A Study of the Relevant Incineration Technologies and Air Pollution Control Devices for the Delaware Sand and Gravel Landfill

Submitted by: Andrew Clibanoff

NNEMS Project Control Number: U-913442-01-0
September 14, 1990

A Study of the Relevant Incineration Technologies and Air Pollution Control Devices for the **Delaware Sand and Gravel Landfill**

Submitted by: Andrew Clibanoff
NNEMS Project Control Number: U-913442-01-0

Abstract

The Delaware Sand and Gravel Landfill, located in New Castle County, DE, is an NPL site in its remediation design phase. A Record of Decision has mandated use of on-site incineration to dispose of approximately 25,000 cu. yd. of contaminated soils and wastes. This paper discusses the incineration technologies that may be applicable to the project and recommends the selection of a rotary kiln incinerator, based on the kiln's relative versatility when compared to the other incineration technologies. A study of air pollution control equipment was also included in the paper. No special permits for PCB incineration are required for this project, as PCB concentrations are below 50 ppm, the TSCA regulated standard. Emission of dioxin and related organic compounds can be prevented or minimized by maintaining a temperature above 1700°F in the afterburner. There is a definite need for more sampling of the wastes and soils that are going to be incinerated. The majority of sampling to date has been on soils surrounding the suspected highly contaminated areas. Further waste characterization must be completed before the final design of the incinerator and air pollution control equipment can be accomplished.

DISCLAIMER

This report was furnished to the U.S. Environmental Protection Agency by the graduate student identified on the cover page, under a National Network for Environmental Management Studies fellowship.

The contents are essentially as received from the author. The opinions, findings, and conclusions expressed are those of the author and not necessarily those of the U.S. Environmental Protection Agency. Mention, if any, of company, process, or product names is not to be considered as an endorsement by the U.S. Environmental Protection Agency.

Table of Contents

Table of Contents (cont'd)

List of Figures

List of Tables

1.0 Introduction

This paper is submitted in fulfillment of the requirements of the National Network for Environmental Management Studies (NNEMS) program The scope of this NNEMS project includes the assessment of the feasibility of incineration technology as a viable alternative in the remediation effort occurring at the Delaware Sand and Gravel Landfill, New Castle County, Delaware. The status of this site is that it is currently on the National Priorities List (NPL) and is awaiting final remediation design. A remedial investigation report and feasibility study were completed in early 1988. A record of decision (ROD) has been written calling for the on-site incineration of the contaminated materials (waste and soil) that have been linked to groundwater degradation.

The paper will first present a site history and background, followed by a section on the relevant incineration and emission control technologies

2.0 Background and Site History

The Delaware Sand and Gravel Landfill was an industrial waste landfill officially operating from 1968 through 1976. The landfill is approximately 27 acres in size and is located about two miles southwest of New Castle County, Delaware. Directly west of the site across Army Creek lies the Army Creek Landfill, another Superfund site. It is believed that the environmental degradation occurring in the vicinity can be differentiated between the two adjacent landfills. Figure 1 is a site location map for the Delaware Sand and Gravel Landfill. The site, as suggested by its name, was once operated as a sand and gravel quarry.

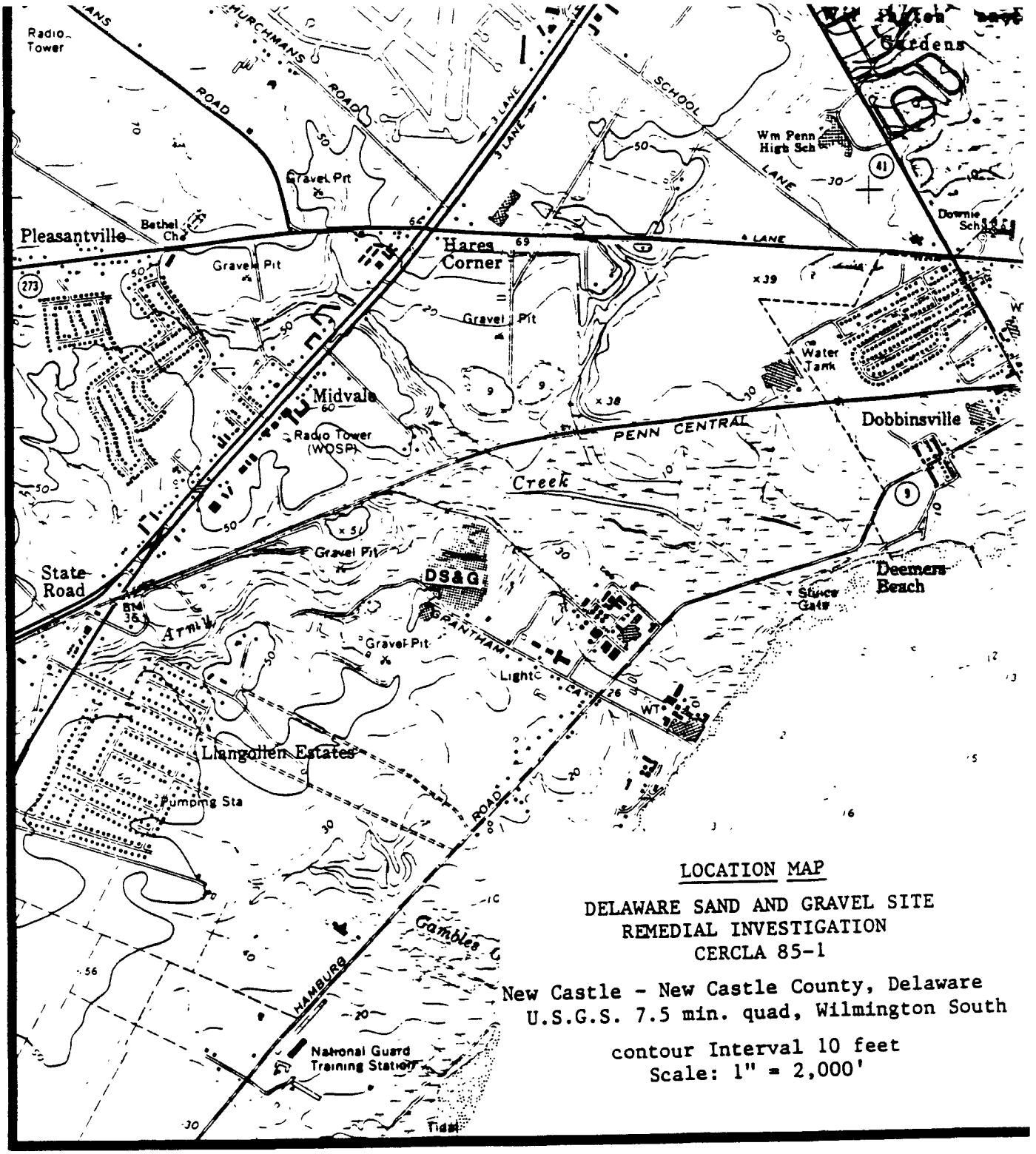


Figure 1

Location map for the Delaware Sand and Gravel Landfill
(DS&G)

SOURCE - FEASIBILITY STUDY (DUNN GEOSCIENCE CORP.)

In 1968, the Delaware Water and Air Resources Commission granted Delaware Sand and Gravel a Certificate of Approval for a sanitary landfill One year later, an Air Pollution Control Permit allowed the disposal of cardboard, wire, pallets, corkdust, and styrofoam. In 1970, the Delaware State Board of Health issued a solid waste disposal permit to the facility. A Solid Waste Disposal Permit was issued from 1971 through 1976 by the Delaware Department of Natural Resources and Environmental Control (DNREC) In 1975, DNREC applied an enforcement action against the DS&G Landfill upon observation of improper operating procedures including poor cover and compaction

2.1. Disposal Areas

Disposal of wastes at Delaware Sand and Gravel Landfill took place at four smaller areas on the site. These areas are termed the Drum Disposal Area, Ridge Area, Inert Area, and Grantham South Area. These areas, as well as the locations of boreholes, monitoring wells, and drinking water wells are depicted in figure 2. A further discussion of the individual waste disposal areas is below.

2.1.1. Drum Disposal Area

This area, located in the northern portion of the property, as shown in figure 2, accepted reportedly 7,000 drums containing industrial liquids and sludges from perfume, paint, plastics and petroleum refining processes. The Drum Disposal Area was reported to be a pit approximately 150 ft. x 70 ft. x 15 ft. or 0.23 acres in surface area. However, the areal extent of the Drum Disposal Area proper was delineated by surface geophysical data and measured to actually be 0.42 acres. This estimate does not include an

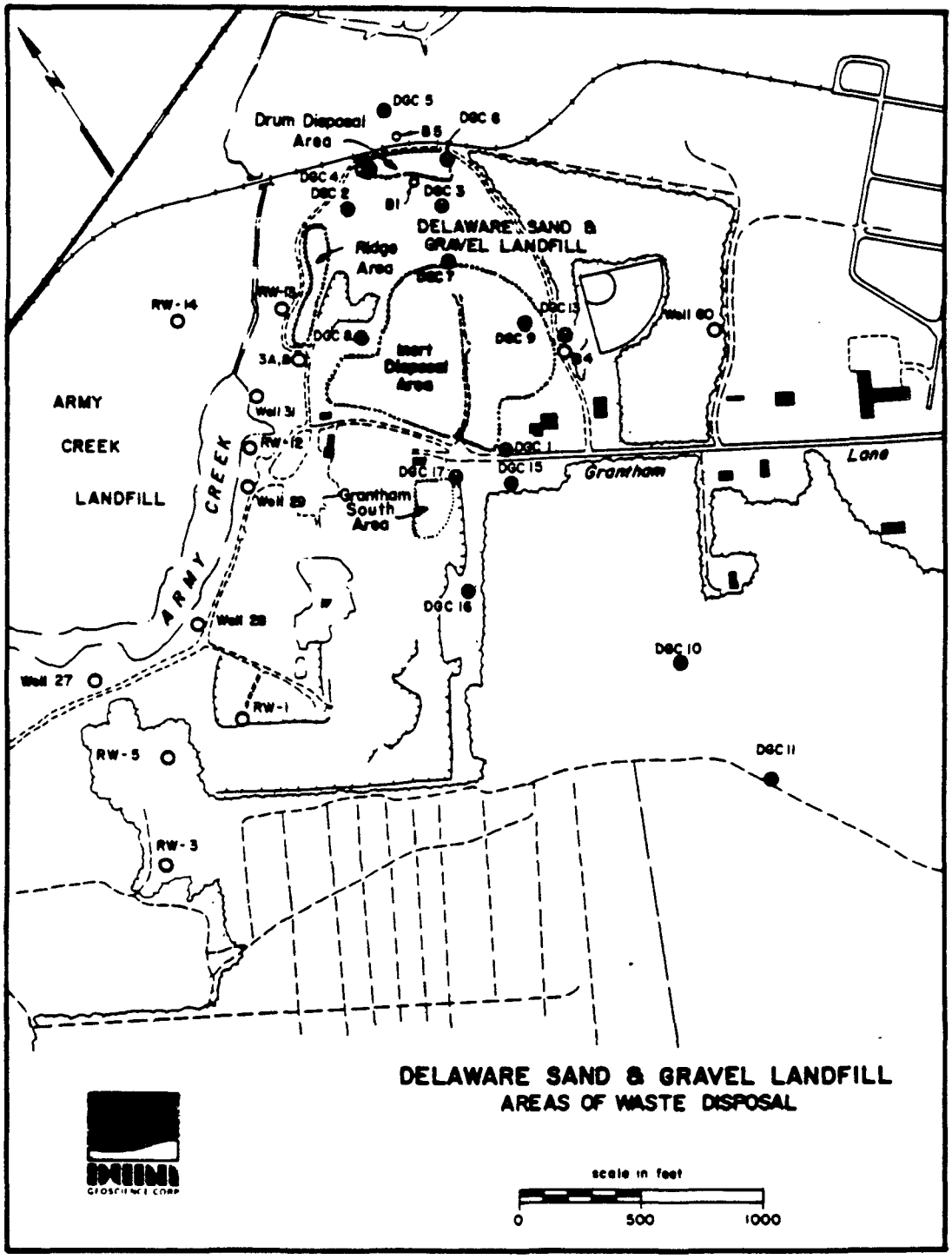


Figure 2: Areas of Waste disposal in the DS&G Landfill.

