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RECORD OF DECISION AMENDMENT
DELAWARE SAND AND GRAVEL SITE

DECLARATION

SCANNED
JUL 27 2001
File# DE017 BQ

Site Name and Location

Delaware Sand and Gravel Site
New Castle, New Castle County, Delaware

Statement of Basis and Purpose

This decision document revises the Record of Decision (ROD) signed on April 22, 1988, for the Delaware Sand and Gravel Site (Site), in New Castle, New Castle County, Delaware. The revised remedy was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), 42 U.S.C. §§ 9601 et seq., and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300. This decision document explains the factual and legal basis for revising the remedy for this Site. The information supporting this remedial action decision is contained in the Administrative Record file for this Site.

The Delaware Department of Natural Resources and Environmental Control concurs with the selected remedy.

Assessment of the Site

Pursuant to duly delegated authority, I hereby determine, pursuant to Section 106 of CERCLA, 42 U.S.C. § 9606, that actual or threatened releases of hazardous substances, pollutants or contaminants from this Site, if not addressed by implementing the response action selected in this Record of Decision, may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

This ROD amendment revises the remedy previously selected to address the buried materials and contaminated soils in the Drum Disposal, Ridge and Inert Areas of the Site. This ROD amendment will be the final Record of Decision for the Site. The principal threats associated with these portions of the Site are buried drums and contaminated soils containing hazardous substances in the Drum Disposal Area and contaminated soils containing hazardous substances in the Ridge Area.

The selected remedy includes the following major components:

- Constructing a slurry wall around the Drum Disposal Area

- De-watering the area contained by the slurry wall
- Excavating buried drums in the Drum Disposal Area
- Treating and/or disposing excavated drums and their contents offsite
- Excavating contaminated soils within the Ridge Area and consolidating those soils in the Drum Disposal Area
- Treating contaminated soils within the Drum Disposal Area utilizing both soil vapor extraction and bioremediation
- Constructing a multi-layered landfill cap over the Drum Disposal Area
- Constructing a soil cap over the Ridge Area
- Removing surface debris and constructing a multi-layer landfill cap over the Inert Area
- Conducting maintenance and environmental monitoring to ensure the effectiveness of the remedial action.

Declaration of Statutory Determinations

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action and is cost-effective. This remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable, and it satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining onsite above health-based levels, a review will be conducted within five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment. Such reviews will be conducted every five years thereafter until EPA determines that the cleanup levels set forth in this ROD have been achieved, or that the hazardous substances remaining at the Site do not prevent unlimited use and unrestricted exposure at the Site.

W Rasmussen

for Stanley L. Laskowski
Acting Regional Administrator
Region III

9/30/93
Date

Record of Decision Amendment
Delaware Sand & Gravel Site
New Castle County, Delaware

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DECISION SUMMARY

1.0 INTRODUCTION

The Delaware Sand & Gravel Landfill Site ("DS&G" or "Site") is a former sand and gravel quarry comprised of 27 acres and located approximately two miles southwest of the City of New Castle. Approximately 550,000 cubic yards of industrial wastes and construction debris, including at least 7,000 drums, were disposed of within four distinct disposal areas on the DS&G property (see the enlarged area of Figure 1 and associated discussion for further information about each disposal area). The Site is bordered to the east by tracks of the Penn Central Railroad and on the west and north by Army Creek, which discharges into the Delaware River approximately one mile to the east. Public roads adjacent to the Delaware Sand & Gravel Site are Grantham Lane to the south and Route 9 to the east. The Site is adjacent to and southeast of another Superfund site, Army Creek Landfill, which was a municipal and industrial waste disposal site owned and operated by New Castle County. For more information on the Site location, Site description, Site history, enforcement and community relations activities conducted prior to April 1988 refer to Sections I-III and Section V of the Record of Decision issued on April 22, 1988.

The U.S. Environmental Protection Agency (EPA) is the lead agency for response activities at the Site. The Delaware Department of Natural Resources and Environmental Control (DNREC) is the support agency for this response action.

On April 22, 1988, EPA, in consultation with DNREC, issued a Record of Decision (ROD) for the Delaware Sand & Gravel Site. In recognition of the area-specific conditions found during the Remedial Investigation and Feasibility Study, the ROD provided for area-specific remedies. Since the ROD addressed the construction of three separate projects to deal with the conditions found at the Site, EPA divided the planned site activities into three operable units (OUs). A description of the major components of each OU is provided in Section 2.0 below. The second operable unit addressed both the Drum Disposal and Ridge areas (see Figure 1). The selected remedy for the second operable unit included: (1) performing a pre-design waste characterization study; (2) excavating wastes and contaminated soils; and (3) treating excavated wastes and soils in an onsite incinerator.

The pre-design investigation performed by the United States Army Corps of Engineers (USACE) found that the nature and extent of contamination at the Drum Disposal Area (DDA) was significantly more complex than anticipated in the 1988 ROD. The study found that a considerable number of intact drums remain buried in the DDA and that contaminants from the DDA had migrated along an underlying clay layer further than was previously known. Based

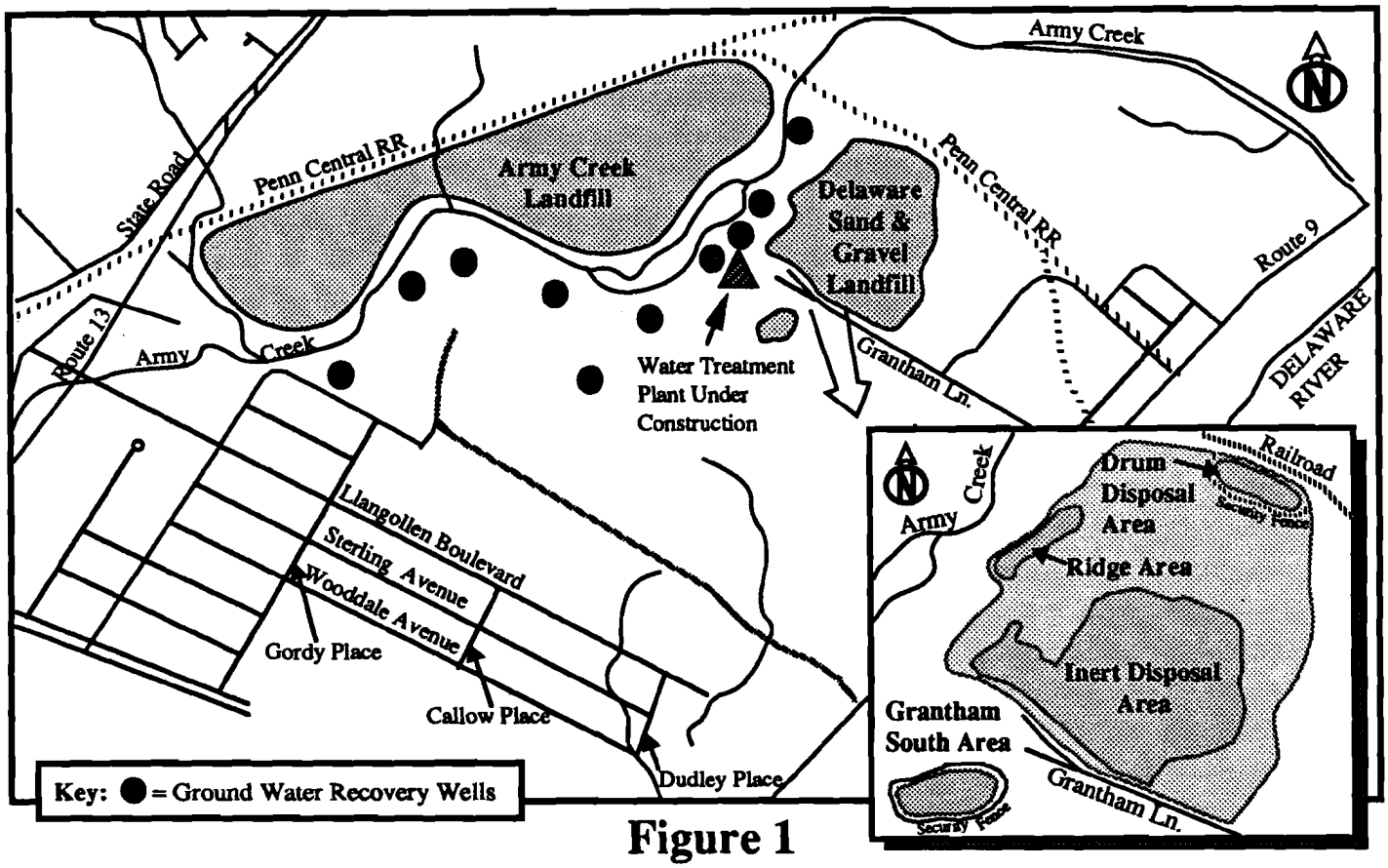


Figure 1

Delaware Sand & Gravel Landfill Disposal Areas

The Drum Disposal Area: The Drum Disposal Area occupies approximately three quarters of an acre and is located south of the railroad tracks. This area was originally a pit where drums containing liquids and sludges, including perfume, plastics, paint, and petroleum, from various industrial processes were disposed. The majority of drum contents were organics and inorganic solids. Ground water monitoring in the vicinity of the Drum Disposal Area indicates that the buried wastes are releasing contaminants into the underlying ground water.

The Ridge Area: The Ridge Area runs parallel to Army Creek occupying approximately half an acre. The Ridge Area was used primarily for surface storage of drums and large storage tanks containing inorganic and organic sludges and solids. The drums and tanks have been removed, or emptied, and steam cleaned; however, contaminated surface soils remain.

The Inert Disposal Area: The Inert Disposal Area is topographically the highest waste disposal area on site and occupies nearly 11 acres. Field investigations suggest that nearly one half million cubic yards of construction rubble and scattered chemical wastes were deposited in this disposal area. The refuse was covered with a thin layer of soil. Abandoned cars, trucks, storage tanks, and other solid wastes currently occupy the surface of the Inert Disposal Area.

The Grantham South Area: The Grantham South Area is located on two acres on the southern side of Grantham Lane. An estimated 73,400 cubic yards of construction rubble and scattered chemical wastes were deposited in a layer nearly 35 feet thick. Pre-construction field investigations identified elevated levels of organic and inorganic contaminants within the refuse layer.

on this more complete characterization of the DDA and its effect on the scope of the project, EPA and DNREC determined that the remedy selected in the ROD had to be revised to address these previously unrecognized site conditions.

This ROD Amendment revises the selected remedy for the Drum Disposal and Ridge Areas described in the April 1988 ROD for this Site. This amendment (revision) documents EPA's decision to remediate the Drum Disposal and Ridge areas employing a combination of engineering controls in conjunction with conventional and innovative treatment technologies. The selected treatment technologies include soil vapor extraction and bioventing.

This ROD Amendment also provides notice of upgrade to the design of the landfill cap at the Inert Area (OU3). The decision to design and construct a multi-layer landfill cap instead of a native soil cover over the Inert Area, as described in the 1988 ROD, represents a significant change to a component of the remedy selected. In addition to preventing the threat of direct contact with wastes, the multi-layer composite barrier cap will minimize leaching of hazardous substances to the ground water.

This ROD Amendment does not pertain to the Grantham South Area (OU1). The multi-layer composite barrier cap and gas venting system selected for the Grantham South Area has been constructed and is fully functional.

1.1 Community Participation and Information Availability

The Focused Feasibility Study and Proposed Plan to Amend the Record of Decision for the Delaware Sand and Gravel Site were released to the public for comment on July 29, 1993. These two documents were made available to the community in the information repositories maintained at the EPA Docket Room in Region III and at DNREC's New Castle office. The notice of availability for these two documents was published in the Wilmington News Journal on July 29, 1993, and the New Castle Weekly on August 25 and September 1, 1993. In addition, a public meeting was held on September 2, 1993. At this meeting representatives from EPA and DNREC answered questions about conditions at the Site and the remedial alternatives under consideration. The public comment period on the Proposed Plan was held from July 29, 1993, to September 13, 1993. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this ROD. These activities were undertaken by EPA as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation and Liability Act of 1980, as amended (CERCLA), and Section 300.435(c)(2)(ii) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The Administrative Record for the Site is maintained at the following information repositories:

Delaware DNREC 715 Grantham Lane New Castle, DE 19720 (302) 323-4540	U.S. EPA Docket Room Region III 841 Chestnut Bldg., 9th Fl. Philadelphia, PA 19107 (215) 597-3037

The Administrative Record includes all documents such as work plans, data analyses, public comments, meeting transcripts, and other relevant information upon which the selection of the amended response action was based. In accordance with Section 300.825(a)(2) of the NCP, this ROD Amendment has become part of the Administrative Record.

2.0 SUMMARY OF ORIGINAL REMEDY

As mentioned above, the ROD provided for area-specific remedies. Since the ROD addressed the construction of three separate projects to deal with the conditions found at the Site, EPA divided the planned site activities into three operable units. An operable unit (OU) is a portion of a Superfund site that is addressed separately from the rest of the site to allow for easier project management or a more timely response. The following is a description of the major components of the area-specific remedies selected for each OU:

Grantham South Area (Operable Unit 1)

- Installing a security fence;
- Capping of the Grantham South Area to prevent the threat of direct contact and potential leachate generation; and
- Installing a gas venting system.

Drum Disposal and Ridge Areas (Operable Unit 2)

- Pre-design waste characterization study;
- Excavating wastes and contaminated soil; and
- Implementing onsite thermal destruction of buried wastes and contaminated soil from the Drum Disposal Area and contaminated surface soil from the Ridge Area to prevent the threat of direct contact and leachate generation.

Inert Disposal Area (Operable Unit 3)

- Removing surface debris and capping over the Inert Disposal Area to prevent the threat of direct contact with the contaminated wastes and soils.

2.1 Grantham South Area - Operable Unit 1

Phasing the remedies enabled EPA to design and construct a cap at the Grantham South Area (OU1) while completing the additional field work required in preparation for a more complex Remedial Design for the Ridge and Drum Disposal Areas (OU2). Construction of the multi-layer landfill cap at the Grantham South Area began in September 1989 and was completed in September 1991. The selected remedy is in place at the Grantham South Area; therefore, this portion of the Site will not be discussed further in this decision document.

3.0 RATIONALE FOR CHANGING REMEDY SELECTED IN 1988 ROD

3.1 Drum Disposal and Ridge Areas - Operable Unit 2

From 1991 to 1993, in accordance with the ROD, USACE conducted an extensive pre-design investigation in the Drum Disposal and Ridge Areas to generate additional data necessary to effectively perform the engineering design of the incineration project. The model of contamination is fundamentally unchanged; however, two significant findings were made during the pre-design investigation that led to the determination that a more appropriate remedial strategy may be available.

First, limited trenching through the DDA revealed that a considerable number of intact or semi-intact drums containing hazardous substances remain in the uppermost fifteen feet of soil. Information in EPA's possession prior to the pre-design field work had led the Agency to conclude that nearly all drums were emptied and/or crushed before burial. The incineration technology is best suited to treating a homogeneous waste stream which enables the incinerator operator to optimize temperature and retention times to destroy the highest percentage of hazardous constituents. Drums and pockets of highly contaminated soils containing dissimilar wastes are more difficult to incinerate successfully.

