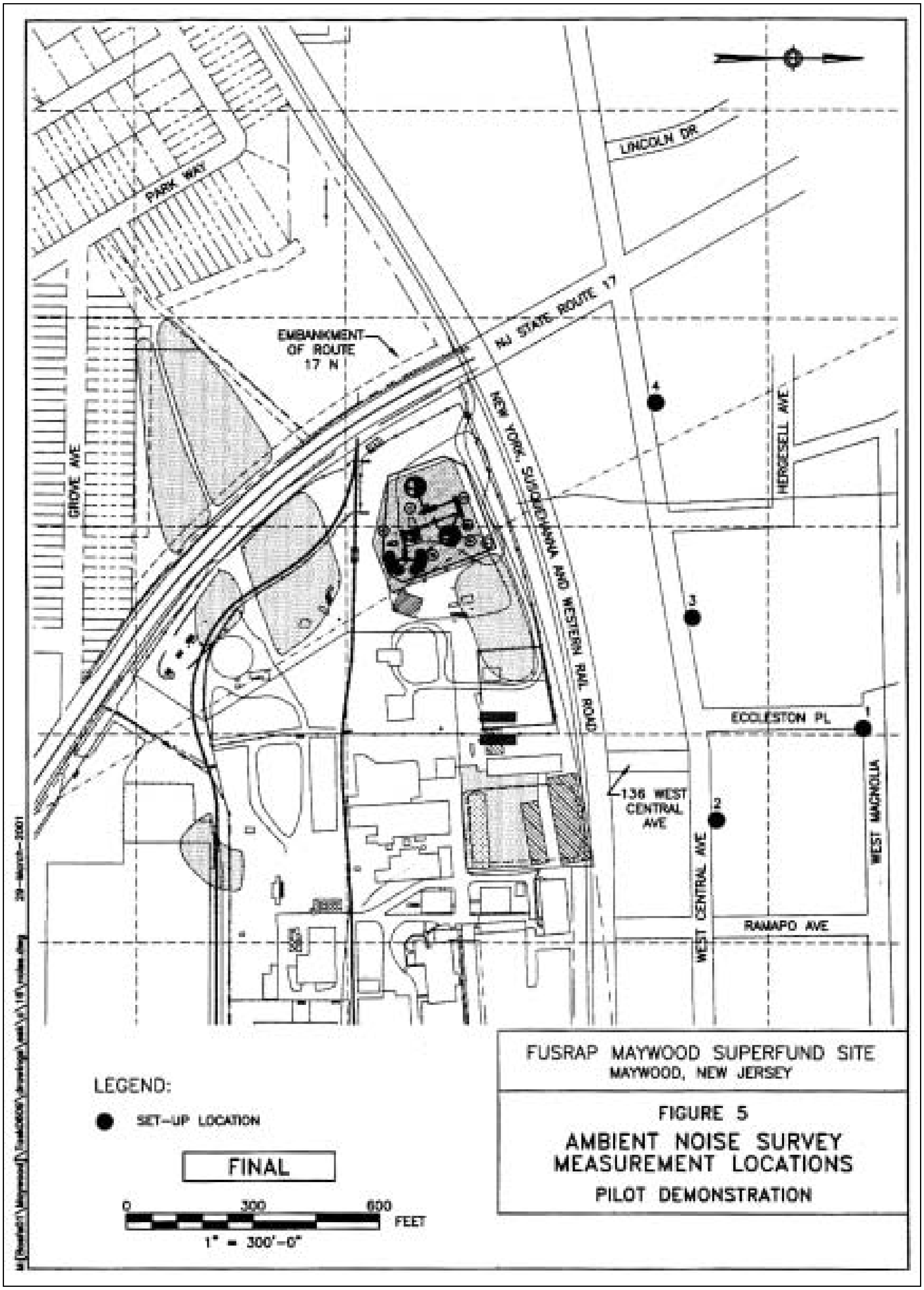

Figure 5
Ambient Noise Survey Measurement Locations, Pilot Demonstration

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APPENDICES

(Appendices A-L are contained on CD)

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