* SOURCE : FEASIBILITY STUDY (DUNN GEOSCIENCE CORP.)

adjacent 0 25 acre area just west of the Drum Disposal Area proper where an additional geophysical anomaly was detected

Soil quality analyses of samples from boring DGC-06 (just east of Drum Disposal Area proper) indicates contamination of organics in the low parts per million range over an approximate depth interval of 5 to 30 ft. (see appendix B). If there truly is a 25 ft. depth of contaminated materials, tne volume of materials requiring treatment may range from 20,000 cu yd to over 27,000 cu. yd depending on whether the adjacent area is actually contaminated However, boring DGC-04, west of the adjacent area shows little to no sign of contamination. Boring DGC-05, north of the area adjacent to the Drum Disposal Area proper also appears to be clean. It is quite clear that more sampling is needed to determine more accurately the extent of contamination in the soils of the Drum Disposal Area.

2.1.2. Ridge Area

This area, approximately 0.5 acres in size, is located on the western portion of the property, just east of recovery well RW-13 (figure 2). The Ridge Area contains scattered wastes (drums, large storage tanks, pallets, etc.) on the slope surfaces and ridge top. This area has been labeled as a limited drum and industrial waste disposal area.

2 1.3 Inert Area

This area, close to eleven acres in size, is located in the central southern portion of the DS&G property. Wastes disposed of in this area are assumed to be, as the name implies, relatively inert. The area is relatively level with steep side slopes and high vegetative growth. The surface is heavily littered with items such as junked cars, trucks, trailers, concrete forms, gas cylinders, domestic trash, paper rolls and wire bundles. Waste can

also be seen protruding from the sides of the slopes indicating that waste had been buried

2.1 4. Grantham South Area

This area, approximately 1.3 acres in size is located immediately south of Grantham Lane, directly across the street from the Inert Disposal Area (figure 2). It was reported that when the sand cliff remaining from quarrying behind the landfill owner's home began to erode, the owner backfilled the area presumably with inert waste. Reports from the owner's ex-wife as well as visual observations indicate that chemical wastes were disposed in this area as well.

2 2 Nature and Extent of Contamination

As mentioned earlier, the Delaware Sand and Gravel Landfill was operated as a permitted facility from 1968 to 1976. It is believed that dumping may have begun as early as 1961 and the dumping of household and construction wastes has continued to the present. The wastes disposed of at the site were mostly construction and industrial type wastes.

In 1984, a removal action was performed at the Drum Disposal Area. Several hundred drums were sampled and removed from the landfill's surface eliminating any immediate threat to human health and the environment. 576 drums were sampled with the results shown in table 1. It is believed that the remaining 7,000 - 100,000 drums in the Drum Disposal Area contain similar wastes. It is believed that the contamination at the Ridge Area is similar to that found at the Drum Disposal Area. The Grantham South and the Inert Disposal Areas are both believed to contain mainly inert wastes, such as wood, wire, hose, cardboard, styrofoam, etc.

Type	# of Drums	Estimated Volume
Organic Solids	206	7,700 gallons
Inorganic Solids	201	6,900
Base/Neutral Liquids	37*	690
Flammable Solids	97	3,700
Base/Neutral Liquids pH 12	2	69
Acids	2	27
Organic Liquids	19	400
Contaminated PCB Solids	6	200
Contaminated PCB Liquids	2	27
PCB Solids	2	55
PCB Liquid	2	40

* includes 2 drums of flammable base/neutral liquids

Table 1 : 1984 Drum Removal Sampling Results

Source: RI Report

There has been evidence that the waste products disposed at the Delaware Sand and Gravel Landfill, particularly from the Drum Disposal and Ridge Areas, are leaching and causing environmental degradation of the surrounding area The groundwater in the Upper Potomac Hydrologic Zone and on-site soils appear to be suffering the most. The predominant contaminants are iron, manganese, benzene, toluene, xylene, MEK, and MIBK with maximum concentrations of the organics in the low parts per million range. An overview of the air, water and soil environmental quality at the site is given below.

2.2.1 Air

The ambient air quality at the DS&G Landfill shows no evidence of air contamination with respect to volatile organics above background levels. A soil gas survey performed at the Grantham South Area did not detect any significant areas of volatile organic contamination. Only one sample had significant concentrations (2-9 ppm) of volatile organics. This probably indicates a small, isolated gasoline spill since the compounds detected strongly resembled oil or gasoline components. Therefore, the air currently poses no threat to the surrounding community. However, once remediation begins to take place, efforts must be undertaken to minimize the hazards of the potential air pollution problems associated with excavation and incineration.

2.2.2 Water

2.2.2.1 Surface Water and Stream Sediments

No significant degradation attributed to the Delaware Sand and Gravel Landfill could be found in the water and sediments from Army Creek, the Gravel Pit pond, or the intermittent stream east of DS&G. In fact, the quality

of water in Army Creek downstream of DS&G is actually better than it is upstream However, even downstream, Army Creek is still polluted as there is evidence of stress on aquatic life

2 2.2.2 Groundwater

As briefly mentioned earlier, groundwater quality within the Upper Potomac Hydrologic Zone (UPHZ) has been degraded with respect to inorganic and organic parameters in the DS&G vicinity A distinct plume of organics and metals appears to be emanating from the Drum Disposal Area The predominant contaminants identified in this plume are benzene, toluene, xylenes, ethyl benzene, bis (2-chloroethyl) ether, MIBK, MEK, iron and manganese All analytical data on water can be found in appendix A.

Groundwater quality degradation was first noticed in late 1971 when a domestic well in the nearby Llangollen Estates became contaminated. Evidence Indicated that the source of the contamination was coming from the Army Creek Landfill. In response, New Castle County installed a system of recovery wells in 1973 and 1974 to protect the Artesian Water Company's drinking water wells for Llangollen Estates by intercepting contaminated groundwater. As it turns out, these recovery wells are now intercepting the wastes emanating from the DS&G Landfill. Figures 3,4, and 5 show the reduction of size of the chloride ion contaminant plumes over time. Chloride was chosen because it is generally regarded as a conservative ion which does not readily degrade, adsorb onto aquifer materials, or precipitate under normal groundwater conditions. It can be said with reasonable confidence that the recovery well system is containing the contamination in the site vicinity .