Second, the study found that source constituents had moved downward from the buried drums to an underlying clay layer and spread laterally creating a 5-10 foot-thick layer of contaminated soils within the saturated zone. This subsurface layer of contaminated soils, which lies beneath 25 to 30 feet of uncontaminated soils, contains levels of pollutants high enough to be considered a secondary source of contamination to the ground water. In addition to increasing the volume of material that would be subject to remediation under the existing ROD, the practicability of excavating a 5-10 feet-thick layer of contaminated soils overlain by 30 feet of clean soils is questionable.

The data collected during the pre-design investigation, taken together with data presented in the 1987 Remedial Investigation, provides a more thorough understanding of the nature and extent of contamination. Based on this more complete characterization of the DDA, EPA and DNREC determined that the remedy selected in the ROD should be amended to address previously unrecognized site conditions.

The pre-design investigation confirmed the nature and extent of contamination at the Ridge Area identified in the original ROD. The only reason the Ridge Area is subject to this amendment is that the original ROD included incineration of contaminated Ridge soils along with the DDA soils. Since onsite incineration of contaminated soils is no longer being employed the remedy selected for the Ridge Area is also being changed by this ROD Amendment.

In December 1992, a group of cooperating potentially responsible parties (PRPs) agreed to conduct a Focused Feasibility Study (FFS) in an effort to develop and evaluate the most appropriate remedial strategy for the DDA and Ridge Areas. Two remedial alternatives were analyzed in detail in the FFS. The first alternative is the excavation and onsite incineration remedy selected in the original ROD modified to include the greater volume and specific character of materials now known to exist at the DDA. The second alternative developed in the FFS includes a combination of engineering controls and both conventional and innovative treatment technologies. This second alternative evaluated in the FFS was not evaluated in the original Feasibility Study.

On March 23, 1992, EPA determined, in accordance with Section 300.415 of the NCP, that the buried drums in the DDA pose an imminent and substantial threat to human health, welfare, and the environment. In June 1992, EPA entered into an Administrative Order on Consent with 22 cooperating PRPs who agreed to design and construct a slurry wall around the DDA as an interim action. The slurry wall will conjoin the underlying natural clay layer and prevent contaminants from migrating from the DDA; it will also provide containment during drum removal. The slurry wall design was completed in September 1993. The construction is scheduled for completion in the Fall of 1994.

3.2 Inert Area - Operable Unit 3

In the June 1992 Administrative Order, the PRPs also agreed to perform the remedial design for the Inert Area. The 1988 ROD required that surface debris (i.e., trucks, buses, cars, etc.) be removed and that a landfill cap be constructed over the Inert Area. The ROD identified RCRA Subtitle D and Delaware Solid Waste regulations 7 Delaware Code, Chapter 60, as being applicable to the Inert Area for proper closure of a solid waste

landfill. These regulations have been developed for standard municipal waste landfills and require a native soil cover to prevent direct contact with wastes and minimize erosion.

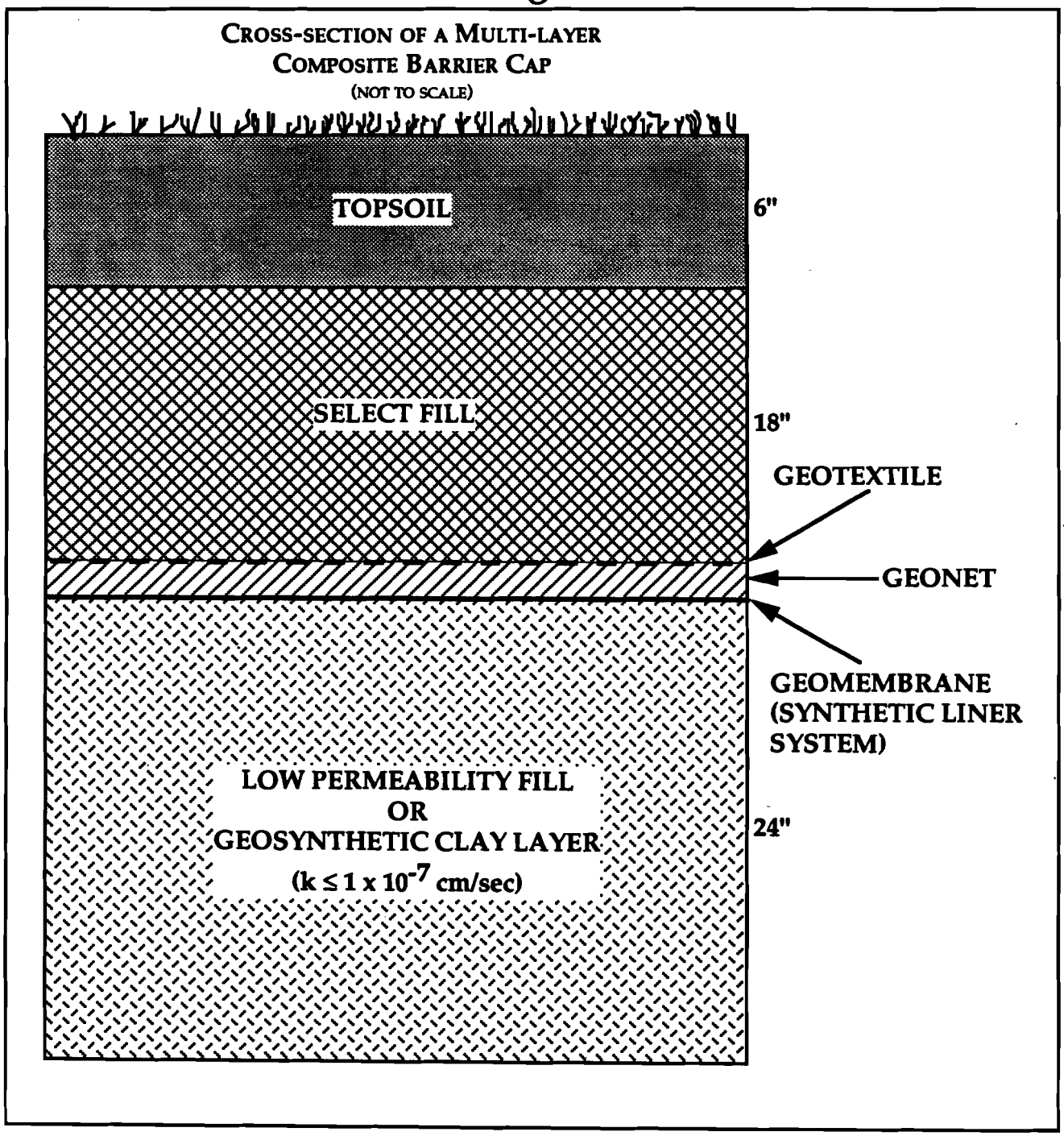
As noted in the Remedial Investigation, "this name [Inert Area] is merely a carry over in terminology from past practices as wastes in this area are probably not completely inert." The Inert Area was used for the disposal of construction rubble and industrial wastes during the same time period as the Grantham South Area. The landfill operator did not segregate wastes transported to the Site prior to disposal. Wastes hauled to the Site were just as likely to be placed in the Inert Area as the Grantham South Area. For example, acetone was identified in Remedial Investigation soil samples collected while installing ground water monitoring well DGC-09 through the Inert Area. Acetone was detected in each sample taken at 5-feet intervals from the surface to the underlying clay, approximately 30 feet below the surface (refer to table 5.16 from the 1988 ROD). Acetone is a "hazardous substance" within the meaning of Section 101(14) of CERCLA, 42 U.S.C. § 9601(14); 40 CFR Part 302, Table 302.4.

If the Inert Area contains a significant percentage of hazardous substances a native soil cover would be ineffective in minimizing the infiltration of rainwater through the wastes, resulting in migration of hazardous constituents to the ground water. Therefore, the PRP group decided to design a multi-layer landfill cap for the Inert Area which will eliminate the direct contact risk and also reduce the potential migration of hazardous constituents into the ground water (See Figure 2 for representative cap profile). The multi-layer composite barrier cap will provide a low permeability barrier across the landfill which will reduce the infiltration of rainwater through the buried wastes. The multi-layer composite barrier cap will meet the federal and state requirements developed for landfill closure when the landfill contains hazardous substances [40 C.F.R. § 264.310(a); Delaware Regulations Governing Hazardous Waste § 264.310(a)]. The multi-layer composite layer cap will be more protective than the native soil cover and eliminates the need to perform potentially expensive and time consuming intrusive pre-design investigations at the Inert Area. This upgrade to the profile of the landfill cap which will be constructed over the Inert Area represents a significant change to a component identified in the 1988 ROD.

4.0 SUMMARY OF SITE RISK, REMEDIAL OBJECTIVES AND CLEANUP STANDARDS

This section summarizes relevant portions of the baseline risk assessment from the 1988 ROD and provides the basis for the newly developed soil cleanup standards. The following is an excerpt from the Summary of Site Risks section included in the 1988 ROD.

Figure 2


CROSS-SECTION OF A MULTI-LAYER
COMPOSITE BARRIER CAP
(NOT TO SCALE)
TOPSOIL
6"
SELECT FILL
18"
GEOTEXTILE
GEONET
GEOMEMBRANE
(SYNTHETIC LINER
SYSTEM)
LOW PERMEABILITY FILL
OR
GEOSYNTHETIC CLAY LAYER
(k ≤ 1 x 10^-7 cm/sec)
24"

Risk posed by Groundwater Ingestion

Groundwater in the Upper Potomac Hydrologic Zone is contaminated by leachate emanating from the Drum Disposal Area. Groundwater contamination has migrated away from the Drum Disposal Area; however, the current recovery well pumping scenario prevents DS&G contaminants from migrating to any known water supply sources.

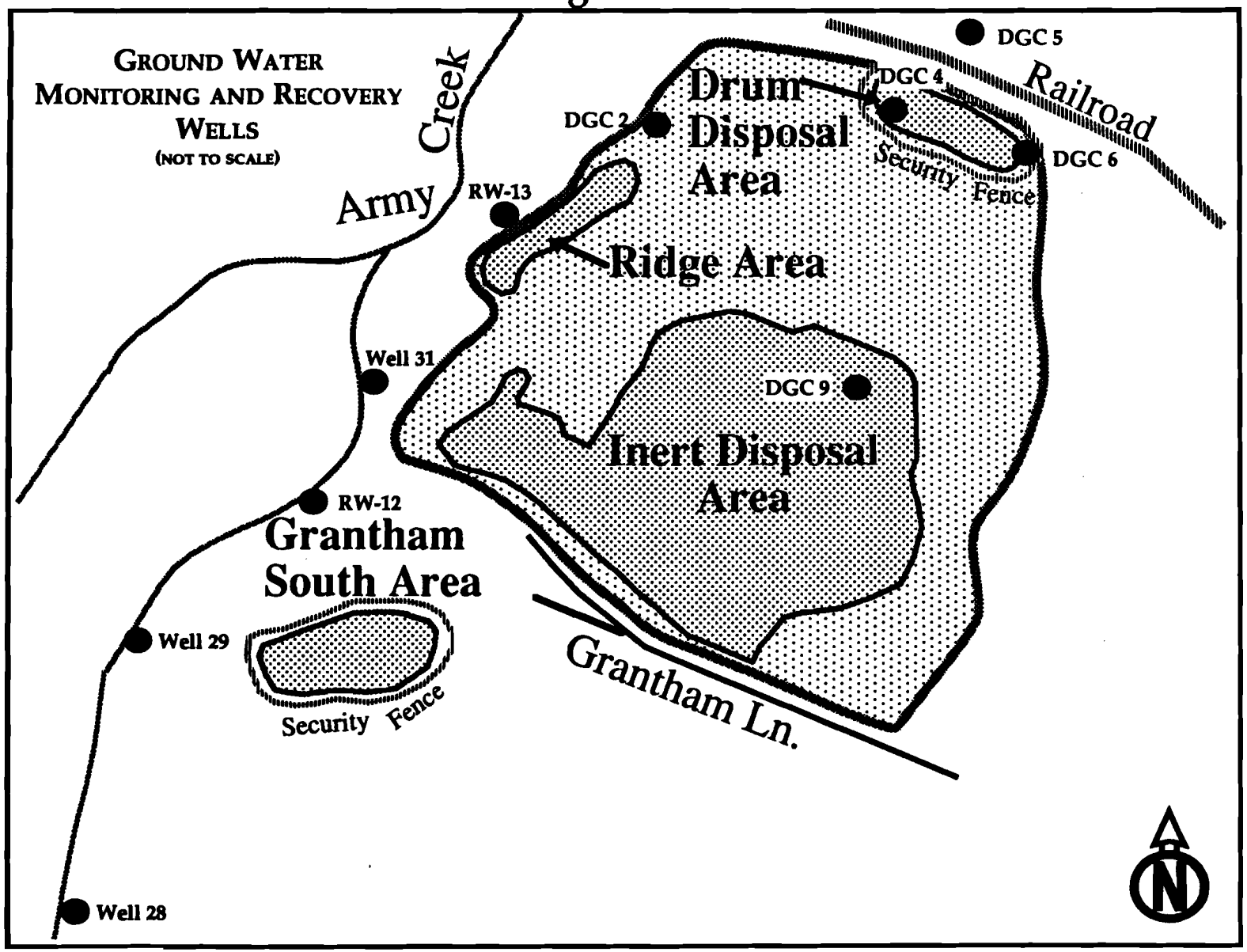
Consequently groundwater ingestion risks were calculated on the potential exposure through development of domestic wells installed within or on the site boundary.

Groundwater from DS&G monitoring wells (DGC-02d, DGC-02s, DGC-04, DGC-05 and DGC-06) is unsafe for human consumption due to carcinogenic and non-carcinogenic risks while groundwater from Army Creek recovery wells (RW-13, RW-31, RW-12, and RW-29) is unsafe for human consumption due only to carcinogenic risks.... (See Figure 3 for well locations)

Remedial action is generally warranted at a site when the calculated carcinogenic risk level exceeds 1×10^{-4}, meaning that one additional person out of 10,000 exposed is at risk of developing cancer. The potential for health effects resulting from exposure to noncarcinogenic compounds is evaluated by comparing an estimated daily dose presented by site conditions to an acceptable level. If this ratio exceeds 1.0, there is a potential health risk associated with exposure to that particular chemical. These ratios can be added for exposure to multiple contaminants. The sum of these ratios, known as a Hazard Index, is not a mathematical prediction for the severity of toxic effects, but rather a numerical indicator of the transition from acceptable to unacceptable levels.

The baseline risks were characterized in the original ROD and remain unchanged. Ground water is contaminated by leachate emanating from, among other places, the Drum Disposal Area. Although the Army Creek recovery well system is preventing contaminants from both the Army Creek and Delaware Sand & Gravel sites from migrating to any known water supply sources, future use of ground water through development of domestic drinking water wells installed within or on the Site boundary would present unacceptable carcinogenic and noncarcinogenic risks to persons ingesting the water. The Risk Assessment prepared as part of the original Remedial Investigation assessed the potential public health impacts that may result from exposure to chemicals associated with the Site in the absence of active remediation. When evaluating this potential future use scenario, the Risk Assessment determined that consumption of water from ground water monitoring wells installed within the Site boundary would present a potential carcinogenic risk in excess of 1×10^{-3}. This means that approximately one additional person

Figure 3


GROUND WATER
MONITORING AND RECOVERY
WELLS
(NOT TO SCALE)
Army Creek
Railroad
DGC 5
DGC 4
DGC 2
DGC 6
Drum
Disposal
Area
Security Fence
RW-13
Ridge Area
Well 31
DGC 9
Inert Disposal
Area
RW-12
Grantham
South Area
Well 29
Security Fence
Grantham Ln.
Well 28
N

out of 1,000 using the ground water as a drinking water source would be at risk of developing cancer during a lifetime. The assessment also determined that the Hazard Index calculated for three of the wells was considerably greater than 1.0.

Actual or threatened releases of hazardous substances from this Site, if not addressed by the selected remedy as amended, may present an imminent and substantial endangerment to public health, welfare, or the environment.

4.1 Soil Cleanup Standards

Once the buried drums are removed, the primary remedial objective is to protect the ground water from hazardous constituents currently leaching from contaminated soils. Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) for public drinking water supplies have been established under the Safe Drinking Water Act and are considered relevant and appropriate standards for ground water. However, meeting the chemical-specific MCLs and non-zero MCLGs would still result in a cumulative risk in excess of 10^{-4} due to the fact that there are multiple contaminants associated with the Site. In accordance with the NCP, use of risk-based target concentrations are necessary to set a protective remediation level. Risk-based target concentrations are concentration levels that result in a cumulative carcinogenic risk within EPA's target risk range of 10^{-4} to 10^{-6}.

As part of the Focused Feasibility Study, hydrologic and hydrogeologic modeling was performed to determine acceptable soil contaminant concentrations within the Drum Disposal and Ridge Areas. The "Summers Model", which is a conservative soil attenuation model that considers constituent migration in the unsaturated zone and dilution in the saturated zone, was used to determine the effects of contaminant dispersion in the ground water. A critical data element of the Summers model is the "recharge" component to ground water attributable to the leaching of the contaminated soil within the DDA. With respect to the DDA, this input variable was estimated using the HELP (Hydrologic Evaluation of Landfill Performance) Model. The HELP model estimates the infiltration through various soil layers. The HELP model was used in this specific application to determine the recharge/leaching component from the DDA.

The models were applied using available site specific data such as permeability of the sands and underlying clays, and movement of the ground water. The models assume that ground water quality at the boundary of the Drum Disposal and Ridge Areas must meet risk-based levels. Acceptable soil concentrations are then back-calculated. Acceptable soil concentrations ("soil cleanup standards") were developed to ensure that these risk-based concentrations in the ground water would be achieved.

The model to establish soil cleanup standards for the DDA assumed the existence of the slurry wall and a multi-layer composite barrier cap, as these elements are common to each of the remedial alternatives evaluated in the FFS. The model developed to simulate conditions at the Ridge Area did not include any engineering controls. Consequently, the soil cleanup standards for the Ridge Area are more stringent than those calculated for the DDA.

Soil cleanup standards based on ingestion of soil were considered, but it was apparent that the direct contact threat was not driving the remedial action because the acceptable concentrations were relatively high. Soil cleanup standards based on ground water ingestion would be significantly lower than standards based on soil ingestion. The Drum Disposal Area will be covered with a multi-layer composite barrier cap which will prevent direct contact with contaminated soils. Therefore, the pathway of concern is through ingestion of ground water.

The models project that if each contaminant within the DDA and Ridge Area is reduced to the soil concentration listed in Tables 1 and 2, respectively, the cumulative carcinogenic risk associated with attainment of these standards is within the 10^{-6} risk range. For example, Table 1 identifies soil cleanup standards for the Drum Disposal Area. If the concentration of each contaminant of concern within the DDA is reduced to its respective soil cleanup standard, the cumulative carcinogenic risk associated with exposure to the ground water would be approximately 8.0×10^{-6}, meaning that approximately one additional person out of 125,000 exposed is at risk of developing cancer during a lifetime. The potential for health effects resulting from non-carcinogens would be reduced to safe levels by reducing the Hazard Index to less than 1.0. This analysis considers the potential future use of ground water on the Site as a drinking water source.

4.2 Application of Soil Cleanup Standards

The comprehensive remedial objective of the remedial action is to reduce the concentration of Site related contaminants such that: (1) the potential carcinogenic risk to people exposed to the Site is within the 10^{-6} risk range; and, (2) the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects is reduced to acceptable levels (i.e., a Hazard Index less than 1.0).

The contaminant-specific soil cleanup standards listed in Table 1 were developed considering the concentrations and chemical/physical properties of the compounds present and the theoretical efficiencies of the treatment technologies proposed. The results of field and laboratory studies indicate that all contaminants of concern should be reduced to acceptable levels

Table 1 - Drum Disposal Area

9900 260 4100

Carcinogen

Compound	Initial Soil Concentration*	Soil Cleanup Standard	Post-treatment Carcinogenic Risk
Benzene	11,810	831	1.00E-06
Bis(2-chloroethyl) ether	Below Detection Level	5	1.00E-06
Bis(2-chloroisopropyl) ether	1,740	576	1.00E-06
Methylene Chloride	152,860	1,000	2.00E-07 38000
1,2-Dichloroethane	16,360	250 3100	4.17E-06
Trichloroethylene	9,665	1,000 26,000	1.46E-07
Tetrachloroethylene	9,665	1,000 6500	7.39E-08
Styrene	1,864	1,000 2,000	1.94E-07
PCB-1248	10,930	10,930	1.38E-07
PCB-1254	52,170	52,170	3.44E-07
Cumulative Risk			**8.26E-06**

Noncarcinogen

Compound	Initial Soil Concentration*	Soil Cleanup Standard	Post-treatment Hazard Index**
Bis(2-chloroisopropyl) ether	1,740	576	.00825
Methylene Chloride	152,860	1,000	.0166
Acetone	21,290	5,000	.025
Total Xylenes	797,220	5,000	.000364
Toluene	195,170	5,000	.00291
Phenols	1,600	5,000	.0205
Naphthalene	560	560	.000457
Ethylbenzene	45,660	45,660	.0145
Trichloroethylene	9,665	1,000	.0176
Tetrachloroethylene	9,665	1,000	.0025
2-methylphenol	485	485	.00108
4-methylphenol	1,213	1,213	.0269
Chlorobenzene	9,633	5,000	.0265
Styrene	1,864	1,000	.000426
Cumulative Risk			**.1636**

* Initial Soil Concentrations based on 95% Percentile Upper Confidence Limit of the mean soil concentration.
** Hazard Index is a value used to evaluate the potential for noncarcinogenic effects that occur in humans.
Note: All units are micrograms/kilogram or parts per billion.

Table 2 - Ridge Area

Carcinogen

Compound	Initial Soil Concentration*	Soil Cleanup Standard	Post-excavation Carcinogenic Risk
Bis(2-chloroethyl) ether	400	0.77	1.00E-06
Bis(2-chloroisopropyl) ether	400	93	1.00E-06
Methylene Chloride	925	812	1.00E-06
Cumulative Risk			**3.00E-06**

Noncarcinogen

Compound	Initial Soil Concentration*	Soil Cleanup Standard	Post-excavation Hazard Index**
Bis(2-chloroisopropyl) ether	400	93	.00825
Methylene Chloride	925	812	.085
Cumulative Risk			**.09325**

* Initial Soil Concentrations based on 95% Percentile Upper Confidence Limit of the mean soil concentration.
** Hazard Index is a value used to evaluate the potential for noncarcinogenic effects that occur in humans.
Note: All units are micrograms/kilogram or parts per billion.

within six years. A majority of the hazardous constituents will likely be degraded to concentrations below the soil cleanup standards identified in Table 1. The "in field" performance efficiencies (i.e., removal and degradation) may not conform uniformly to the theoretical efficiencies.

Active operation of the soil treatment system will continue for a minimum of eight years or until a zero slope reduction condition (i.e., the practical limits of the technology) is reached, whichever is later. At that point, soils within the slurry wall will be collected and analyzed to confirm that the performance standards outlined in Table 1 are met. If the compound-specific performance standards are met, then the remedial objective of reduction of carcinogenic risks to the 10^{-6} range and a Hazard Index rating for noncarcinogenic risks of less than 1.0 will also be met.

However, since the "in-field" removal efficiencies may differ from the theoretical efficiencies, achievement of the overall remedial objective may be possible without achievement of each compound-specific soil cleanup standard. If the analysis of the soils within the slurry wall following operation for the period specified above confirms that the remaining hazardous constituents would pose a carcinogenic risk no greater than the acceptable risk range and the Hazard Index rating would be less than 1.0, the performance standards for the remedy will be deemed to have been met.

It should be noted that while the DDA soil cleanup standards will act as performance standards, the Ridge Area soil cleanup standards (Table 2) will be used to determine which soils within the Ridge Area will be excavated. Refer to Section 7.0 for a more complete description of the amended remedial action. The soils excavated from the Ridge Area will be treated along with the contaminated soils from the DDA.

5.0 DESCRIPTION OF THE ALTERNATIVES

In consideration of the current understanding of site conditions, the onsite incineration remedy described in the 1988 ROD was revised and reevaluated against a newly developed alternative. The two remedial alternatives developed and evaluated in detail in the Focused Feasibility Study as possible response actions to address the risks posed by current and future exposure to contamination at the DDA and Ridge Area are described below.

Common Elements: Each of the alternatives considered include the installation of a slurry wall around the DDA [implementation of this element has been initiated as part of an ongoing removal action under an Administrative Order on Consent (See Section 3.1)]. The slurry wall will conjoin the underlying natural clay layer and prevent contaminants from migrating from the DDA; it

will also provide containment during drum removal. If Alternative 1 were selected, the slurry wall would be beneficial by controlling migration of contaminants from the DDA during the potentially lengthy design and administrative review process and would reduce the volume of contaminated soils to be excavated and incinerated. If Alternative 2 were selected, the slurry wall would provide for a more controlled "soil treatment chamber" resulting in more efficient implementation of soil vacuum extraction. Each alternative includes excavation of a relatively small volume of contaminated soils from the Ridge Area. The excavated Ridge Area soils would be consolidated with the DDA soils for subsequent treatment. A 12-inch thick soil cover will be constructed over the Ridge Area; a multi-layer composite barrier cap will be constructed over the DDA.

Restrictions on the deed to the Site to ensure that the containment components are not compromised by future use of the property.

Each alternative also includes long-term environmental monitoring to evaluate the effectiveness of the remedy and a wetlands monitoring plan to determine whether or not the adjacent wetlands are being impacted by Site contaminants. The environmental monitoring will include periodic ground water and air analyses. Final determination of the specific number and location of monitoring points, the frequency and duration of sampling, and the analytical parameters and methods to be included in the monitoring program will be made by EPA, in consultation with DNREC[1], during the remedial design and, as appropriate, during implementation of the selected remedy.

In addition, each alternative includes the construction of a multi-layer landfill cap over the Inert Area. The remedial design of the multi-layer composite barrier cap has been completed under an Administrative Order (See Section 3.2).

Alternative 1: Onsite Incineration -- Construction of a slurry wall around the DDA, de-watering of area contained by slurry

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[1] In accordance with 40 C.F.R. § 300.515(h)(3) in Subpart F of the NCP, the phrase "EPA, in consultation with DNREC" when used in this ROD means that EPA (the lead agency) shall provide DNREC (the support agency) an opportunity to review and comment on the remedial design and any proposed determinations on potential applicable or relevant and appropriate requirements (ARARs) or criteria, advisories or guidance "to be considered" (TBCs). In accordance with 40 C.F.R. § 300.515(g), the extent and nature of the State of Delaware's involvement during remedial design and remedial action shall be specified in the site-specific cooperative agreements or a Superfund State contract, consistent with 40 C.F.R. Part 35, Subpart O.

wall, excavation and onsite incineration of drums and soils exceeding cleanup standards (including Ridge Area soils), construction of a multi-layer composite barrier cap over the DDA, construction of a soil cover over the Ridge Area, construction of a multi-layer composite barrier cap over the Inert Area.

- Capital Cost: $70,633,000
- Annual O&M Cost: $290,000
- Present Worth: $74,291,900
- Years to Implement: 5

This alternative involves removal of all drums, wastes and soils within the DDA and Ridge Areas which contain concentrations of contaminants above the soil cleanup standards identified in Tables 1 and 2, respectively. Based on the current understanding of the Site, and using the soil cleanup standards to estimate excavation limits, approximately 62,000 cubic yards of contaminated soil and debris would be excavated from the DDA; approximately 500 cubic yards would be removed from the Ridge Area and treated along with the materials taken from the DDA. Excavation would begin within the boundaries of the DDA and move downward to the saturated zone, where contaminated soils are located. Excavation would then proceed laterally to the boundaries of the slurry wall, with "clean" soils found above the saturated zone to be stockpiled for subsequent backfill material. After de-watering, contaminated soils within the "saturated" zone would be subjected to thermal destruction in an onsite incinerator.

The initial ground water removal operation is projected to generate 680,000 gallons of contaminated water which would either be transported offsite and disposed at a waste treatment facility or treated onsite using an aqueous waste treatment system. Effluent from the onsite treatment of aqueous waste would comply with state requirements pertaining to point source discharges to surface water including effluent limitations under the Delaware Surface Water Quality Standards which apply to the protection of aquatic life.

An onsite incinerator would be utilized to effect thermal destruction of the contaminated soils and drummed materials excavated from the Drum Disposal and Ridge Areas. The onsite incinerator would be designed and operated in compliance with the substantive portions of federal and state requirements regulating incinerators (40 C.F.R. Part 264, Subpart O; Delaware Regulations Governing Hazardous Waste [DRGHW] Part 264, Subpart O). In addition, the onsite incinerator would be designed and operated in compliance with the substantive portions of federal standards to control metals emissions in Boilers and Industrial Furnaces (40 C.F.R. Part 266 Subpart H; DRGHW Part 266, Subpart H) and federal standards to control dioxin/furan emissions in Municipal Waste Combustors (40 C.F.R. Part 60, Subpart Ea).

Residual ash and scrubber water from the incinerator would be analyzed in accordance with the hazardous waste identification requirements (40 C.F.R. §§ 261.20-.24; DRGHW §§ 261.20-.24) and disposed of in accordance with federal and state regulations. Preliminary data obtained during the pre-design investigation indicates that ash would not be a RCRA characteristic waste and therefore could be placed back into the excavation without need for further treatment.

After all wastes and soils containing concentrations of hazardous constituents exceeding the soil cleanup standards (See Table 1) were treated in the onsite incinerator, the incinerator would be dismantled and removed from the Site.

A multi-layer composite barrier cap which would conjoin the top of the slurry wall would then be constructed over the DDA. The landfill cap would be necessary to prevent the migration of hazardous constituents which remain in soils at concentrations less than the soil cleanup standards. The DDA soil cleanup standards were developed assuming the existence of engineering controls (See Section 4.1).

Alternative 2: Soil Vapor Extraction/Bioremediation -- Construction of a slurry wall around the DDA, de-watering of area contained by slurry wall, excavation and offsite treatment/disposal of buried drums and waste, excavation of contaminated soils within the Ridge Area and consolidation of those soils in the DDA, treatment of residually contaminated soils within the containment area (DDA) utilizing both soil vapor extraction and bioremediation, construction of a multi-layer composite barrier cap over the DDA, construction of a soil cover over the Ridge Area, construction of a multi-layer composite barrier cap over the Inert Area.

- Capital Cost: $29,241,300
- Annual O&M Cost: $380,500
- Present Worth: $33,540,100
- Years to Implement: 6

This alternative consists of a combination of various elements, each selected to deal with a particular source of contamination or contaminant migration pathway. Unlike the original Feasibility Study which evaluated the feasibility of meeting remedial objectives by employing each technology independently (i.e., soil vapor extraction, incineration, bioremediation, etc.), this alternative was developed by orchestrating several treatment technologies and engineering controls.