M7243A19

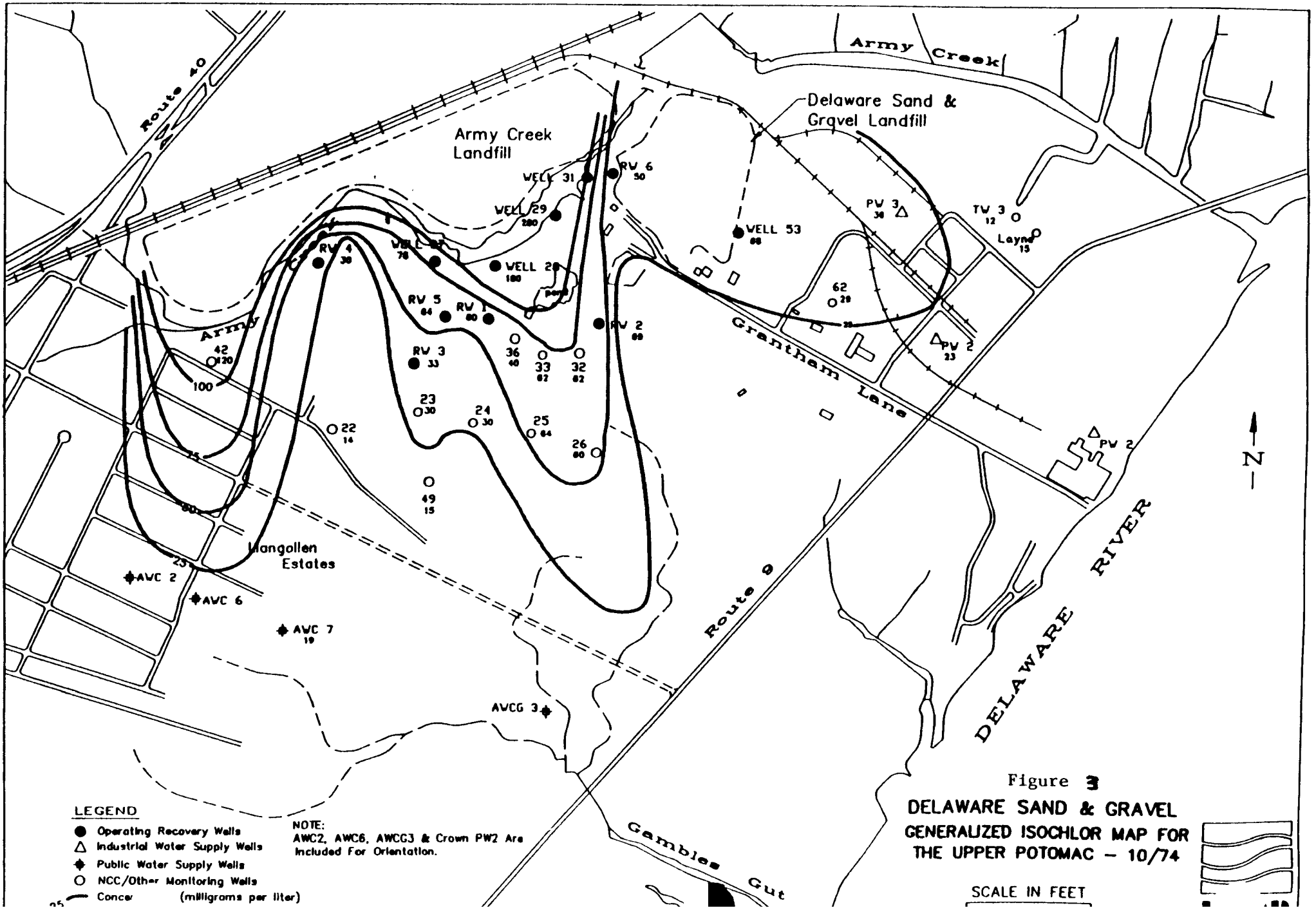


Figure 3

DELAWARE SAND & GRAVEL
GENERALIZED ISOCHLOR MAP FOR
THE UPPER POTOMAC – 10/74

SCALE IN FEET

M7243A18

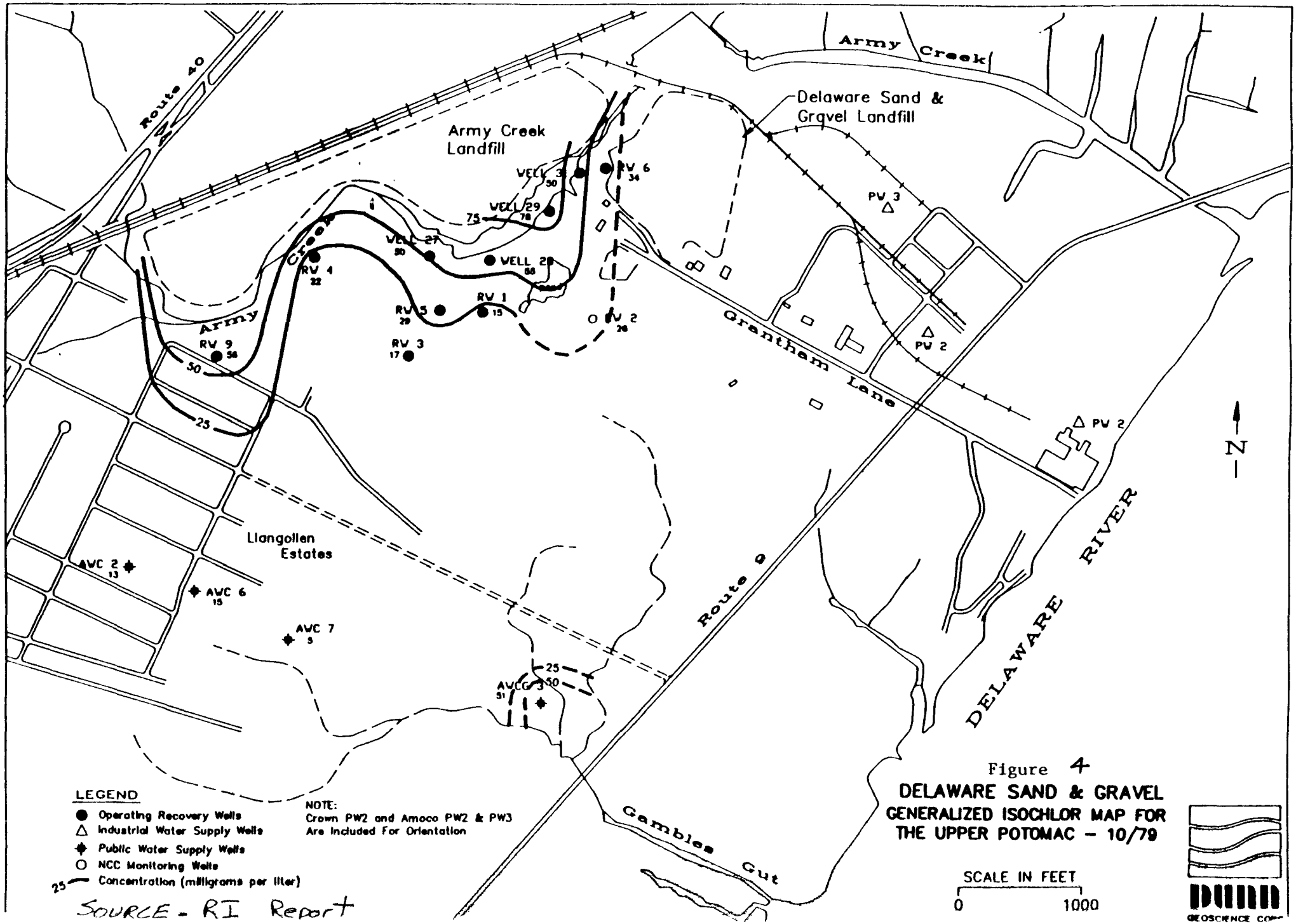


Figure 4

DELAWARE SAND & GRAVEL
GENERALIZED ISOCHLOR MAP FOR THE UPPER POTOMAC – 10/79

M7243A16

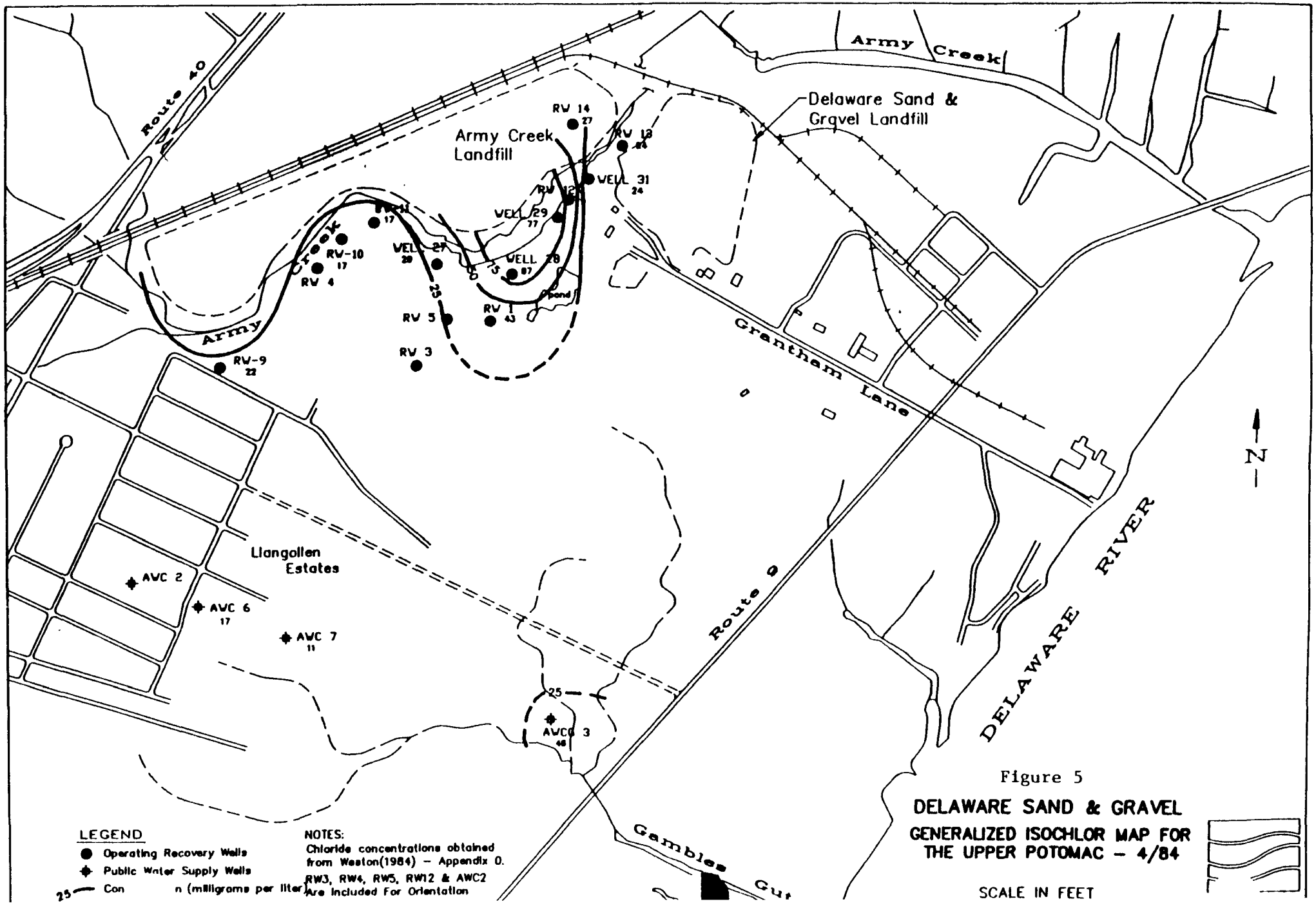


Figure 5

DELAWARE SAND & GRAVEL

GENERALIZED ISOCHLOR MAP FOR THE UPPER POTOMAC – 4/84

SCALE IN FEET

2.2.3 Soil

2.2.3.1 Surficial Soils

The analytical results (appendix B) for the surficial soils indicate isolated areas of contamination in both the Ridge and Grantham South Areas One consideration that must be recognized is the fact that most of the surficial soils on site have been reworked by man. Much of the soils remaining on-site are the fines left over from the quarrying operation. These fines were used as cover material for the Inert and the Drum Disposal Areas. Therefore, any samples collected in these areas probably do not represent waste disposal.

2.2.3.2 Formation Soils

Analytical data (appendix B) from split spooned samples have indicated a plume of organics and metals emanating from the Drum Disposal Area and possibly some metal contamination emanating from the Inert Disposal Area. Organic compounds were detected in soil boring samples collected near the Drum Disposal Area, the base of the Columbia Formation close to the Drum Disposal Area, the uppermost Potomac silty clays beneath and adjacent to the Drum Disposal Area, and the top portion of the upper Upper Potomac sands.

2.3 Components of the Record of Decision

In early 1989, a Record of Decision (ROD) was drafted calling for the following measures to be taken in the remediation effort:

- Excavation of wastes and contaminated soils from the Drum Disposal and Ridge Areas. Treatment of these materials by on-site incineration to alleviate the direct contact threat and leachate generation from the major contamination sources on the site.
- Capping of the Grantham South Area to remove the direct contact threat and lessen leachate generation.

- Debris removal and capping of the Inert Disposal Area to remove the potential direct contact threat and to meet the Delaware State Solid Waste Regulations.
- Continued operation of the in-place recovery well system to eliminate potential groundwater ingestion risk.
- Implementation of recovered contaminated groundwater treatment system prior to discharge to Army Creek

3.0 Incineration Technology

Several recent laws or amendments make incineration one of the more favorable applications for hazardous waste remediation The Superfund Amendments and Reauthorization Act (SARA) of 1986 placed new emphasis on the treatment of Superfund site wastes. $8 5 billion has been authorized by SARA for Superfund cleanup from October, 1986 through October, 1991 (Cudahy, 1989). The RCRA Hazardous and Solid Waste Amendments of 1984 (HSWA) placed a land ban on untreated hazardous wastes beyond certain dates. The statute requires EPA to set levels or methods of treatment, if any, which "substantially diminish the toxicity of the waste or substantially reduce the likelihood of migration of hazardous constituents from the waste so that short-term and long-term threats to human health and the environment are minimized." (Esposito, 1988). Figure 6 is a summary of the suitability of the various technologies available for in situ waste destruction. Incineration technologies effectively address both of theses RCRA concerns.

Incineration technology offers several attractive features for the treatment of hazardous wastes. It is immediate, requires a relatively small area for set-up and operation, and is a proven means of destruction for many organic wastes. When initially compared to other treatment methods, incineration appears to be costly. However, incineration will permanently destroy hazardous organics, removing the possibility of future liability for

Figure 6 In Situ Waste Treatment Technology Matrix.
(Adapted From Reference 1)

	Incineration	Pyrolysis	Wet Oxidation	Neutralization	Precipitation	Distillation Air Stripping / Soil Aeration	Activated Carbon	Evaporation / Dewatering	Phase Separation	Fixation	Extraction/Soil Washing	Membrane Sep / Ion Exchange	Evaporation	Filtration	Activated Sludge	In Situ Biodegradation
Aqueous Wastes:																
Metals	○	×	×	●	●	×	×	○	×	×	×	○	●	●	●	×	×
Highly Toxic Organics	○	○	●	○	○	●	×	●	×	●	×	○	●	●	●	○	○
Volatile Organics	○	○	●	○	○	●	●	●	×	●	×	○	○	×	×	○	○
Toxic Organics	○	○	●	○	○	●	●	●	×	●	×	○	●	●	×	●	●
Radioactive	○	×	×	×	○	×	×	×	×	×	×	×	×	○	●	×	×
Corrosive	○	×	×	●	●	○	×	×	×	×	×	×	×	×	×	×	×
Cyanide	○	○	●	○	○	×	×	×	×	×	×	×	×	×	×	○	×
Pesticide	○	○	●	●	●	●	×	●	×	●	×	○	●	●	●	○	×
Asbestos	×	×	×	○	○	×	×	×	×	×	×	×	○	●	●	×	×
Explosive	○	×	×	×	●	×	×	●	○	●	×	○	●	○	×	○	○
Organic Liquids:																	
Metals	○	○	×	●	●	●	×	×	×	●	○	×	×	●	●	×	×
Highly Toxic Organics	●	●	●	×	×	●	×	○	×	○	×	×	×	×	×	×	×
Volatile Organics	●	●	●	×	×	●	×	×	×	○	×	×	×	×	×	×	×
Toxic Organics	●	●	●	×	×	●	×	×	×	○	×	×	×	×	×	×	×
Radioactive	○	×	×	×	○	●	×	×	×	○	○	×	×	○	○	×	×
Corrosive	○	×	×	●	○	●	×	×	×	○	×	×	×	×	×	×	×
Cyanide	●	●	●	×	×	●	×	×	×	○	×	×	×	×	×	×	×
Pesticide	●	●	●	×	×	●	×	×	×	○	×	×	×	×	×	×	×
Sludges/Soils:																	
Metals	○	○	×	○	●	×	×	○	●	×	●	●	×	○	×	×	×
Highly Toxic Organics	●	●	●	×	×	●	×	●	●	●	●	○	×	●	●	×	○
Volatile Organics	●	●	●	×	×	●	●	○	●	○	○	○	×	×	×	×	○
Toxic Organics	●	●	●	×	○	○	×	●	●	●	●	○	×	○	○	×	●
Radioactive	○	×	×	×	×	×	×	×	●	●	●	×	×	×	×	×	×
Corrosive	○	×	×	●	×	×	×	×	●	×	●	×	×	×	×	×	×
Cyanide	○	○	●	×	○	○	×	×	●	×	○	×	×	×	×	×	○
Pesticide	●	●	○	×	●	○	×	●	●	○	●	●	×	●	○	×	○
Asbestos	×	×	×	×	×	×	×	×	●	×	●	×	×	×	×	×	×
Explosive	○	○	×	○	×	×	×	●	●	●	●	○	×	×	×	×	○

● Applicable ○ Potentially Applicable × Not Applicable

Source: Brunner, 1988

their disposal. Most of the other treatment methods do not completely destroy the wastes, making future liability a distinct possibility (Brunner, 1988)

On-site incineration of hazardous wastes can be more appealing than transporting material to a central processing facility. On-site incineration avoids the high transportation costs as well as the NIMBY (not in my back yard) philosophy that can surround a central facility On-site treatment is provided by situating modular-constructed facilities within the confines of the site.

3.1. General Incinerator Operation

Incineration is an engineered process using thermal oxidation of a waste material to produce a less bulky, toxic, or noxious material. A waste must be combustible to some extent in order for incineration to be considered as a possible treatment method. In running an efficient incineration process, the 3 T's of combustion, temperature, residence time and turbulence, must be controlled as closely as possible. The waste characteristics are likewise important parameters, including chemical structure and physical form. In the combustion process, the following reactions ideally take place.

- All hydrogen present converts to water vapor, unless otherwise noted below.
- All chloride (or fluoride) converts to hydrogen chloride, HCl (or hydrogen fluoride, HF).
- All carbon converts to carbon dioxide, CO_2.
- All sulfur converts to sulfur dioxide, SO_2.
- Alkali metals convert to hydroxides: sodium to sodium hydroxide ($2Na + O_2 + H_2 \rightarrow 2\ NaOH$) and potassium to potassium hydroxide ($2K + O_2 + H_2 \rightarrow KOH$).

- Non-alkali metals convert to oxides copper to copper oxide ($2Cu + O_2 \rightarrow 2CuO$), iron to iron oxide ($4Fe + 3O_2 \rightarrow 2Fe_2O_3$).
- All nitrogen from the waste, the fuel, or air, will take the form of a diatomic molecule, i e , nitrogen is present as N_2

However, incinerators are not 100% efficient, and therefore may emit products of incomplete combustion (PIC). These PICs may be as hazardous or even more hazardous than the product in the waste feed. Therefore, some type of air pollution control device is usually required prior to discharge to the atmosphere.

3.2. Types of Hazardous Waste Incinerators

Currently in the marketplace, there are many different thermal technologies that have been recognized as potential treatment alternatives for hazardous wastes. The basic operation of each of these technologies is the application of heat (thermal) energy to the medium (soil) and contaminant. The increase in temperature causes the breakdown of the organic material. In most cases, this breakdown occurs under the presence of excess oxygen, and results in the combustion and destruction of the organic compounds.

The various incineration technologies may be classified as either high temperature or low temperature processes. High temperature processes are those which can heat soil to greater than 1000 °F while low temperature processes can heat soil to a maximum of 1000 °F. Examples of low temperature processes would be in-situ radio frequency, low temperature thermal aeration, and low temperature thermal stripping. There will be no further discussion of the low temperature processes in this paper as these processes are incapable of treating the more difficult compounds such as PCBs and dioxins. PCB contamination has been found at the DS&G Landfill.

The high temperature processes virtually guarantee the destruction of all organic constituents.

The types of high temperature hazardous waste incinerators currently available or soon to be available are : (1) Rotary Kiln, (2) Infrared, (3) Conventional Fluidized Bed, (4) Circulating Fluidized Bed, (5) Advanced Electric Reactor, (6) Plasma Arc, (7) Liquid Injection, (8) Molten Salt, and (9) Oxygen Burner Of the nine listed technologies, the first four are the most applicable to the Delaware Sand and Gravel Landfill remediation effort and will be discussed in greater detail.

3.2.1. Rotary Kiln Incinerator

A rotary kiln is a cylindrical, refractory-lined shell mounted at an incline from the horizontal plane. Figure 7 depicts a typical rotary kiln incinerator A rotary kiln system includes provisions for feeding, supplemental fuel injection, the kiln itself, an afterburner and an ash collection system. This type of incinerator is capable of handling solids, liquids, and sludges and would be applicable to the DS&G site.

When operating, the cylinder (primary combustion chamber) is rotated to promote mixing of the wastes with the combustion air and to aid in moving the waste through the reactor. Waste is deposited at one end and the waste burns out to an ash by the time it reaches the other end. The constant rotation also provides fresh surface exposure to oxidation which promotes destruction. A typical range for rotation would be from 0.75 to 4 rpm.

The gas stream, upon exiting the primary combustion chamber, is directed to an afterburner. The kiln will burn out solids and will volatize organics. All the organics will generally not be incinerated in the kiln and a high temperature must be maintained at a specific residence time for

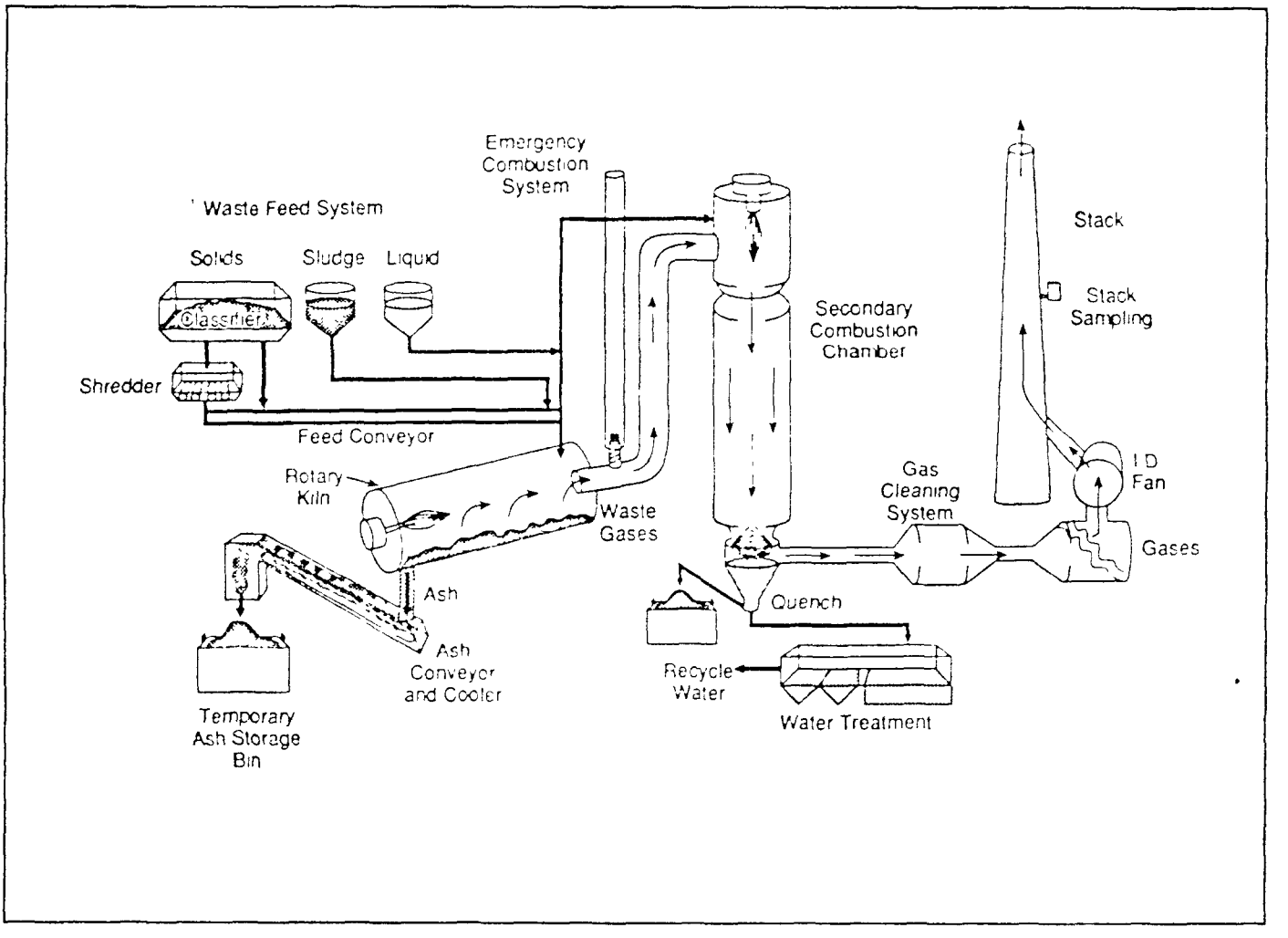


Figure 7: Rotary Kiln Incinerator.