After the slurry wall is constructed, the interior would be de-watered to create a positive gradient into the enclosed area. The initial ground water removal operation is projected to generate 680,000 gallons of contaminated water which would either be

transported off site and disposed at a waste treatment facility or treated onsite using an aqueous waste treatment system. Effluent from the treatment of aqueous waste would comply with state and federal requirements pertaining to point source discharges to surface water including effluent limitations under the Delaware Surface Water Quality Standards which have been established to protect the designated uses of the surface water body.

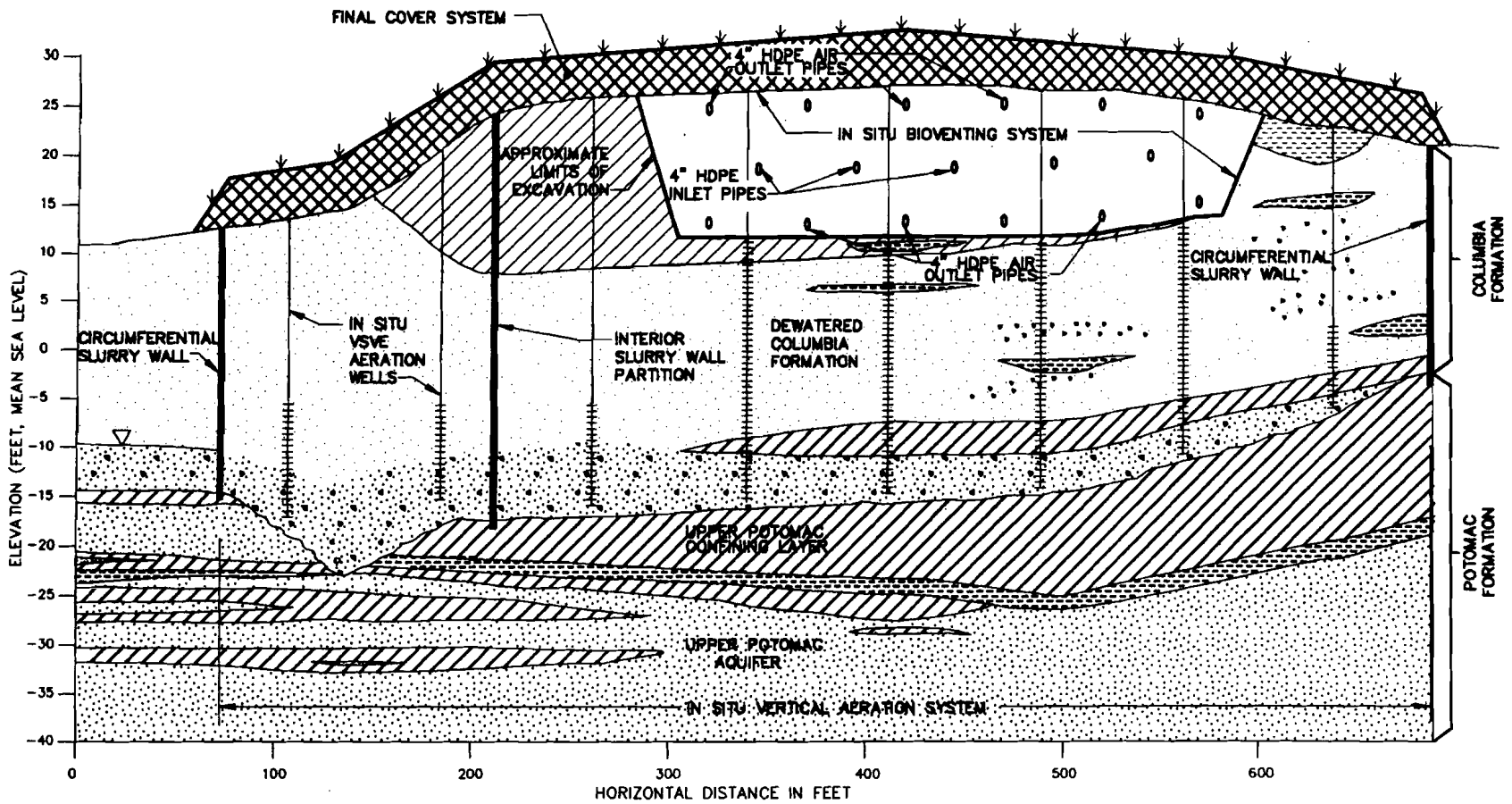
The upper 15 feet of the DDA would be excavated as a means of providing primary source reduction by removal of buried drums and highly contaminated soils directly associated with those drums. Intact drums containing liquids would be pumped out or vacuumed dry and compatible liquids bulked in tanks. The recovered materials (i.e., drums, contents, and soil in direct contact with the waste) would be sampled and bulked according to compatibility. Onsite handling of any wastes found to exhibit a characteristic of a hazardous waste would comply with the substantive portions of federal and state regulations that pertain to generators of hazardous waste (40 C.F.R. §§ 262.10, 262.20(a)-(d), 262.21, 262.23, 262.50-.55, 262.57; DRGHW §§ 262.10-.33, 262.40, 262.42, 262.50) and transporters of hazardous waste (DRGHW §§ 263.30-.31). A decision matrix to be developed during the remedial design would be utilized to select the appropriate offsite treatment and/or disposal option for each category of waste. In addition, a decision matrix would be developed to establish criteria to identify the "highly contaminated" soils which would be removed for offsite treatment and/or disposal along with the drummed waste. The remaining soils excavated along with the buried drums would be segregated from the drummed waste and temporarily stockpiled onsite.

Contaminated soils which exceed the cleanup standards (See Table 2) in the Ridge Area would be excavated. Three "hot spots" (areas with soils contaminated above the cleanup levels) within the Ridge Area were identified during the pre-design investigation. Approximately 500 cubic yards of contaminated soil would be excavated. Excavated soil would be consolidated with the DDA soils prior to treatment. Confirmatory sampling would be conducted to verify that all soils exceeding the Ridge Area soil cleanup standards have been excavated. After the confirmatory sampling verifies that the contaminated soils have been removed, the excavated areas would be backfilled with clean soil. A 12-inch thick soil cover would then be constructed over the Ridge Area.

A Soil Vapor Extraction/Bioventing System (SVE/BVS) would be constructed within the excavation area created by drum removal in the DDA and would be used to treat shallow soil (soils to a depth of 15-18 feet). The dimensions of the *in situ* SVE/BVS would be approximately 340 feet by 140 feet, as shown in Figure 4. The SVE/BVS would be designed to provide physical removal of volatile

Figure 4

FILE NO. DSG2-3
DATE: 09-28-93



LEGEND

- SAND
- SILT
- SAND & GRAVEL
- CLAY & SILTY CLAY

NOTE:

1. THE FIGURE SHOWS HORIZONTAL INSTALLATION OF THE AIR DISTRIBUTION PIPING. FINAL SELECTION BETWEEN HORIZONTAL OR VERTICAL AIR DISTRIBUTION PIPING WILL BE MADE DURING FINAL DESIGN.
2. THE FIGURE IS ADAPTED FROM THE PRE-CONCEPTUAL IN SITU SVE/BVS DESIGN REPORT PREPARED BY GERAGHTY & MILLER, INC.

McLAREN/HART
ENVIRONMENTAL ENGINEERING CORP.
LESTER, PA

GENERALIZED PROFILE OF THE REMEDIAL ACTION
DELAWARE SAND & GRAVEL
NEWCASTLE, DELAWARE

DATE: 01-22-93
APP'D: K.P.
DRAWING NO.

constituents and to create an environment within the soil matrix which would stimulate growth of natural microorganisms already present in the impacted soils. Excavated soils (including soils removed from the Ridge Area) would be homogenized and augmented with moisture and nutrients before being placed in the SVE/BVS. Air distribution piping would be installed within the excavated soil matrix and necessary emission controls constructed to complete the system.

Emission controls would be provided if necessary to comply with State and federal regulations pertaining to air emissions. The major regulations include the Delaware Regulations Governing the Control of Air Pollution (Regulation 19, Section 2.1 and Regulation 24) and federal air emission standards pertaining to process vents (40 C.F.R. §§ 264.1031-.1034). The EPA guidance document *Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites* (OSWER Directive 9355.0-28, June 15, 1989), would also be considered in determining the need for air emission controls.

An air dispersion model and risk assessment would be performed during the remedial design to calculate the potential risk that would be presented to human health by the emission of volatile organic compounds. Emissions would be controlled so as not to pose a carcinogenic risk greater than 1×10^{-6}.

Air flow through the *in situ* SVE/BVS would be induced by withdrawing air from the air-outlet piping. Final spacing of the air distribution piping is dependent upon the optimal oxygen transfer requirements for the *in situ* SVE/BVS and the resulting permeability of the DDA soil matrix after installation of the SVE/BVS. The system would be designed to provide an air flow rate that will result in soil vapor extraction and maintain aerobic conditions in the soil.

Contaminated soils located below the drum excavation area (deeper than 15 feet) and in the saturated zone within the boundaries of the slurry wall would be remediated using an *in situ* Vertical Soil Vapor Extraction and Bioremediation System (VSVE/BRS). The VSVE/BRS would consist of a series of vertical air extraction and injection wells screened within the contaminated zone and connected to a vacuum extraction and treatment system located above-ground. Provisions would be made to allow treatment of the extracted off-gas, as required. The requirements and modeling procedure described above for the SVE/BVS would also be used to determine if air emission controls were required for the VSVE/BRS. The emissions would be evaluated on a cumulative basis.

Active operational management of the SVE/BVS and VSVE/BRS treatment systems would continue until soil cleanup standards are achieved. Given theoretical performance efficiencies, most site

contaminants should be reduced to less than the level of their respective cleanup standards within two years and all standards should be met after six years; however, each system would be operated for a minimum of eight years or until a zero slope reduction condition (i.e., the practical limits of the technology) is reached, whichever is later. After eight years of operation or a zero slope reduction condition is reached, soils within the slurry wall would be collected and analyzed to confirm that the remedial objectives have been met. The number and location of soil samples necessary to verify that the remedial objectives have been met will be determined during the remedial design.

Following completion of the excavation activities and the construction of SVE/BVS and VSVE/BRS systems, a multi-layer composite barrier cap designed to incorporate an appropriate number of sampling ports would be constructed over the DDA and would conjoin the top of the slurry wall. The sampling ports would allow the underlying soils to be sampled to confirm that remedial objectives have been met. The location and number of sampling ports necessary to adequately confirm that the soil cleanup standards have been met would be determined by EPA, in consultation with DNREC, during the remedial design.

6.0 EVALUATION OF ALTERNATIVES

The two remedial action alternatives described above were compared against the nine evaluation criteria set forth in the NCP, 40 C.F.R. § 300.430(e)(9). These nine evaluation criteria can be categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The criteria associated with each category are as follows:

THRESHOLD CRITERIA

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements (ARARs)

PRIMARY BALANCING CRITERIA

- Long-term effectiveness
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

MODIFYING CRITERIA

- Community acceptance
- State acceptance

These evaluation criteria relate directly to the requirements of Section 121 of CERCLA, 42 U.S.C. § 9621, which are used to determine the overall feasibility and acceptability of the remedy. Threshold criteria must be satisfied in order for a remedy to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs between remedies. Support agency and community acceptance are modifying criteria which are taken into account after public comment is received on the Proposed Plan.

The following summary profiles the performance of Alternative 2 (SVE/Bioremediation) in terms of the nine criteria, noting how it compares to Alternative 1 (Onsite Incineration).

Overall Protection of Human Health and the Environment

Both of the alternatives would provide adequate protection of human health and the environment by eliminating, reducing, and controlling hazardous constituents through treatment and engineering controls. Treatability studies suggest that Alternative 2, the preferred alternative, would reduce the concentration of most site contaminants to less than the levels of their respective cleanup standards within two years. Operating the soil vapor extraction/bioremediation systems for an additional several years would result in all cleanup standards being met, with most contaminants being reduced to much lower levels. The slurry wall and multi-layer composite barrier cap will control migration of any residual contaminants which are not removed or destroyed. The limited excavation and handling of contaminated soils involved with the *in situ* treatment reduces the short-term risk posed to site workers during construction activities as compared to the full-scale excavation required to implement Alternative 1 (Onsite Incineration). Alternative 1 (Onsite Incineration) would meet the cleanup standards through thermal destruction of contaminants in soils where contamination exceeds the cleanup standards. Both Alternatives 1 and 2 would be protective of human health and the environment by eliminating buried drums and treating contaminated soils.

Compliance with ARARs

This criterion addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements (ARARs) of federal and state environmental laws. This section identifies the major ARARs that the alternatives must meet and discusses how they will be met (See Table 3).

The primary objective of the action to be taken at the Site is to protect the ground water from contaminants which are currently leaching from buried drums and contaminated soils. Maximum Contaminant Levels (MCLs) and non-zero Maximum Contaminant Level Goals (MCLGs) for public drinking water supplies have been

TABLE 3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED MATERIAL (TBCs) DELAWARE SAND AND GRAVEL SITE				
ARAR or TBC	Legal Citation	Classification	Requirement Synopsis	Applicability to Selected Remedy
I. CHEMICAL SPECIFIC				
A. Water				
1. Safe Drinking Water Act	42 U.S.C. § 300f et seq.			
a. Maximum Contaminant Levels (MCLS)	40 C.F.R. §§ 141.11-.12 and 141.61-.62	Relevant and Appropriate	MCLs are enforceable standards for public drinking water supply systems which have at least 15 service connections or are used by at least 25 persons. These requirements are not directly applicable; however, under the circumstances of this Site, MCLs are relevant and appropriate requirements for those contaminants for which (1) there are no non-zero MCLGs and (2) there are effective MCLs.	The NCP requires that remedial actions taken to protect groundwater that is a current or potential source or drinking water must meet the MCL for each site-related contaminant if the Maximum Contaminant Level Goal (MCLG) is set at a level of zero and MCLs are relevant and appropriate under the circumstances of the site. Soil cleanup standards were developed to ensure that the Upper Potomac Aquifer water quality meets MCLs and non-zero MCLGs.
b. Maximum Contaminant Level Goals (MCLGs)	40 C.F.R. §§ 141.50(b) and 141.151(b)	Relevant and Appropriate	MCLGs are non-enforceable health goals for public water supplies which have at least 15 service connections or are used by at least 25 persons. Under the circumstances of this Site, the MCLGs are relevant and appropriate requirements for those contaminants for which there are MCLGs greater than zero.	The NCP requires that remedial actions taken to protect groundwater that is a current or potential source or drinking water must meet non-zero MCLGs for contaminants of concern for which they exist, where they are relevant and appropriate requirements. Soil cleanup standards were developed to ensure that the Upper Potomac water quality meets non-zero MCLGs
2. EPA Health Advisories on Drinking Water (EPA Office of Drinking Water)	No legal citation	To be Considered	These advisories are non-enforceable guidelines for public water supply systems	To be considered for remedial actions involving ground water monitoring, recovery and treatment.
3. Health Effects Assessment (EPA Environmental Criteria and Assessment Office)	No legal citation	To be Considered	These are assessments of chemical-specific health effects that are based on non-enforceable toxicity data.	These assessments are to be considered where remedial alternatives address risk-based criteria or when setting standards for cleanups.

TABLE 3
APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)
AND TO BE CONSIDERED MATERIAL (TBCs)
DELAWARE SAND AND GRAVEL SITE

ARAR or TBC	Legal Citation	Classification	Requirement Synopsis	Applicability to Selected Remedy
4. Integrated Risk Information System (IRIS) (EPA Office of Research and Development)	No legal citation	To be Considered	IRIS is an EPA data base containing up-to-date health risk and EPA regulatory information for numerous chemicals. IRIS contains only those reference doses (RfDs) and cancer slope factors that have been verified by the RfD or Carcinogen Risk Assessment Verification Endeavor Workgroups, and is the preferred source of toxicity information.	These non-enforceable toxicity values are to be considered where remedial alternatives address risk based criteria or when setting standards for cleanups. IRIS was consulted during the development of soil cleanup standards at the Drum Disposal and Ridge Areas.
5. Delaware Regulations Governing Public Drinking Water	Delaware Regulations Governing Public Drinking Water, Revised March 11, 1991 Sections 22.2, 22.3, 22.4, 22.6, 22.10	Relevant and Appropriate	Sets criteria for public drinking water supplies. However, under the circumstances of this site, these requirements are relevant and appropriate.	Remedial action must meet levels which are equal to or more stringent than Federal MCLs and non-zero MCLGs.
6. Delaware Surface Water Quality Standards	Delaware Surface Water Quality Standards, as revised February 26, 1993 Section 9	Applicable	Criteria are provided to maintain surface water of satisfactory quality consistent with public health and recreational purposes, the propagation and protection of fish and aquatic life, and other beneficial uses of water.	Any surface water discharge must not contribute to or cause an excursion to these "in stream" water quality criteria if the state standards are more stringent than federal standards. These standards will be applicable under the same circumstances as the Federal Ambient Water Quality Criteria.
II. LOCATION SPECIFIC				
A. Ground Water Protection Strategy of 1984 EPA 440/6-84-002	No legal citation	To be Considered	Identifies ground water quality to be achieved during remedial actions based on aquifer characteristics and use.	The EPA aquifer classification will be taken into consideration during design and implementation of the treatment remedy. The Upper Potomac Aquifer is a class IIA aquifer.
B. Coastal Zone Management Act of 1972; Reauthorization Amendments of 1990	15 C.F.R. §§ 930.38 - 930.44	Applicable	Requires that Federal agencies conducting or supporting activities directly affecting the coastal zone, conduct or support those activities in a manner that is consistent with the approved appropriate State coastal zone management program. (See Delaware's Comprehensive Update and Routine Program Implementation, March 1993)	On-site remedial actions are required to be consistent, to the maximum extent practicable, with Delaware's coastal zone management program. EPA must notify Delaware of its determination that the actions are consistent to the maximum extent practicable.

TABLE 3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED MATERIAL (TBCs) DELAWARE SAND AND GRAVEL SITE				
ARAR or TBC	Legal Citation	Classification	Requirement Synopsis	Applicability to Selected Remedy
C. Regulation pursuant to National Historic Preservation Act of 1966, as amended	36 C.F.R. § 800.5(e)	Applicable	Requires remedial action to take into account effects on properties included in or eligible for the National Register of Historic Places and to minimize harm to National Historic Landmarks.	Actions will be taken to mitigate any adverse effects on the Dell'Aversano homestead, as the property is eligible for inclusion on the National Register of Historic Places.
III. ACTION SPECIFIC				
A. Water				
1. Delaware Regulations Governing Construction of Water Wells	Delaware Regulations Governing Construction of Water Wells, January 20, 1987 Sections 3,4,5,6,7,8,9,10	Applicable	Contain requirements governing the location, design, installation, use, disinfection, modification, repair, and abandonment of all wells and associated pumping equipment.	All wells will be installed, maintained and abandoned in accordance with the substantive portions of state regulations.
2. Delaware Regulations Governing the Control of Water Pollution	Delaware Regulations Governing the Control of Water Pollution, as amended June 23, 1983 Section 8.03(b)	Applicable	Contains water quality regulations for discharge into surface water	Stormwater controls will be exercised to prevent stormwater runoff from contacting contaminated soil and flowing into Army Creek. In the event that water extracted from the interior of the slurry wall is treated for onsite discharge, technology based limits will apply.
B. Air				
1. Delaware Regulations Governing the Control of Air Pollution	Delaware Regulations Governing the Control of Air Pollution Regulation 19, Section 2.1 Regulation 24	Applicable	Sets forth the requirement that a permit is necessary if emissions will exceed 10 lbs/day. Although a permit is not necessary for onsite activities, all substantive requirements must be met. Regulation 19 deals with odor, Regulation 24 deals with volatile organic compounds.	If emissions exceed 10 lbs/day then the substantive requirements of the regulation must be met. (TBC-Policy requires permit if air stripper emission > 2.4 lbs/day)
2. Control of Air Emissions from Air Stripers at Superfund Ground Water Sites, June 15, 1989 OSWER Directive 9355.0-28	No legal citation	To be Considered	This policy guides the selection of controls for air strippers (or SVE) at sites according to the air quality status of the Site's location (i.e., attainment or non-attainment area).	To be considered in determining if air emissions controls are necessary for the soil vapor extraction and bioventing system. Sources most in need of controls are those with emissions rates in excess of 3 lbs/hour or 15 lbs/day or a potential rate of 10 tons/year of total VOCs.
C. Waste Handling and Disposal				

TABLE 3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED MATERIAL (TBCs) DELAWARE SAND AND GRAVEL SITE				
ARAR or TBC	Legal Citation	Classification	Requirement Synopsis	Applicability to Selected Remedy
1. Delaware Regulations Governing Hazardous Waste	Delaware Regulations Governing Hazardous Waste See below for specific State citations	See below	Delaware Regulations Governing Hazardous Waste, Part 261 define "hazardous waste". The regulations listed below apply to the handling of such hazardous waste.	See below
2. Resource Conservation and Recovery Act of 1976 (RCRA); Hazardous and Solid Waste Amendments of 1984	See below for specific federal citations.	See below	Regulates the management of hazardous waste, to ensure the safe disposal of wastes, and to provide for resource recovery by controlling hazardous wastes "from cradle to grave."	Federal regulations would not apply for those RCRA regulations which Delaware has the authority from EPA to administer. See below
a. Identification and Listing of Hazardous Wastes	Delaware Regulations Governing Hazardous Wastes, §§ 261.20-.24	Applicable	Identifies solid wastes which are identified as hazardous wastes.	Criteria to be used in determining whether wastes are subject to RCRA hazardous waste regulations.
b. Identification and Listing of Hazardous Wastes	EPA Regulations, 40 C.F.R. §§ 261.20-.24	Relevant and Appropriate	Identifies solid wastes which are identified as hazardous wastes.	Criteria to be used in determining whether wastes are subject to RCRA hazardous waste regulations.
c. Standards Applicable to Generators of Hazardous Waste	Delaware Regulations Governing Hazardous Waste, §§ 262.10-.33, .40, .42, .50	Applicable	Establishes standards for generators of hazardous wastes including waste determination manifests and pre-transport requirements.	May apply to wastes "generated" by the remedial actions and/or treatment residues.
d. Standards Applicable to Generators of Hazardous Waste	EPA Regulations, 40 C.F.R. §§ 262.10, 262.20(a)-(d), 262.21, .23, .50-.55, .57	Relevant and Appropriate	Establishes standards for generators of hazardous wastes including waste determination manifests and pre-transport requirements.	May apply to wastes "generated" by the remedial actions and/or treatment residues.
e. Standards Applicable to Transporters of Hazardous Waste	Delaware Regulations Governing Hazardous Waste, §§ 263.30 and 263.31	Applicable	Sets forth regulations for off-site transporters of hazardous waste in the handling, transportation, and management of the waste. Sections 263.30 and 263.31 pertain to accidental hazardous waste discharges during transfer.	Apply to any company contracted to transport hazardous material from the Site. In the event that a spill occurs while onsite, immediate action will be taken to minimize the spill and cleanup spilled materials.
f. RCRA Requirements for Use and Management of Containers	Delaware Regulations Governing Hazardous Waste, §§ 264.171-178	Applicable	Requirements for storage of hazardous waste in storage containers.	Applicable for on-site treatment systems and temporary storage containers.
g. RCRA Requirements for Use and Management of Containers	EPA Regulations, 40 C.F.R. § 264.175	Relevant and Appropriate	Requirements for storage of hazardous waste in storage containers.	Applicable for on-site treatment systems and temporary storage containers.

TABLE 3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED MATERIAL (TBCs) DELAWARE SAND AND GRAVEL SITE				
ARAR or TBC	Legal Citation	Classification	Requirement Synopsis	Applicability to Selected Remedy
h. RCRA Requirements for Tanks Systems	Delaware Regulations Governing Hazardous Waste, §§ 264.191-199	Applicable	Requirements for storage or treatment of hazardous waste in tank systems.	Applicable for on-site treatment systems and temporary storage tanks.
i. RCRA Requirements for Tanks Systems	EPA Regulations, 40 C.F.R. §§ 264.191-.196, .198, .199	Relevant and Appropriate	Requirements for storage or treatment of hazardous waste in tank systems.	Applicable for on-site treatment systems and temporary storage tanks.
j. RCRA Requirements for Waste Piles	Delaware Regulations Governing Hazardous Waste, §§ 264.250-.258(a)	Applicable	Requirements for design, operation and closure of waste piles	Applicable if RCRA characteristic wastes are stockpiled in waste piles during construction of the SVE/bioventing system.
k. RCRA Requirements for Waste Piles	EPA Regulations, 40 C.F.R. §§ 264.251-.256, .259	Relevant and Appropriate	Requirements for design, operation and closure of waste piles	Applicable if RCRA characteristic wastes are stockpiled in waste piles during construction of the SVE/bioventing system.
l. RCRA Requirements for Landfill Caps	Delaware Regulations Governing Hazardous Waste, §§ 264.303(a) and 264.310(a)	Applicable	Requirements for landfill cap performance and post-closure maintenance	Applicable for the multi-layer composite barrier caps to be constructed at the Drum Disposal and Ridge Areas.
m. RCRA Requirements for Landfill Caps	EPA Regulations, 40 C.F.R. §§ 264.303(a) and 264.310(a)	Relevant and Appropriate	Requirements for landfill cap performance and post-closure maintenance	Applicable for the multi-layer composite barrier caps to be constructed at the Drum Disposal and Ridge Areas.
n. RCRA Manifest System, Recordkeeping, and Reporting	Delaware Regulations Governing Hazardous Waste, §§ 264.73 and 264.77	Applicable	Requirements for manifesting for off-site disposal of hazardous wastes.	Applicable for off-site disposal of hazardous waste generated by treatment systems.
o. RCRA Manifest System, Recordkeeping, and Reporting	EPA Regulations, 40 C.F.R. §§ 264.73 and 264.77	Relevant and Appropriate	Requirements for manifesting for off-site disposal of hazardous wastes.	Applicable for off-site disposal of hazardous waste generated by treatment systems.
p. Air Emission Standards for Process Vents	EPA Regulations, 40 C.F.R. §§ 264.1031-.1034	Applicable	Establishes requirements for process vents associated with operations that manage hazardous wastes with organic concentrations of at least 10 parts per million weight. Section 264.1032 governs process vents; Section 264.1033 governs closed vent systems	Regulations pertain to operations of the soil vapor extraction and bioventing systems. It will be determined whether the system will be an open or closed vent system during the remedial design.
D. Soils/Sediments				

TABLE 3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) AND TO BE CONSIDERED MATERIAL (TBCs) DELAWARE SAND AND GRAVEL SITE				
ARAR or TBC	Legal Citation	Classification	Requirement Synopsis	Applicability to Selected Remedy
1. Delaware Sediment and Stormwater Regulations	Delaware Sediment and Stormwater Regulations, January 23, 1991 Sections 3, 6, 9, 10, 11, 15	Applicable	Establishes management programs for construction projects that disturb more than 5,000 sf of land.	Applicable for excavation activities at the Ridge and Drum Disposal Areas and landfill cap construction at the Inert Area.
E. Miscellaneous				
1. Delaware Coastal Zone	Delaware Coastal Zone Act Sections 7003, 7004	To be considered	Establishes management policies related to a wide range of coastal, beach, wetlands, woodlands and other natural areas.	May require establishment of management plans for adequate wetland areas and flood hazard areas.
2. Delaware Regulations Governing Hazardous Substance Cleanup	Delaware Regulations Governing Hazardous Substance Cleanup, January 1993 Section 9	Relevant and Appropriate	Establishes cleanup criteria for hazardous waste sites. Only criteria considered relevant and appropriate are for soil cleanup standards developed to protect the groundwater (1×10^{-5}; Hazard Index of 1; or natural background if higher)	Relevant and appropriate for the development of soil cleanup standards at the Ridge and Drum Disposal Areas.
3. Delaware Environmental Protection Act	7 Delaware Code, Chapter 60, Sections 10(2) and 12(a)-(d)	To be considered	Establishes policy for development of all land, underwater and air resources	Applicable to remedial actions.

established under the Safe Drinking Water Act and are considered relevant and appropriate standards for ground water. However, meeting the chemical-specific MCLs and non-zero MCLGs would still result in a cumulative risk in excess of 10^{-4} due to the fact that there are multiple contaminants associated with the Site. In accordance with the NCP, use of risk-based target concentrations are necessary to set a protective remediation level. Numeric modeling indicates that if the soil cleanup standards listed in Tables 1 and 2 are met, the result will lead to contaminant concentrations in the ground water that are equal to or less than the chemical-specific MCLs and non-zero MCLGs. Health Effects Assessments and U.S. EPA Health Advisories were considered in establishing ground water cleanup standards for the Site. Alternative 1 and 2 would reduce the concentrations of hazardous constituents in the soil to less than the soil cleanup standards.

Soil vapor extraction in Alternative 2 would result in off-gas containing volatile organic compounds (VOCs); onsite incineration would result in air emissions at the stack. Air emission controls may be necessary to meet state and federal requirements. These requirements pertaining to air emissions include the Delaware Regulations Governing the Control of Air Pollution (Regulation 19, Section 2.1 and Regulation 24).

Alternative 2 would also comply with the substantive portions of requirements regulating air emissions from process vents (40 C.F.R. §§ 264.1031-.1034). The EPA guidance document entitled Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites would be considered in assessing the need for controlling air emissions for the soil vapor extraction remedy.

Alternative 1 would comply with the substantive portions of federal and state requirements regulating incinerators (40 C.F.R. Part 264, Subpart O; DRGHW Part 264, Subpart O). In addition, federal standards to control metals emissions in Boilers and Industrial Furnaces (40 C.F.R Part 266, Subpart H; DRGHW Part 266, Subpart H) and federal standards to control dioxin/furan emissions in Municipal Waste Combustors (40 C.F.R. Part 60, Subpart Ea) are relevant and appropriate to onsite incineration of wastes. Alternative 1 would be designed and operated in such a manner as to comply with the above-mentioned requirements.

Both alternatives include onsite or offsite treatment of water extracted from the interior of the slurry wall. Effluent from the treatment of aqueous waste would comply with state requirements pertaining to point source discharges to surface water, including effluent limitations under the State Surface Water Quality Standards.