Source: Johnson & Cosmos, 1989

destruction This is the purpose of the secondary combustion chamber, or an afterburner.

The rotary kiln incinerator typically operates at temperatures between 1500 °F and 2900°F, with residence times of 0.5 - 2.0 hours for solids and two seconds for gases. Successful operation of rotary kilns have been demonstrated to have a destruction and removal efficiency of 99.9999% for wastes such as explosives, PCBs and dioxins. The rotary kiln is the most commercially available type of incinerator on the market today.

Advantages

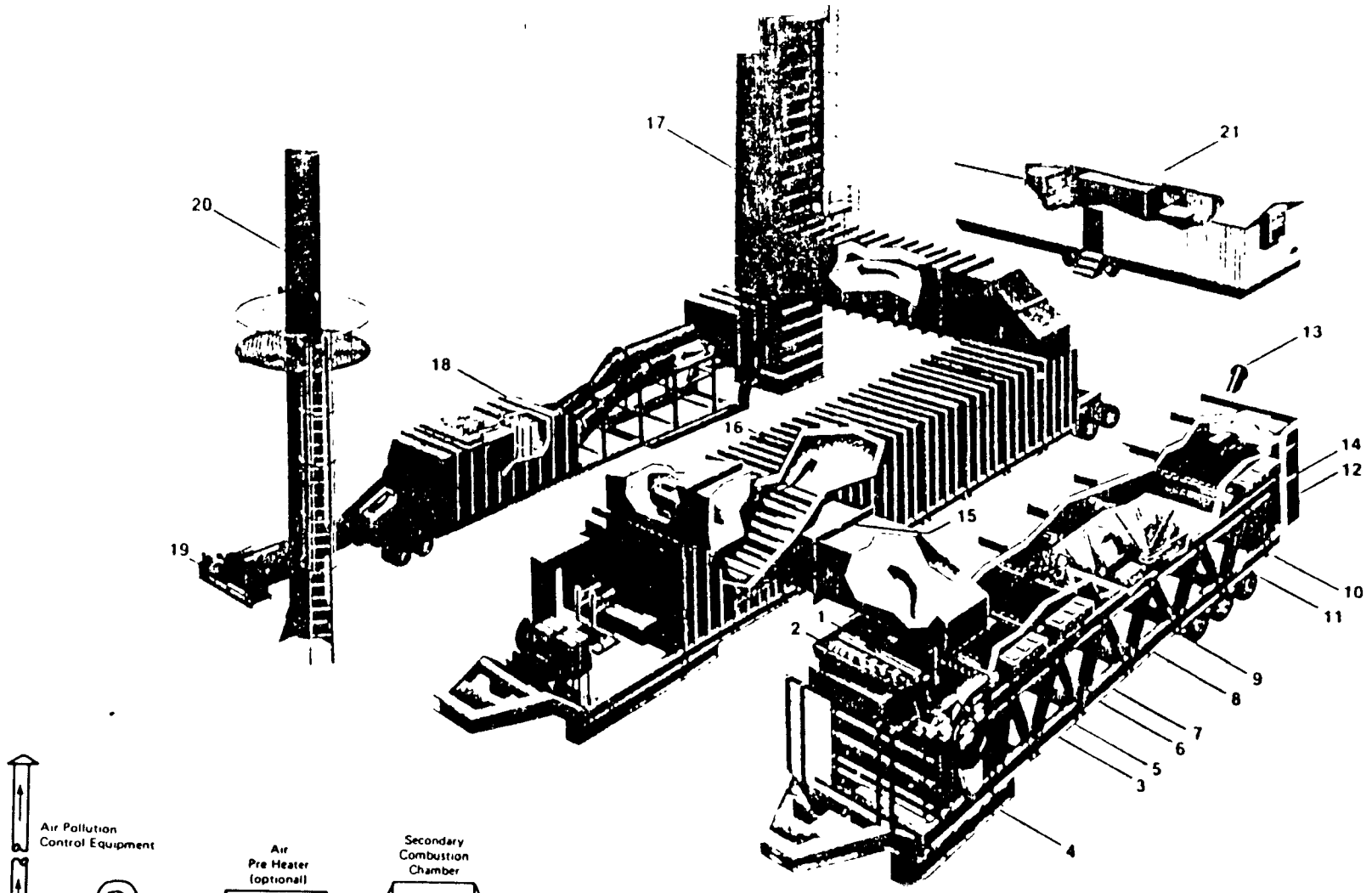
- Not dependent on feed quality
- Fuel requirement follows feed loading, the less feed, the less fuel required
- Minimal waste pre-processing required
- Techniques exist for direct disposal of waste in metal drums
- Able to incinerate variec nds of waste at the same time
- Many types of feed mechanisms available
- Residence time of waste in kiln readily controlled
- High turbulence and effective contact with air within kiln

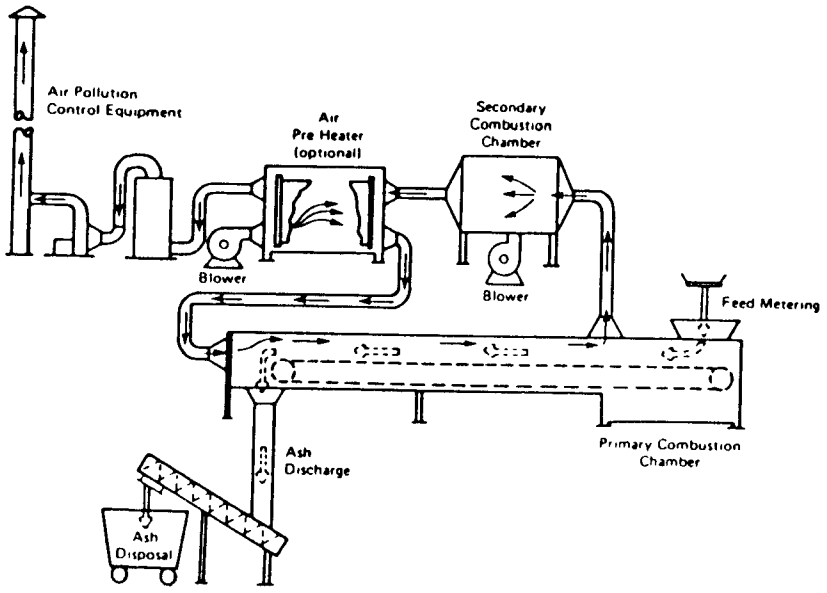
Disadvantages

- Relatively high particulate carryover to gas stream
- Normally requires a separate afterburner for destruction of volatiles
- Unable to control conditions along kiln length
- Requires a relatively high amount of excess air (100-150 % of stoichiometric amount)
- Effective kiln seal is difficult to maintain
- Operation in a slagging mode to process inorganic wastes or metal drums increases kiln maintenance requirements

3.2.2. Infrared Furnace

The infrared furnace was developed and marketed by Shirco Infrared Systems of Dallas, Texas. The furnace consists essentially of a conveyor belt system passing through a long refractory lined chamber as shown in figure 8 Wastes are fed by gravity onto the belt and are immediately leveled to a depth





delivers preconditioned waste material to the primary furnace through a rotary airlock into the Spreading Section **(2)** There the material is spread and leveled on the Metering Conveyor **(3)** before entering the Feed Module **(4)** The Furnace Conveyor **(5)** moves the waste material through Fiber Blanket **(6)** insulated Powered Modules **(7)** where it is brought to combustion temperature by Infrared Heating Elements **(8)** and gently turned by Rotary Rakes **(9)** If residual material falls through the belt, it is collected in Hoppers **(10)** where it is removed by the center mounted Collector Screw **(11)** for analysis Processed material (or ash) passes from the Discharge Module **(12)** into the Ash Discharge System **(13)** to an external receptacle

The Combustion Air System **(14)** delivers air from a blower through manifolds to side ports Exhaust gases are drafted through the furnace to the Exhaust Duct **(15)** and to the Secondary Process Chamber **(16)** to incinerate any remaining combustibles Gases exit the secondary chamber and go through the base of the Emergency Bypass Stack **(17)** into the Emissions Control System **(18)** where they are cooled and cleaned before being exhausted by an Induced Draft Blower **(19)** through the Exhaust Stack **(20)**

The System Control Center **(21)** houses the primary controls to start, run, monitor and shut down all electrical and instrumentation subsystems

Figure 8: Infrared Incinerators

Sources: Johnson & Cosmos, 1989
Brunner, 1988

of two to three inches. The waste must be sized to no more than two inches in effective diameter. The belt speed and travel is chosen to provide burnout of the waste with minimal agitation. This feature results in a relatively low level of particulate emissions.

An induced draft fan maintains a negative pressure throughout the system. Combustion air is introduced at the discharge end of the belt so that waste and air travel countercurrently. Supplemental heat is provided by electric infrared heating elements within the furnace above the belt. The furnace is designed to provide and maintain a temperature of 1600 °F above the traveling conveyor. An afterburner is provided for destruction of volatiles.

The infrared furnace is capable of handling sludge cake, soil and other wastes. This alternative may be applicable to the DS&G site.

Advantages

- Not dependent on feed quality
- Low level of agitation of the product on the conveyor belt results in a smaller fraction of ash carryover to the gas stream
- The use of ceramic fiber insulation allows furnace to heat to operating temperature in less than two hours
- Furnace is applicable for intermittent or infrequent loading
- Heat generated by electric elements does not produce additional flue gas, as the burning of fossil fuels would
- The fuel requirement follows the feed loading rate
- Electric power elements are variable within their range
- Only 20-30% in excess of stoichiometric air requirements needed
- Minimal waste processing required
- Control of conditions along furnace length is readily available by separate control of individual heating elements and by varying air injection quality and location

Disadvantages

- Electric power costs four times that of fossil fuel
- When tied to existing power sources, installed kilowatt charges may be substantial
- An afterburner is normally required for the destruction of volatiles
- The mixing of fuel oil with soil to decrease electrical costs will generate additional flue gases

3.2 3 Conventional Fluidized Bed

The conventional fluid bed incinerator, figure 9, is a cylindrical refractory lined shell with a supporting structure above its bottom surface to hold a sand bed (fluidized bed). The structure has a series of tuyeres which allow the passage of air upward into the bed while preventing the passage of sand. Air, which is usually preheated, is introduced at the fluidizing air inlet at pressures from 3.5 to 5 psig. A high degree of turbulence is created in the sand bed by the passage of this air stream which creates motion on the top of the bed with the appearance of a liquid.

Waste is normally introduced within or just above the sand bed. The sizing of the furnace is a function of the moisture in the feed, the greater the moisture content, the larger the bed surface. Fluidization provides maximum contact of air with the waste surface to maximize the efficiency of the burning process.

Maintenance of the bed integrity is a function of the waste being combusted. The waste non-combustible content (ash) will either remain in the bed or become airborne and exit the furnace within the flue gas stream. Generally, sand has to be made up at the rate of approximately 5% of the bed volume every 100 hours of operation.

Because of intimate mixing of air and sludge in the fluid bed, excess air requirements are low, from 40% to 60%. The bed is maintained in the range of

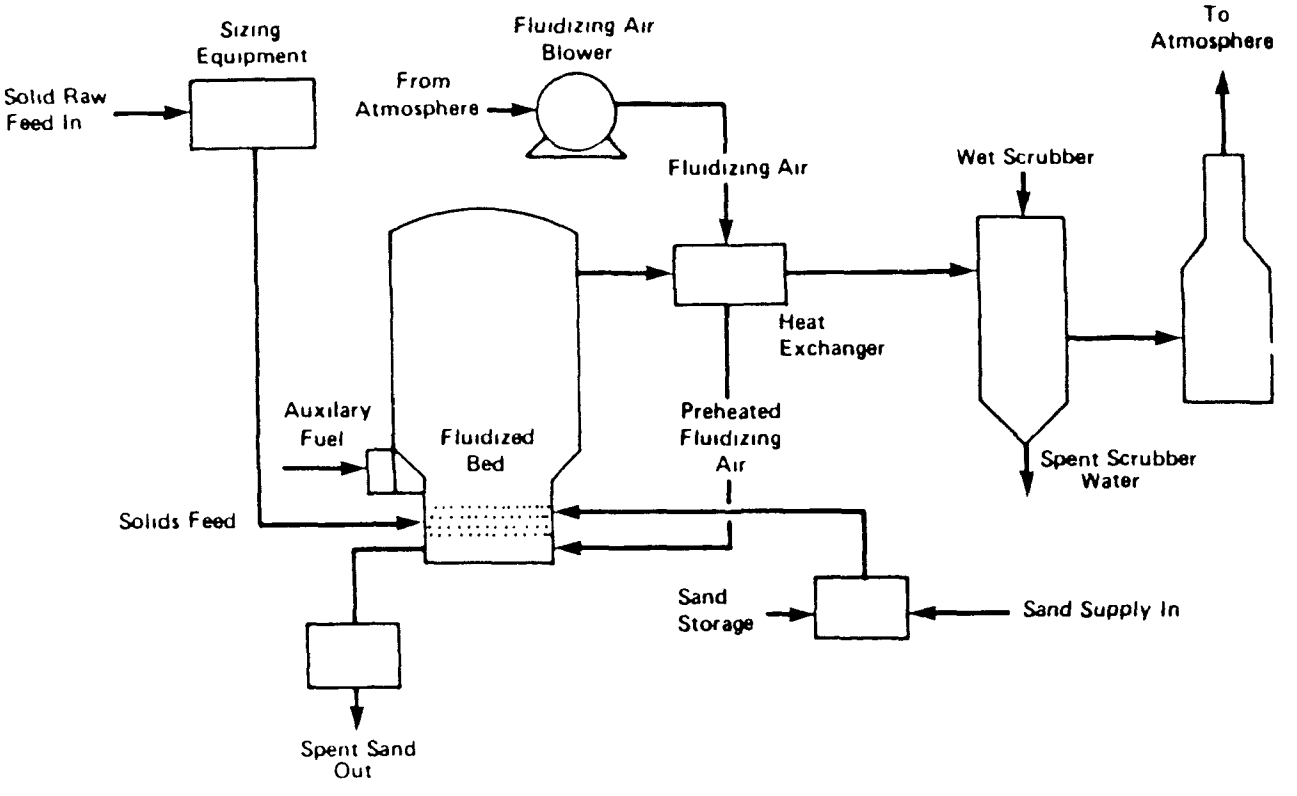


Figure 9 Conventional Fluid Bed Incinerator System.

Source: Brunner, 1988

1300 °F to 1500 °F, depending on the nature of the feed The temperature of the freeboard (volume above the bed) is usually no more than 100 °F higher than the bed temperature. The residence time of gases in the freeboard is normally in the range of 3 to 6 seconds, usually enough time to alleviate the need for an afterburner. For example, if an organic compound that requires 2200 °F at a residence time of 1 sec. for four nines destruction is subject to a residence time of 5 sec., perhaps only 1600 °F may be required for the same level of destruction

Advantages

- Design simplicity, few moving parts
- Excellent efficiency at rated load
- Thermally secure, able to be taken off line to hot standby without maintaining fuel feed
- High residence time in freeboard, afterburner usually not required
- appplicable to the incineration of solids, liquids, and gases

Disadvantages

- Dependent on feed quality; test burns necessary to ascertain possibility of bed seizure when burning the material
- Poor efficiency at low loads
- Increase potential for air emissions compared to other systems
- Sand make-up is required on a continual basis
- Waste sizing is required
- Ash is discharged wet, dry ash discharge requires additional equipment

3.2.4. Circulating Fluidized Bed

The circulating fluid bed incineration system, developed by Ogden, Inc., is distinct from conventional fluid beds. In this incinerator, shown in figure 10, combustible waste is introduce into the bed along with recirculated bed material from the hot cyclone. A high air/gas velocity (from 15 to 20 ft/sec compared to 1.5 to 4.5 ft/sec in conventional systems) runs through the bed, causing the bed to rise through the reaction zone to the top of the combustion

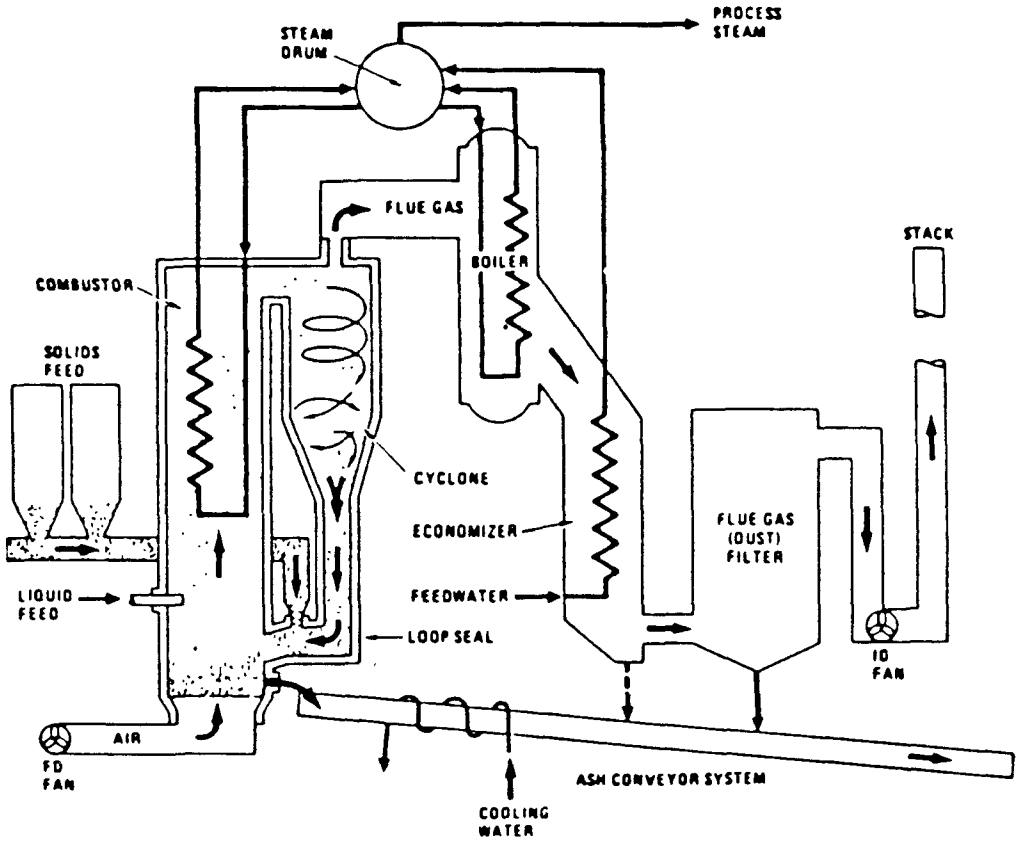


Figure 10 Circulating Fluid Bed Schematic.

Source: Brunner, 1988

chamber (freeboard) and pass through a hot cyclonic collector. Hot gas rise from the cyclone while the majority of solids drop to the bottom and are re-injected into the furnace bed. Flue gas exiting the cyclone passes through a conventional exhaust gas treatment system which removes particulate and other undesirable constituents from the gas stream.

Feed is introduced in the leg between the cyclone and the bed of the reactor. Solid or sludge waste is fed from a feeding bin using augers into the feed leg Liquid or slurry wastes are pumped from a feed tank to the reactor No atomizers or specialty nozzles are required for introduction of fluid wastes into the sand bed.

The design operating temperature is normally 1600 °F although the system can withstand temperatures up to 2000°F on a continuous basis. A major feature of the circulating fluid bed system is its ability to control the residence time of wastes to well over 15 seconds.

Advantages

- Same as conventional fluid bed plus:
- Can control residence time of wastes to over 15 seconds, thereby decreasing the temperature required for destruction
- Smaller particulate air emission potential than conventional fluid bed incinerator

Disadvantages

- Same as conventional fluid bed incinerator.

3.2.5 Advanced Electric Reactor

The Advanced Electric Reactor (AER) uses intense thermal radiation to heat wastes to between 4000 °F and 5000 °F. The AER consists of a vertical tubular core of porous carbon which is heated by electric heating elements. The waste is fed through the center of the core where the heated carbon transfers energy to the waste. This technology is not applicable because it is

not available in a full-scale model and the company that developed the pilot scale reactor, J. M. Huber Corp., has stated that their incineration services are no longer commercially available.

3.2.6 Plasma Arc

Plasma systems use the extremely high temperatures developed within the plasma stream to destroy hazardous organic wastes. The principle of plasma arc technology is the breaking of the chemical bonds between the elements of the organic constituents. This occurs in an atomization zone where a series of co-linear electrodes generate an electric arc, or plasma, which is stabilized by field coil magnets. As a low pressure air stream passes through the arc, the electrical energy is converted to thermal energy by the activation of the molecules of oxygen and nitrogen into their ionized atomic states. The temperature of the plasma are will exceed 5,000 °F. When the excited atoms and molecules relax to lower energy states intense ultraviolet energy is emitted. This energy from the decaying plasma is transferred to the injected waste stream.