The implementation of either alternative would result in the generation of residual wastes. Alternative 1 would generate incinerator ash and scrubber water.[2] If it is determined that off-gas from the soil vapor extraction/bioventing component of Alternative 2 requires emission controls, it is likely that carbon filters would be utilized (the specific type of emission controls would be determined during the remedial design). Any residual wastes would be evaluated in accordance with the federal and state hazardous waste identification requirements (40 C.F.R. §§ 261.20-.24; DRGHW §§ 261.20-.24). Onsite handling of any residual wastes found to exhibit a characteristic of a hazardous waste would comply with the substantive portions of federal and state regulations that pertain to generators of hazardous waste (40 C.F.R. §§ 262.10, .20, .21, .23, .42, .50-.55, .57; DRGHW §§ 262.10-.33, .40, .42, .50) and transporters of hazardous waste (DRGHW §§ 263.30-31).

The implementation of either alternative would include a considerable amount of excavation and handling of excavated materials onsite. The excavated materials would have to be temporarily "stockpiled" until their ultimate disposition is completed (i.e., incinerated, returned to bioventing system for treatment or transported offsite for treatment, etc.). Any onsite storage of hazardous wastes would comply with the substantive portions of federal and state requirements regulating containers (40 C.F.R. § 264.175; DRGHW §§ 264.171-.178), tanks (40 C.F.R. §§ 264.191-.196, .198, .199; DRGHW §§ 264.191-.199), and waste piles [40 C.F.R. §§ 264.251-.256, .259; DRGHW §§ 264.250-.258(a)], depending on the type of waste present and the manner in which it is stockpiled.

In summary, both alternatives would meet their respective applicable or relevant and appropriate requirements of federal and state environmental laws (ARARs).

Long-term Effectiveness and Permanence

Both alternatives use treatment technologies that are permanent and irreversible. The amended remedy is versatile in that it can be operated in the soil vapor extraction mode or at a slower bioremediation mode. During the soil vapor extraction mode, contaminants are stripped from the soils and, if necessary, captured as off-gas in an emission control unit. When air is pulled through the soils at a slower rate, the increased oxygen levels stimulate microorganisms which are already present in the

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[2] Preliminary data obtained during the pre-design investigation indicates that the ash would not be a RCRA characteristic waste; therefore, the cost estimate for Alternative 1 assumed that off-site disposal at a permitted RCRA landfill is unnecessary.

contaminated soils. The microorganisms degrade the contaminants. Both the SVE or bioremediation will result in the permanent removal or destruction of hazardous constituents. Onsite incineration thermally destroys the contaminants in a permanent fashion.

Both alternatives employ a slurry wall/multi-layer cap containment system to isolate the residual source constituents which will not be treated (i.e., metals) from the environment. Each alternative includes long-term environmental monitoring to ensure the effectiveness of the remedy.

Reduction of Toxicity, Mobility, and Volume

Both alternatives reduce the volume of contaminated media through the removal of sources of contamination within the upper level of the DDA. Toxicity is reduced by Alternative 2 through *in situ* biodegradation of contaminants and/or removal and offsite treatment in the soil vapor extraction mode. Alternative 1 would provide even greater reduction of toxicity through thermal destruction of organic compounds. Both alternatives significantly reduce the mobility of any residual source constituents through construction of the slurry wall and multi-layer landfill cap. Alternative 1 and 2 each would significantly reduce the toxicity, mobility and volume of contaminated media through treatment. Although incineration has the potential to increase the mobility of a small quantity of metals with low boiling points, Alternative 1 grades slightly higher than Alternative 2 with respect to this evaluation criterion because incineration would result in the near complete destruction of organic contaminants.

Short-term Effectiveness

Alternative 2 involves relatively limited excavation and handling of contaminated soils. The *in situ* treatment reduces the short-term risk posed to site workers during construction activities compared to the full scale excavation entailed by Alternative 1. Both alternatives entail potential air emissions; however, emissions will be effectively monitored during excavation, construction and operation and will be controlled to prevent unacceptable levels of exposure. Alternative 1 may pose an additional short-term risk to workers and neighboring populations due to the non-homogeneous waste stream, or the potential malfunction of the onsite incinerator. These potential risks would be reduced through implementation of an air monitoring program, emission controls, and continuous monitoring of the thermal treatment system combined with automatic incinerator shut-off features. Alternative 2 is superior to Alternative 1 with respect to short-term effectiveness.

Implementability

Alternative 2 would utilize technology that is readily available and standard equipment that is available locally. Contamination in relatively inaccessible areas is treated *in situ*, simplifying the logistics. The remedial design would take less than one year to complete and no administrative delays are anticipated. The majority of the cleanup standards should be met within two years of the start of operations. Alternative 1 would employ a readily available and well understood technology. The presence of both PCBs and certain metals in the waste stream means that the incinerator feed stock must be pre-characterized so that the temperature and retention time can be managed to minimize problematic emissions. Efforts to acquire all necessary permits and regulatory approvals to site a new incinerator, even on a temporary basis, routinely result in substantial delays. Considering both technical and administrative feasibility, Alternative 2 is superior to Alternative 1 with respect to implementability.

Cost

The present worth of Alternative 2 (SVE/Bioremediation) is estimated at $33,540,100. Alternative 2 is less costly than Alternative 1 (Onsite Incineration), the present value of which is $74,291,900, yet Alternative 2 provides the same degree of risk reduction.

State Acceptance

The Delaware Department of Natural Resources and Environmental Control has concurred with the amended remedy for the Drum Disposal and Ridge Areas.

Community Acceptance

The Proposed Plan to Amend the Record of Decision was released to solicit public comment regarding the proposed remedial alternatives on July 29, 1993. At that time a 45-day comment period was opened. A public meeting on the Proposed Plan was held September 2, 1993, in New Castle, Delaware. Comments raised at the public meeting and received during the comment period are summarized in the Responsiveness Summary which is included in this ROD Amendment. In general, the public did not object to Alternative 2 (SVE/Bioremediation).

7.0 AMENDED REMEDY: DESCRIPTION AND PERFORMANCE STANDARDS

Following review and consideration of the information in the Administrative Record file, the requirements of CERCLA and the NCP, and public comment, EPA has selected Alternative 2 (Soil Vapor Extraction/Bioremediation) as the amended remedy for this

Site. Based on current information, this alternative appears to provide the best balance of trade-offs with respect to the nine criteria set forth in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. § 300.430(e)(9)(iii), which EPA uses to evaluate remedial alternatives.

The amended remedy consists of the following major components:

Drum Disposal Area

- Construction of a circumferential slurry wall outside the Drum Disposal Area
- De-watering the interior of the slurry wall; on- or offsite treatment and disposal of extracted water
- Excavation of wastes buried within the Drum Disposal Area
- Treatment and/or disposal of drummed materials and highly contaminated soils
- Treatment of soils within the containment area using soil vapor extraction and bioremediation (bioventing)
- Construction of a multi-layer landfill cap
- Perimeter fencing
- Deed Restriction

Ridge Area

- Removal of existing surficial debris
- Excavation of surface soils exceeding soil cleanup standards
- Treatment of the excavated soil with the material within the Drum Disposal Area
- Backfilling with clean soil, regrading and construction of a soil cover.

Inert Area

- Removal of existing surficial debris
- Construction of a multi-layer landfill cap
- Perimeter fencing

- Deed Restriction

Environmental Monitoring

- Monitoring ground water, air and adjacent wetlands

The cost summary for the selected remedy is shown in Table 4. Each component of the remedy and performance standards are described below.

7.1 DRUM DISPOSAL AREA

A. Construction of a circumferential slurry wall outside the Drum Disposal Area

A slurry wall will be constructed outside the DDA, enclosing the horizontal limit of contaminants within the Columbia Aquifer. The estimated location of the slurry wall is shown in Figure 5. The primary purpose of the slurry wall is to isolate those soils containing the majority of hazardous constituents in the unsaturated and saturated portion of the Columbia Formation from the surrounding subsurface environment. It is estimated that a slurry wall 1,700 feet long by 50 feet deep will be required. The slurry wall will be constructed of a soil-bentonite mix and will have an in-place permeability of less than 1×10^{-7} cm/sec. Implementation of this element of the selected remedy has already been initiated under an AOC signed in June 1992 (see Section 3.1 above).

The slurry wall will tie-in to the Potomac clay. As the clay thins to the northwest (outside the DDA proper), a partitioned slurry wall will be built, to create two separate cells (see Figure 5). The larger cell will contain all of the DDA proper and will be keyed-in to the thicker, impermeable Potomac clays. The smaller cell will contain contaminated soils near the zero clay area and will further isolate this northwestern area, which is underlain with thinner clays than the DDA proper. The installation of the slurry wall will also result in more efficient implementation of vacuum extraction for soils presently within the saturated zone.

Performance Standards for the slurry wall:

Implementation of this element of the alternative has been initiated under an Administrative Order on Consent (AOC), dated June 12, 1992. The slurry wall must be constructed in conformance with the Statement of Work attached to the AOC and the Slurry Wall Design document completed in September 1993 and approved by EPA, in consultation with DNREC.

TABLE 4 ALTERNATIVE 2: BIOREMEDIATION/SOIL VAPOR EXTRACTION		
Item	Cost Basis	Cost, $
DDA CONSTRUCTION COST ESTIMATE		
Site Preparation	Lump Sum	$250,000
Mobilization/Demobilization	Lump Sum	$500,000
Slurry Wall	85,000 sq.ft. @ $15/sq.ft.	$1,275,000
Groundwater Extraction System (includes tank farm)	20 wells w/pumps, piping, tank	$580,000
Water Disposal	680,000 gal. @ $0.25/gal.	$170,000
Screening/Materials Handling	15,400 cu.yd. @ $50/cu.yd.	$770,000
Liquid Waste Disposal	229,000 lb @ $1.00/lb	$229,000
Drummed Material Disposal	675 cu.yd. @ $2,250/cu.yd. 675 cu.yd. @ $100/cu.yd.	$1,586,000
Clean Fill	1,350 cu.yd. @ $20/cu.yd.	$27,000
Bio-remediation (includes operations)	14,050 cu.yd. @ $150/cu.yd.	$2,108,000
Vapor Extraction (includes operations)	50,000 cu.yd. @ $75/cu.yd.	$3,750,000
Multi-layer Cap	2.78 acres @ $250,000/acre	$695,000
Support Services	30 months @ $100,000/month	$3,000,000
SUBTOTAL		$14,940,000
Engineering/Construction Services @ 20%		$2,988,000
SUBTOTAL		$17,928,000
Contingency @ 25%		$4,482,000
TOTAL		$22,410,000

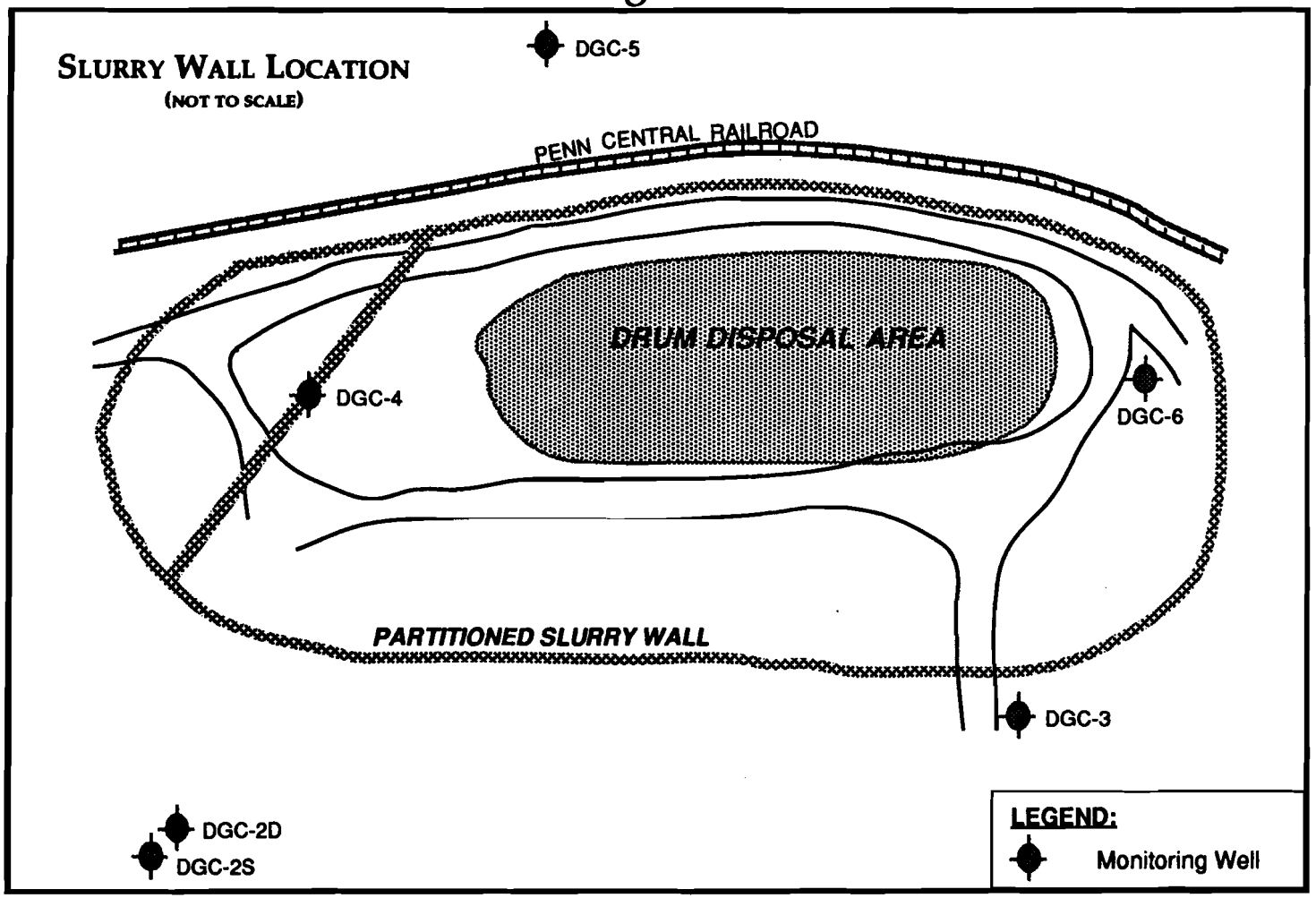
(DSG/TABLE4)

TABLE 4 ALTERNATIVE 2: BIOREMEDIATION/SOIL VAPOR EXTRACTION		
Item	Cost Basis	Cost, $
RIDGE AREA CONSTRUCTION COST ESTIMATE		
Site Preparation	Lump Sum	$50,000
Mobilization/Demobilization	Lump Sum	$100,000
Surface Waste Removal	Lump Sum	$100,000
Excavation and Transportation	510 cu.yd. @ $50/cu.yd.	$26,000
Bioremediation (includes operation)	Lump Sum	$230,000
Clean Fill	510 cu.yd. @ $50/cu.yd.	$10,200
Site Regrading	Lump Sum	$32,000
Soil Cap	Lump Sum	$50,000
Hydro-Seeding	Lump Sum	$2,000
SUBTOTAL		$600,200
Engineering/Construction Services @ 20%		$120,000
SUBTOTAL		$720,200
Contingency @ 25%		$180,100
TOTAL		$900,300
INERT AREA CONSTRUCTION COST ESTIMATE		
Removal of Debris	Lump Sum	$500,000
Site Regrading	Lump Sum	$704,000
Multi-Layer Cover	11 acres @ $250,000/acre	$2,750,000
SUBTOTAL		$3,954,000

(DSG/TABLE4)

TABLE 4 ALTERNATIVE 2: BIOREMEDIATION/SOIL VAPOR EXTRACTION		
Item	Cost Basis	Cost, $
Engineering/Construction Services @ 20%		$790,800
SUBTOTAL		$4,744,800
Contingency @ 25%		$1,186,200
TOTAL		$5,931,000
ALTERNATIVE 2: BIOREMEDIATION/SOIL VAPOR EXTRACTION DDA ANNUAL OPERATIONS & MAINTENANCE		
Extraction System Operation	Labor & Electric	$50,000
Water Disposal	11,000 gal. @ $0.50/gal.	$5,500
Site Maintenance	Mowing, Earthwork, Fence, Lump Sum	$50,000
Groundwater Monitoring	10 wells, 4 rounds @ $25,000/round	$100,000
TOTAL ANNUAL COSTS		$205,500/yr
PRESENT WORTH O&M	30 yrs. @ 8%	$2,314,000
RIDGE AREA ANNUAL OPERATIONS & MAINTENANCE		
Cap Maintenance	Lump Sum	$25,000
TOTAL ANNUAL COSTS		$25,000/yr
PRESENT WORTH O&M	30 yrs. @ 8%	$281,400
INERT AREA ANNUAL OPERATION & MAINTENANCE		
Cap Maintenance	Lump Sum	$150,000
TOTAL ANNUAL COST		$150,000/yr
PRESENT WORTH O&M	30 yrs. @ 8%	$1,688,700

Figure 5


SLURRY WALL LOCATION
(NOT TO SCALE)
DGC-5
PENN CENTRAL RAILROAD
DRUM DISPOSAL AREA
DGC-4
DGC-6
PARTITIONED SLURRY WALL
DGC-3
DGC-2D
DGC-2S
LEGEND:
Monitoring Well

A post-construction maintenance plan shall be developed to maintain the integrity and effectiveness of the slurry wall, including making repairs to the wall, as necessary.