3.2.7 Liquid Injector

Liquid injection incinerators are one of the most commonly used incinerators for hazardous waste disposal. A liquid injection system contains a refractory-lined cylinder as a combustion chamber and usually another chamber for further combustion. Burners are normally located in the chamber in such a manner that the flames do not impinge on the refractory walls The liquid waste, which must be converted to the gas phase prior to combustion, is initially atomized when it passes through the burner nozzles while entering the combustor. As the name implies, the liquid injection incinerator is confined to hazardous liquids, slurries and sludges with a

viscosity value of 10,000 SSU or less. Because the majority of wastes to be treated at the DS&G Landfill are in soils, the liquid injection incinerator is not applicable for this remediation effort.

3.2.8 Molten Salt Incinerator

The molten salt process is an oxidation and recombinant process where wastes are oxidized and/or chemically altered to innocuous substances A salt bed (made up of either sodium chloride, sodium sulfate, sodium phosphate, sodium carbonate, or corresponding calcium salts) is heated to fluidization. Typical bed temperatures range from 1400 °F to 1600 °F. Waste components dissolve within the melt, producing an off-gas containing carbon dioxide, steam, oxygen, and nitrogen from the air supply. The off-gas will also contain particulate matter, salt and other components generated within the melt and elutriated into the stream. The molten salt acts as a dispersing medium for both the waste being processed and the air used in the reaction. The salt acts as a catalyst for oxidation reactions and accelerates the destruction of organic materials while preventing the discharge of acidic gases by neutralization. Ash generated, as well as other noncombustibles are physically retained within the melt.

3.2.9 Oxygen Burners

Oxygen burners or oxygen-enriched incineration are a technology that is essentially an improvement over existing burner designs wherein air enriched with oxygen is used in place of ambient combustion air. As oxygen replaces part of the combustion air, the nitrogen content of the gas stream through the incinerator is reduced accordingly. The advantage to this is that NO_x emissions can be reduced substantially. Other advantages also include.

- Incinerator throughput, normally limited by residence time requirements, blower capacity, and capacities of the off-gas

treatment units, can be increased significantly.

- Consumption of supplemental fuel (if required) is reduced because of a decrease in the sensible heat lost to the flue
- Improved DRE occurs as a result of longer residence times (in retrofitted installations) and a richer mixture.
- Off-gas treatment can be accomplished in smaller units and can be more effective.

The only disadvantage to oxygen burners is the added cost of the oxygen. I was unable to find any economic information regarding the cost of the operation of an oxygen-enriched incineration process.

3.3 Incinerator Selection

Table 2 shows the typical operating ranges of various incineration processes Table 3 shows the applicability of various incineration processes to incineration of hazardous waste by type.

The best choice for the incineration of soils and wastes at the Delaware Sand and Gravel Landfill would be the rotary kiln incinerator. It is the most proven and commercially available incinerator on the market. The rotary kiln incinerator has become known as the workhorse of the industry. The rotary kiln can handle solids, sludges, and liquids all at the same time Kilns used for incineration are batch fed with solids of varying shape, size, and heat content. This provides flexibility not available in other incinerator systems Little to no pre-treatment of the wastes is necessary. The afterburner can reach temperatures up to 2900°F, more than high enough to completely destroy the most stubborn organic compounds. A number of transportable rotary kilns have been successfully operated throughout the United States.

The actual design of a rotary kiln system for the DS&G Landfill application takes quite a bit of time. The preparation of a detailed cost estimate of a complete incinerator facility takes about twelve engineer-weeks. Incinerator combustion chambers are sized on the basis of

TABLE 2. PERTINENT INCINERATION PROCESSES AND THEIR TYPICAL OPERATING RANGES

Process	Temperature range, °F (°C)	Residence time
Rotary kiln	1,500 to 2,900 (820 to 1,600)	Liquids and gases, seconds; solids, hours
Liquid injection	1,200 to 2,900 (650 to 1,600)	0.1 to 2 seconds
Fluidized bed	840 to 1,800 (450 to 980)	Liquids and gases, seconds; solids, longer
Multiple hearth	Drying zone 600 to 1,000 (320 to 540) Incineration 1,400 to 1,800 (760 to 980)	0.25 to 1.5 hours
Coincineration	300 to 2,900 (150 to 1,600)	Seconds to hours
Starved air combustion/pyrolysis	900 to 1,500 (480 to 820)	Tenth of a second to several hours

Source : Kinkhabwala, 1988

TABLE 3 APPLICABILITY OF AVAILABLE INCINERATION PROCESSES TO INCINERATION OF HAZARDOUS WASTE BY TYPE

Waste type	Rotary kiln[a]	Liquid injection	Fluidized bed[a]	Multiple hearth	Coincineration	Starved air combustion/ pyrolysis
Solids						
Granular homogeneous	X		X	X	X	X
Irregular bulky (pallets, etc.)	X				X	X[b]
Low melting point (tars, etc.)	X	X[c]	X		X	X
Organic compounds with fusible ash constituents	X			X	X	X
Unprepared large bulky material	X					
Gases						
Organic vapor laden	X[d]	X[d]	X[d]	X[d]	X[d]	X[d]
Liquids						
High organic strength aqueous wastes often toxic	X[e]	X	X		X	
Organic liquids	X[e]	X	X		X	
Solids liquids						
Waste contains halogenated aromatic compounds (2,200°F minimum)	X	X[f]			X	
Aqueous organic sludges	X[g]		X	X	X	

[a] Suitable for pyrolysis operation
[b] Handles large material on a limited basis
[c] If material can be melted and pumped
[d] If properly presented to the incinerator
[e] If equipped with auxiliary liquid injection nozzles
[f] If liquid
[g] Provided waste does not become sticky upon drying

Source: Kinkhabwala, 1988

estimates of the flue gas volume generated by the burning of hazardous waste and auxiliary fuel The costs of components downstream of the combustion chambers are a function of flue gas volumetric flowrate. Sampling and characterization of the actual wastes and soils to be incinerated is required (rather than the sampling of surrounding areas which is all that is currently available) before an effective design can be developed.

The cost for a rotary kiln incinerator may range from $150 to $350/ton (Liddicoatt, 1990). Assuming that there is 25,000 yd^3 (20,500 yd^3 from the Drum Disposal Area, 4,500 yd^3 from the Ridge Area) of soil and wastes to be incinerated, the total incineration cost may be expected to range from $8.4 million to $19.5 million.

4.0 Incinerator Emissions

The use of hazardous waste incinerators has met a substantial amount of public opposition because people are concerned about the potential risks to human health and the ecosystem from stack emissions. This concern could be avoided if the general public had a better understanding of incineration emission potentials and available control techniques.

When hazardous wastes are burned with oxygen, they react to form combustion products, such as CO_2, CO, H_2O, HC and particulate matter. Significant amounts of other species are also normally released during incineration, including SO_x, NO_x, acids, salts, halogenated organics, free halogen gases, and amines. The stack gas may contain partially burned hydrocarbons such as benzene, carbon tetrachloride, chloroform, benezene hexachloride, benzo-a-pyrene, and dioxins in the stack gas. These compounds are of concern because they are toxic and carcinogenic at low exposure levels.

Many metals are of concern in hazardous waste incineration because of the possible adverse human health effects associated with exposure to emissions of these elements and/or their compounds from incinerator stacks. Metals of primary interest include arsenic, barium, beryllium, chromium, cadmium, lead, mercury, antimony, silver and thallium.

4 1 Types of Emissions

4 1.1 Particulate Matter

The term particulate matter, comprises a complex category of materials, both solid and liquid, that inhabit the atmosphere. The size range of particulates (also known as aerosols) ranges from 0.1 micron (μ) to 500 μ in diameter. Particles larger than 10 μ can be seen with the naked eye. Particulate matter may originate from inorganic or organometallic substances introduced with the waste, auxiliary fuel, combustion air, or some combination of these materials. Inorganic matter, such as salts and trace metals present in the waste and fuel, are known as ash and cannot be destroyed by incineration. The ash content is usually much higher in solids and sludges than in liquid wastes. Emissions of particulate matter are influenced by the chemical composition of the waste and the auxiliary fuel being incinerated, the type of incinerator and its operating parameters, and the air pollution control system. Most of the pollutants of concern, such as heavy metals and organic toxic byproducts, will condense either as fine particles or on fine particles as the exhaust gas stream cools.

As the quantity of metallic constituents in the feed increases, the quantity of metallic oxides also increases. These particulates are mostly less than one micron in size, and they may include oxides of silicon, sodium, calcium, zinc, magnesium, iron and aluminum with lower percentages of trace

metals. The oxide particles reflect light and produce highly visible emissions which appear worse than stack test results would indicate

The technology for particulate control is well developed. Selection of control equipment depends on several factors such as the inlet grain loading, particle size distribution, acid removal devices and regulatory requirements. Scrubbers, baghouses and wet electrostatic precipitators are currently used on hazardous waste incinerators. Many engineers use quenchers, which serve both to cool the gases and to permit particulate growth, followed by medium to high energy venturi scrubbers for ultimate capture. Alternate designs involve precipitators (either wet or dry) followed by absorbers for the gas components.

4.1.2 Gaseous Matter

Flue gas will normally have components classified as either organic or inorganic. Inorganic gases produced from the burning process normally include carbon dioxide, carbon monoxide, oxides of nitrogen, and oxides of sulfur (if present). Emission of carbon monoxide is normally very low due to the high-level combustion and destruction efficiencies achieved in the hazardous waste incinerators, but emissions of nitrogen oxides are usually high due to thermal fixation of oxygen and nitrogen in the combustion air at high temperatures. Depending on the waste, emission of oxides of sulfur and other various acid gases may also result from hazardous waste incineration. The acid gases emitted may include sulfur dioxide, hydrogen chloride, hydrogen fluoride, and hydrogen bromide. Various scrubbing technologies are available to control all of the above acid gases. Carbon dioxide is currently not considered an air pollutant.

Possible organic gas emissions may include oxygenated hydrocarbons, halogenated hydrocarbons, olefins, and aromatics Emissions of any type of hydrocarbon are normally very low because of the destruction efficiency of the high-temperature combustion process. Incineration of chlorinated hydrocarbons results in the formation of hydrochloric acid and free chlorine The chlorine results from an inadequate supply of hydrogen to convert the chlorine in the compounds to hydrochloric acid Since many chlorinated organics often require an auxiliary fuel for their proper destruction, it is advisable to use natural gas as this will aid in the conversion of the chlorine to HCl

4 1.3 PCBs

Incineration of substances containing PCBs (polychlorinated biphenyls) is covered by the Toxic Substances Control Act (TSCA). Permitting under TSCA is reserved for EPA. Under TSCA a material containing less than 50 ppm PCBs is not controlled. TSCA mandates tha for destruction of PCBs, combustion at 1200 °C with a 2 second retention time and 3% oxygen in the exhaust gas or 1600 °C with a 1.5 second retention time and 2% oxygen in the exhaust is required Additionally there must be a combustion efficiency of at least 99.9%

However, at NPL sites, such as the DS&G Landfill, RCRA and TSCA incineration permits are not required. At these sites, the EPA Regional Administrator sets the applicable standards, which may include compliance with the provisions of incinerator permitting under TSCA without the necessity of obtaining an actual permit.