B. De-watering interior of the slurry wall; onsite or offsite treatment and disposal of extracted water

This element consists of two basic phases: first, an initial step whereby ground water within the slurry wall is removed following slurry wall construction and second, if necessary, a maintenance task of removing ground water generated as a result of infiltration within the slurry wall to maintain a positive gradient into the enclosed area. The initial ground water removal operation is projected to generate 680,000 gallons of contaminated water. Owing to the limited volumes, all ground water removed will be either transported offsite and disposed at an aqueous waste treatment facility or treated on site using an aqueous waste treatment system.

Performance Standards for the de-watering of the interior of the slurry wall and treatment/disposal of extracted water are as follows:

The saturated portions of the Columbia Formation within the slurry wall must be de-watered to maximize the effectiveness of the air delivery system that will be developed during the design of the soil vapor extraction/bioremediation treatment system.

Whether the extracted water is treated onsite or offsite, effluent from the treatment of aqueous waste must comply with state and federal requirements pertaining to point source discharges to surface water including effluent limitations under the Delaware Surface Water Quality Standards.

Piezometers shall be installed, monitored and maintained within the interior of the slurry wall to gauge the effectiveness of the effectiveness of the wall as a low permeability barrier.

C. Excavation of wastes buried within the Drum Disposal Area

Waste characterization performed to date indicates that the upper 15-18 feet of the DDA represents a significant source of the hazardous constituents found at the site; this material is highly heterogeneous, consisting of drummed waste and soils. The upper 15-18 feet of the DDA will be excavated as a means of providing significant primary source reduction by removal of buried drums and treatment of the contaminant mass that could potentially be released into the surrounding subsoils.

The highly heterogeneous nature of the materials to be excavated and the variety of constituents that have been found in different matrices within the DDA indicate that a flexible approach in selecting appropriate treatment technologies for discreet types of waste is required. A treatment/disposal decision matrix will be utilized to select the appropriate treatment and/or disposal option for each category of waste excavated from the DDA. The treatment/disposal decision matrix criteria will be developed during the remedial design.

The upper portion of the DDA will be excavated in a manner that minimizes the release of materials from the buried drums. Segregating as much of the surrounding soils as practical, the drums and drum fragments (along with their contents), debris, and other non-degradable materials will be screened and separated from any soils. These drums will be transported temporarily to a staging area constructed onsite. Soils which are screened and/or segregated from the drummed materials will be stockpiled within the area surrounding the excavation. Based on the number of drums estimated to be present in the DDA, and assuming the amount of "recovered material" per drum will be equivalent to a full drum, approximately 2,700 yd^3 of material would be staged. "Recovered material" includes drum, contents, and soil in direct contact with the waste.

As a further measure to ensure that contaminants will not be transported from the DDA, all liquids encountered during excavation of the DDA will be collected. It is estimated that approximately 5 percent of the drums contain liquid waste which corresponds to a conservative estimate of 27,500 gallons. Intact drums, if encountered during excavation, will be pumped or vacuumed dry and compatible liquids will be bulked in tanks. Spilled liquids will also be pumped or vacuumed and collected in a similar fashion. A series of temporary tanks will be utilized for this purpose. It is anticipated that, based on the decision matrix screening process, the recovered liquids will either be incinerated offsite, treated in an offsite aqueous waste treatment system or treated in an onsite waste treatment system. The means of treatment will be determined based on whether the waste is primarily aqueous or non-aqueous and what appropriate treatment/disposal regulations are applicable.

Performance Standards for the excavation of wastes buried within the DDA:

All drummed materials and scrap metal shall be excavated. Protocol shall be established during the remedial design to confirm that excavation of buried materials is complete.

Any onsite storage of hazardous wastes must comply with the substantive portions of federal and state requirements regulating containers (40 C.F.R. § 264.175; DRGHW §§

264.171-.178), tanks (40 C.F.R. §§ 264.191-.196, .198, .199; DRGHW §§ 264.191-.199), and waste piles [40 C.F.R. §§ 264.251-.256, .259; DRGHW §§ 264.250-.258(a)], depending on the wastes present and the manner in which the material is stockpiled.

D. Treatment and/or disposal of drummed materials and highly contaminated soils

The highly heterogeneous nature of the materials to be excavated and the variety of constituents that have been found in different matrices within the DDA indicate that a flexible approach in selecting appropriate treatment technologies for discreet types of waste is required. A treatment/disposal decision matrix will be utilized to select the appropriate treatment and/or disposal option for each category of waste excavated from the DDA. In addition, a decision matrix will be developed to establish criteria to identify the "highly contaminated" soils which would be removed for offsite treatment and/or disposal along with the drummed waste. The remaining soils excavated along with the buried drums shall be segregated from the drummed waste and temporarily stockpiled onsite. The treatment/disposal decision matrices criteria shall be developed during the remedial design and will be approved by EPA, in consultation with DNREC.

Performance Standards for treatment and/or disposal of drummed materials and highly contaminated soils:

The treatment/disposal decision matrix will be developed to ensure that all federal and state treatment and disposal requirements are met.

All drummed material and highly contaminated soil be evaluated in accordance with federal and state hazardous waste identification requirements (40 C.F.R. §§ 261.20-.24; DRGHW §§ 261.20-.24). Onsite handling of any wastes found to exhibit a characteristic of a hazardous waste must comply with the substantive portions of federal and state regulations that pertain to generators of hazardous waste (40 C.F.R. §§ 262.10, .20, .21, .23, .42, .50-.55, .57; DRGHW §§ 262.10-.33, .40, .42, .50) and transporters of hazardous waste (DRGHW §§ 263.30-31).

Any onsite storage of hazardous wastes must comply with the substantive portions of federal and state requirements regulating containers (40 C.F.R. § 264.175; DRGHW §§ 264.171-.178), tanks (40 C.F.R. §§ 264.191-.196, .198, .199; DRGHW §§ 264.191-.199), and waste piles [40 C.F.R. §§ 264.251-.256, .259; DRGHW §§ 264.250-.258(a)], depending on the wastes present and the manner in which the material is stockpiled.

E. Treatment of soils within the containment area using soil vapor extraction and bioremediation (bioventing)

A Soil Vapor Extraction/Bioventing System (SVE/BVS) will be constructed within the excavation area created by drum removal in the DDA and will be used to treat shallow soil (soils to a depth of approximately 15 feet). The SVE/BVS will be designed to provide physical removal of volatile constituents and create an environment within the soil matrix which will stimulate growth of natural microorganisms already present in the impacted soils. Excavated soils will be homogenized and may be augmented with moisture and nutrients before being placed in the SVE/BVS. Air distribution piping will be installed within the excavated soil matrix and necessary emission controls will be constructed to complete the system.

Air flow through the *in situ* SVE/BVS will be induced by withdrawing air from the air-outlet piping. Final spacing of the air distribution piping is dependent upon the optimal oxygen transfer requirements for the *in situ* SVE/BVS and the resulting permeability of the DDA soil after installation of the SVE/BVS. The system will be designed to provide an air flow rate that will result in efficient soil vapor extraction and maintain aerobic conditions throughout the excavation area.

Contaminated soils located below the drum excavation (deeper than 15-18 feet) and in the saturated zone within the boundaries of the slurry wall will be remediated using an *in situ* Vertical Soil Vapor Extraction and Bioremediation System (VSVE/BRS). The VSVE/BRS will consist of a series of vertical air extraction and injection wells which will be screened within the contamination zone and connected to a vacuum extraction and treatment system located above-ground. Provisions will be made to allow treatment of the extracted off-gas, as required.

Active operational management of the SVE/BVS and VSVE/BRS treatment systems will continue until the remedial objective for the soils (See Section 4.2) has been achieved. Given the theoretical performance efficiencies, most site contaminants should be reduced to less than the level of their respective cleanup standards (See Table 1) within two years; however, each system will be operated for a minimum of eight years or until a zero slope reduction condition (i.e., the practical limits of the technology) is reached, whichever is later. After eight years of operation or a zero slope reduction condition is reached, soils within the slurry wall would be collected and analyzed to confirm that the remedial objective for the soils has been met. The number and location of soil samples necessary to verify that the remedial objective has been met will be determined during the remedial design.

Performance Standards for the treatment of soils within the containment area using soil vapor extraction and bioremediation (bioventing):

Remove or degrade the organic contaminants within the DDA such that: (1) the potential carcinogenic risk to people exposed to the Site is within the 10^{-6} risk range; and, (2) the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects is reduced to acceptable levels (i.e., a Hazard Index less than 1.0).

Air emission controls may be necessary to meet state and federal requirements. These requirements include state regulations pertaining to air emissions [Delaware Regulations Governing the Control of Air Pollution (Section 6003)]. The emissions shall also comply with the substantive portions of requirements regulating air emissions from process vents (40 C.F.R. §§ 264.1031-.1034). The EPA guidance document entitled Control of Air Emissions from Superfund Air Strippers at Superfund Groundwater Sites must be considered in assessing the need for controlling air emissions from the soil vapor extraction remedy. An air dispersion model and risk assessment shall be performed during the remedial design to calculate the potential risk that would be presented to human health by the emission of volatile organic compounds. Emissions shall be controlled so as not to pose a carcinogenic risk greater than 1×10^{-6}.

F. Construction of a multi-layer landfill cap

Following the completion of excavation activities and the construction of SVE/BVS and VSVE/BRS systems, a multi-layer composite barrier cap will be constructed across the entire area of the DDA and the area within the slurry wall. The primary purpose of the cap is to prevent infiltration into the DDA, thereby minimizing leachate generation, preventing direct contact with source constituents, minimizing erosion, and controlling air emissions, as necessary under applicable federal and state regulations.

The boundaries of the multi-layer composite barrier cap will extend out and "tie-in" to the top of the slurry wall. The exact dimensions of the cap will be precisely determined in the remedial design. Site-specific topographical information will be utilized to develop the areal extent of the cap. Grading of the surface surrounding the capped area will be designed to promote run-off, minimize infiltration and control erosion.

Performance Standards for the multi-layer composite barrier cap are described below:

The multi-layer composite barrier cap shall be designed to meet the criteria of 40 C.F.R. 264.303(a) and 40 C.F.R. 264.310(a); DRGHW 264.303(a) and DRGHW 264.310(a).

The cap shall be a multi-layer composite barrier system which minimizes the long-term migration of liquids into the capped area. The cap materials may be naturally occurring soils and synthetic materials which will not leach hazardous constituents. The components of the cap shall be: a vegetated topsoil layer; a select fill soil layer; a drainage layer which minimizes the hydraulic gradient above the impermeable layer (permeability equal to 12" of sand at 1×10^{-2} cm/sec or a geonet with transmissivity equal to or greater than 3×10^{-5} m^2/sec); a low permeability barrier which, when constructed, shall have a sufficiently low permeability such that it prevents infiltration; and a bedding layer. (See Figure 2) The low permeability barrier is comprised of two major components. The synthetic (upper) layer is designed to prevent infiltration of liquids into the waste mass. The underlying low permeability (1×10^{-7} cm/sec) layer provides added assurance that liquids entering the waste mass will be minimized should a breach of the synthetic layer occur. While exact cap configuration may be determined through a value engineering analysis (which may not eliminate any layers), any modifications to the design cannot increase the expected infiltration rate since it would adversely affect the assumption under which soil cleanup standards for the DDA were calculated. Therefore, any modifications to the current configuration must provide the same reduction of infiltration (at a minimum) as this configuration.

The materials and construction of the multi-layer composite barrier cap will accommodate settling and subsidence so that the cap's integrity is maintained.

Prior to the installation of the impermeable system, the area to be capped shall be proof rolled. Identified soft areas shall be brought up to suitable compaction, to be specified in the remedial design.

The top of the impermeable system shall be graded to prevent ponding of liquids and shall be sloped to promote drainage. The drainage system will be designed to convey rainfall down the installed slope at a rate slow enough to prevent erosion and subsequent loss of cap materials.

The landfill cap shall be vegetated in such a way as to provide a high quality wildlife habitat to the maximum

extent practicable (without endangering the liner). The types of grass seed and/or wildflower mix shall be identified in the remedial design.

A post-construction maintenance plan shall be developed to ensure maintainenance of the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events.

G. Perimeter fencing

A perimeter fence has been erected around the DDA. If the existing fence must be removed during construction activities, a replacement fence must be erected upon their completion. A chain-link fence shall be constructed around the perimeter of the landfill cap in order to prevent unauthorized access to the DDA. Plans for maintenance of the fence shall be included in a post-construction maintenance plan.

Performance Standards for Perimeter Fencing

The chain-link fence shall have a minimum height of six feet and shall be equipped with locking gates.

The fence shall be maintained in a manner sufficient to prevent unauthorized access to the landfill until such time as EPA determines that access restrictions are no longer required.

H. Deed Restriction

Restrictions shall be placed by the Site property owner on the deed to the Site in order to prevent installation of drinking water wells on the property and any future uses of the property that could compromise the effectiveness of the selected remedy. The deed restrictions shall remain in effect until EPA determines that they are no longer required to protect human health and welfare and the environment.

7.2 Ridge Area

A. Removal of existing surficial debris

Existing surficial waste from the entire Ridge Area will be removed. Small size materials, such as empty drums, debris and garbage containers, will be collected, staged, tested and transported to an appropriate solid waste landfill for disposal. Large size materials, such as large storage tanks, will be decontaminated and transported to a metal scrap yard for recycling. After removal of all the surficial waste the Ridge Area will be cleared and grubbed.

B. Excavation of surface soils exceeding soil cleanup standards

Soil borings were completed in a 20-feet grid pattern across the Ridge Area during the pre-design investigation. Analyses of the soil samples collected identified three distinct areas that contain concentrations of contaminants greater than the soil cleanup standards identified in Table 2. The three "hot spots" identified in Figure 6 will be excavated. Confirmatory sampling must be conducted to verify that all soils exceeding the Ridge Area soil cleanup standards have been excavated. The excavated soil will be consolidated with the DDA soils. The contaminated soils will be treated in the SVE/BVS with the DDA soils. It is estimated that 500 cubic yards of contaminated soil will be generated from these excavations, which will be completed to an approximate depth of 5 feet.

Performance Standards for the excavation of surface soils exceeding soil cleanup standards:

Soils which contain concentrations of hazardous constituents greater than the respective soil cleanup standards listed in Table 2 will be excavated. The excavated soils may be temporarily stockpiled onsite until which time they are consolidated within the SVE/BVS for treatment.

Any onsite storage of hazardous wastes would comply with the substantive portions of federal and state requirements regulating containers (40 C.F.R. § 264.175; DRGHW §§ 264.171-.178), and waste piles [40 C.F.R. §§ 264.251-.256, .259; DRGHW §§ 264.250-.258(a)], depending on the type of waste present and the manner in which it is stockpiled.

C. Treatment of the excavated Ridge Area soils within the Soil Vapor Extraction/Bioventing System

Once the contaminated Ridge Area soils have been consolidated with the DDA soils, those soils will be considered to be DDA soils. Therefore, refer to description and performance standards included in paragraph 7.1.E, above.

D. Backfill with clean soil, regrade and construct a soil cover.

After appropriate confirmatory sampling to verify that all soils exceeding the Ridge Area soil cleanup standards have been excavated, excavations will be backfilled with clean soil. After the excavated areas are backfilled, a 12-inch thick soil cover will be placed and the surface of the entire Ridge Area will be regraded and seeded to promote proper drainage.

Figure 6

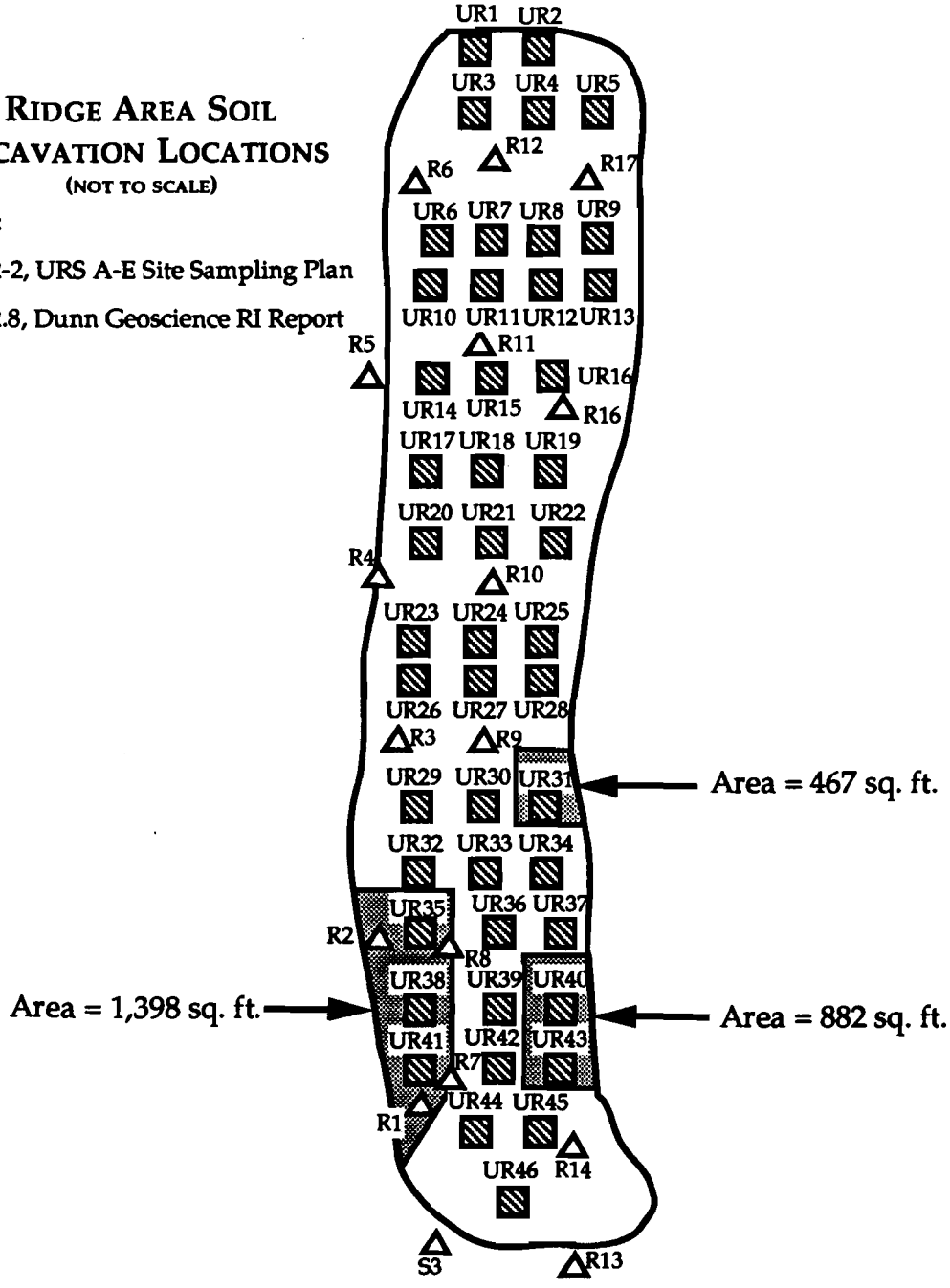
Ridge Area Soil Excavation Locations

(NOT TO SCALE)

Sources:

Figure 2-2, URS A-E Site Sampling Plan

Figure 2.8, Dunn Geoscience RI Report



LEGEND

- Dunn Geoscience Sample Location
- URS Soil Boring
- Extent of Areal Excavation of "Hot Spots"

Note: Vertical excavation extent ≈ 5 feet

"Hot Spots" are areas where surficial soils contain concentrations of hazardous constituents greater than Ridge Area soil clean-up standards as identified in Table 2.

Performance Standards for the soil cover:

A minimum of six inches of fill material and six inches of topsoil will be placed as the soil cap. After capping, the surface will be seeded to facilitate establishment of vegetation, minimize erosion, and provide some increase in available habitat for wildlife. The types of grass seed and/or wildflower mix shall be identified in the remedial design. Plans for long-term maintenance of the vegetated soil cover shall be included in a post-construction maintenance plan.

7.3 Inert Area

A. Removal of existing surficial debris

A large number of abandoned automobiles, trucks, and other vehicles currently exist on the surface of the Inert Area. In addition, significant quantities of salvage yard material are intermingled throughout the area. These materials must be removed from the Inert Area prior to construction so that the material does not hinder construction or support operations in either the Inert Area or Drum Disposal Area.

B. Construction of a multi-layer landfill cap

The remedial design of this element of the selected remedy has already been completed under an AOC signed in June 1992. The following cap system configuration (from top to bottom) has been designed for the portions of the cap with slopes less than 8H:1V:

- 6 inches of topsoil,
- 18 inches of select fill,
- non-woven geotextile,
- geonet
- 40 mil geomembrane, and
- geosynthetic clay liner.

The following cap system configuration (from top to bottom) has been designed for the portions of the cap with slopes greater than 8H:1V but not exceeding 4H:1V:

- 6 inches of topsoil,
- 18 inches of select fill,
- non-woven geotextile,
- geonet,
- non-woven geotextile,
- textured geomembrane, and
- geosynthetic clay liner.

Performance Standards which were used to design the multi-layer composite barrier cap are described below:

The multi-layer cap shall be designed to meet the criteria of 40 C.F.R. 264.303(a) and 40 C.F.R. 264.310(a); DRGHW 264.303(a) and DRGHW 264.310(a). General design guidelines are listed below:

- The cap shall be a multi-layer soil synthetic membrane system which minimizes the long term migration of liquids into the capped area. The cap materials may be naturally occurring soils and synthetic materials which will not leach hazardous constituents. The maximum components of the cap shall be: a vegetated topsoil layer; a select fill layer; a geotextile layer; a geonet layer (permeability equal to 12" of sand at 1×10^{-2} cm/sec); a synthetic liner system and a low permeability (1×10^{-7}) layer;

- The materials and construction of the multi-layer cap will accommodate settling and subsidence so that the cap's integrity is maintained;

- Prior to the installation of the impermeable system, the area to be capped shall be proof rolled. Identified soft areas shall be brought up to suitable compaction, to be specified in the remedial design.

- The top of the impermeable system shall be graded and vegetated to prevent ponding of liquids and shall be sloped to promote drainage. The drainage system will be designed to: (1) convey rainfall down the installed slope at a rate slow enough to prevent erosion and subsequent loss of cap materials, and (2) properly manage storm water run-off; and

- Gas venting system.

The remedial design was approved by EPA, in consultation with DNREC, in July 1993.

A post-construction maintenance plan shall be developed to maintain the integrity and effectiveness of the final cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events.

C. Perimeter fencing

A chain-link fence shall be constructed around the perimeter of the landfill cap in order to prevent unauthorized access to the Inert Area. Plans for long-term maintenance of the fence shall be included a post-construction maintenance plan.

Performance Standards for Perimeter Fencing

The chain-link fence shall have a minimum height of six feet and shall be equipped with locking gates.

The fence shall be maintained in a manner sufficient to prevent unauthorized access to the landfill until such time as EPA, in consultation with DNREC, determines that access restrictions are no longer required.

D. Deed Restriction

Restrictions shall be placed on the deed to the Site to ensure that the containment components are not compromised by future use of the property.

7.4 Environmental Monitoring

Long-term environmental monitoring to evaluate the effectiveness of the remedy shall be performed. The environmental monitoring will include periodic ground water and air analyses. In addition, a wetlands monitoring plan to determine whether or not the adjacent wetlands are being impacted by Site contaminants shall be developed and implemented. Final determination of the specific number and location of monitoring points, the frequency and duration of sampling, and the analytical parameters and methods to be included in the monitoring program will be made by EPA, in consultation with DNREC, during the remedial design and, as appropriate, during implementation of the selected remedy.

It should be noted that some changes to the selected alternative may be made during the remedial design and construction processes. Such changes, in general, reflect modifications resulting from the engineering design process and will not reduce the effectiveness of the selected remedy. Any changes to the amended remedy will be done in accordance with Sections 300.435(c)(2) and 300.825 of the NCP.

8.0 STATUTORY DETERMINATIONS

EPA's primary responsibility at Superfund sites is to undertake remedial actions that are protective of human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C. § 9621, establishes several other statutory requirements and preferences. These requirements specify that when complete, the

selected remedial action for each site must comply with applicable or relevant and appropriate environmental standards established under federal and state environmental laws (ARARs) unless a statutory waiver is invoked. The selected remedy also must be cost effective and utilize treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that permanently and significantly reduce the volume, toxicity or mobility of hazardous substances. The following sections discuss how the selected remedy for this portion of the Site meets these statutory requirements.

8.1 Protection of Human Health and the Environment

The selected remedy protects human health and the environment by removing, destroying or controlling contaminants in buried drums and contaminated soils, thereby reducing contaminant loading to the ground water. Controlling the source of contamination will reduce the potential for exposure to contaminated ground water and soils. The ground water plume management strategy selected in the original ROD continues to effectively prevent the migration of water-borne contaminants to drinking water wells.

Employing the soil vapor extraction and bioremediation technologies to remove and biodegrade contaminants in soils in conjunction with the specified engineering controls will significantly reduce further migration of contamination from the Site. Consequently, these measures will reduce the potential for exposure to contaminated ground water. In addition, the landfill caps at the Drum Disposal and Inert Areas will prevent the threat of direct contact. Environmental monitoring will provide data for evaluating the effectiveness of the remedial action.

Once the Drum Disposal and Ridge Area soil cleanup standards have been achieved and the landfill caps are in place, the carcinogenic risk associated with exposure to ground water shall be within EPA's target risk range of 1×10^{-4} to 1×10^{-6} and there will be no significant potential for adverse noncarcinogenic health effects as a result of exposure to ground water (i.e, the hazard index shall be less than or equal to one).

Deed restrictions will prohibit onsite activities that could compromise the effectiveness of the remedy or result in unacceptable levels of exposure to Site contaminants.

Air emissions from the bioventing system will be reduced to acceptable risk-based levels and ARARs through the installation of emission controls, if they are determined to be necessary by EPA, in consultation with DNREC. Through treatment, engineering controls, monitoring and institutional controls this remedy will be protective of human health and the environment during and upon completion of the remedial action.

8.2 Compliance with Applicable or Relevant and Appropriate Requirements

The selected remedy shall attain all action-, location- and chemical-specific applicable or relevant and appropriate requirements for the Site. The major ARARs are listed in Table 3. Also included in the table are criteria, advisories or guidance "to be considered" (TBCs) for implementation of this remedy.

8.3 Cost-Effectiveness

The amended remedy, Alternative 2 (SVE/Bioremediation), is cost-effective in that it mitigates the risks posed, achieves the remedial objectives, meets all other requirements of CERCLA, and affords overall effectiveness proportionate to the cost. The estimated present worth cost for the amended remedy is $33,540,100. The amended selected remedial alternative is less costly than Alternative 1 (Onsite Incineration), the present worth of which is $74,291,900, yet it provides the same degree of risk reduction.

8.4 Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

EPA and DNREC have determined that the amended remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for the Delaware Sand & Gravel Site. The amended remedy represents the best balance of the nine criteria and the statutory preference for treatment as a principal element.

The bioventing technology, a combination of soil vapor extraction and bioremediation, is a relatively new and promising remediation technique. Although the amended remedy does not offer the degree of permanence that onsite incineration would offer, the treatment and engineering controls do offer a very high degree of long-term effectiveness and permanence. The cap and slurry wall will be inspected and maintained to ensure long-term effectiveness and a deed restriction will be implemented to ensure permanence. The amended remedy (Alternative 2) meets the statutory requirement to utilize permanent solutions and treatment technologies to the maximum extent possible.

8.5 Preference for Treatment as a Principal Element

The selected remedy uses treatment as a principal element to address the threats posed by buried wastes and contaminated soils. Residually contaminated soils will pose a relatively low

long-term threat and shall be managed with a combination of engineering and institutional controls. The amended remedy is consistent with the program expectations to treat principal threats and use engineering controls for wastes that can be reliably controlled in place. EPA and DNREC have therefore determined that buried drum removal and offsite treatment and/or disposal and *in situ* treatment of contaminated soils coupled with containment (i.e., slurry wall and landfill caps) is an appropriate remedial action.

9.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The following changes have been made since the Proposed Plan was issued on July 29, 1993:

Restrictions shall be placed on the deed to the Site in order to prevent any future uses of the property that could compromise the effectiveness of the selected remedy. The deed restrictions shall remain in effect until EPA, in consultation with DNREC, determines that they are no longer required to protect human health and welfare and the environment.

Cost estimates for both alternatives have been revised to include construction and maintenance of the multi-layer cap for the Inert Area. The multi-layer cap is a common element to each of the alternatives evaluated, therefore each cost estimate was increased by the same amount.