From the analytical data currently available for the DS&G Landfill, the PCB contamination is below the 50 ppm level. However, the need for further

sampling and waste characterization is evident before any final incineration design is implemented.

4.1.4 Dioxin

Trace quantities of dioxins have been reported to have been found in the emissions of hazardous waste incinerators. The term dioxin is a generalization of a family of chlorinated organic compounds consisting of two benzene rings connected by two oxygen bridges. When chlorine atoms occupy two or more of the eight available locations on the two benzene rings, the resulting molecule is known as a polychlorinated dibenzo-p-dioxin (PCDD), or dioxin for short. Of the 73 different possible varieties of dioxins, 2,3,7,8-TCDD is the most toxic found to date. PCDDs are thermally stable up through 1300°F and have an extremely low vapor pressure. Figure 11 shows dioxin and some related compound chemical structures.

Although no cases of human death or even long-term disability have been attributed to dioxins in the United States or elsewhere, 2,3,7,8-TCDD was found to be extremely toxic to small animals. It is the most toxic synthetic chemical known, 500 times more potent than strychnine and 10,000 times more potent than cyanide as determined by laboratory analysis. Some observations pertaining to dioxin's human health effects are:

- In each case of exposure a skin disorder, chloracne, has occurred. Chloracne is a severe facial eruption and is a severe irritant.
- Liver damage has been reported a number of months after exposure. However, in each case, signs of this damage have disappeared within a period of two to five years.
- No human symptoms or reactions have been found to be permanently injurious to well-being
- Although no relationship to malignancies has been found between dioxins and human life, this is a fear, particularly as a long-term effect.

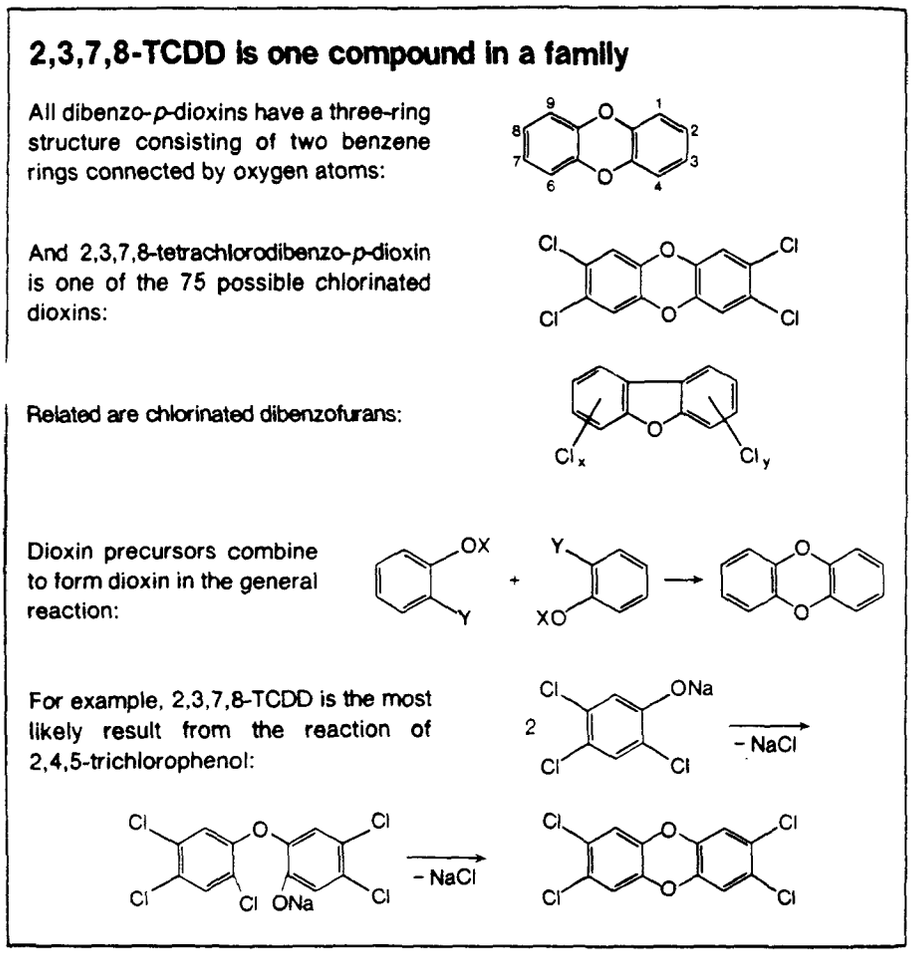


Figure 11: Dioxin and Related Compound Chemical Structure

Source: Worthy, 1983

There are many theories of how dioxin may form during incineration including the following:

- Burning of wastes which contain trace levels of PCDD will necessarily produce PCDD in the exhaust stream.
- The presence of two or more chlorinated organics act as precursors in the formation of PCDD. By a process termed *dimerization* these compounds will combine, under appropriate conditions of temperature and oxygen availability, to form PCDD.
- PCDD may be formed by partial oxidation of single-molecule precursor compounds, such as the partial oxidation of PCBs.
- The presence of chlorine and the chlorine (chloride) attack of basic aromatic hydrocarbon structures associated with lignin, such as wood, vegetable residues, etc., encourage PCDD formatio

Dioxins, as it turns out, are not very difficult to destroy. There is no unique thermal or kinetic stability attributable to dioxins that would prohibit its efficient destruction at high temperatures. The use of an auxiliary fuel and the availability of molecular oxygen reduce dioxin levels substantially. The probability of gas-phase formation of dioxin is very low at high temperatures, ≥1700°F, if mixing between fuel and air is efficient. More sampling and further waste characterization is required to estimate whether dioxin may be a problem at DS&G.

4.2 Air Pollution Control Devices

There are numerous types and sizes of air pollution control devices (APCDs) on the market today. They range from the unsophisticated, a series of baffles, to the relatively complex high-energy water scrubbing devices, utilizing alkali, to clean gas streams of solid, liquid, and gaseous pollutants. Below is a description of a few of the APCDs currently available.

4.2.1 Electrostatic Precipitator

In an electrostatic precipitator (ESP), a negative electrical charge is imparted on the particles in the flue gas. The negatively charged particles are then attracted and retained by positively charged collection electrodes. The particles are removed from the electrodes into collection hoppers by rapping. The process is carried out within an enclosed chamber made of metal or Fiberglass Reinforced Plastic. The grounded collecting electrodes (plates) are suspended within the chamber. Power input is provided by a high-voltage transformer and a rectifier. Discharge electrodes suspended between the plates are negatively charged with voltages ranging from 20 to 100 Kvolts. Figure 12 shows a typical electrostatic precipitator.

4.2.2 Wet Electrostatic Precipitator

Wet Electrostatic Precipitators (WESPs) are a relatively new technology and are generally used for applications where the potential for explosion is high or where particulates are very sticky. Figure 13 is a cross section through a wet ESP They are basically the same technology as dry ESPs with the following two important distinctions:

- A wet spray is included in the inlet section for cooling, gas adsorption, and coarse particle collection
- The collection electrode is wetted to flush away the collected particles.

4.2.3 Fabric Filter (Baghouse)

Fabric filters remove dust and particles from the flue gas by passing the gas through a fabric bag. The cleaned gas exits from one side of the filter while the dust is collected on the other side. Baghouses are very efficient for gases containing small particles. The collected dust may be removed from the filter bag by any of three methods: mechanical shaking, reverse flow back-flushing at low pressure (reverse air), or reverse flow back-flushing at

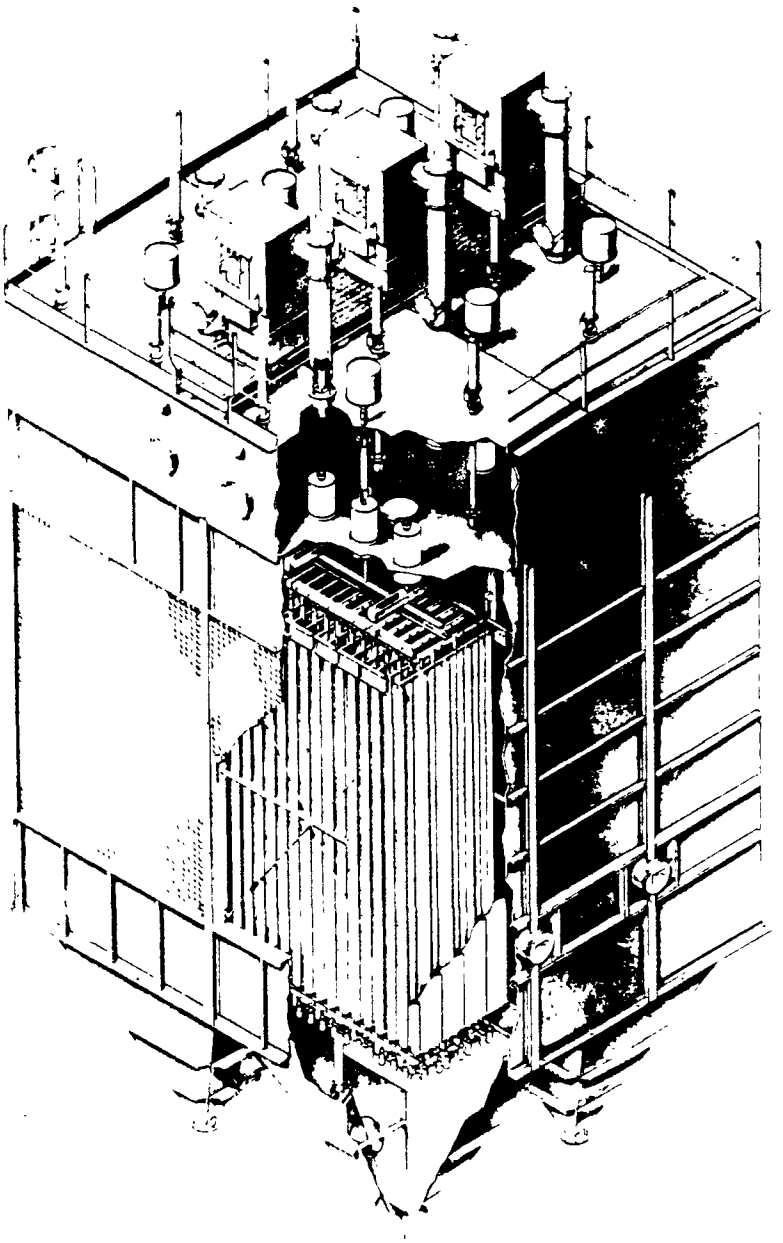


Figure 12 Typical electrostatic precipitator

Source: Brunner, 1986

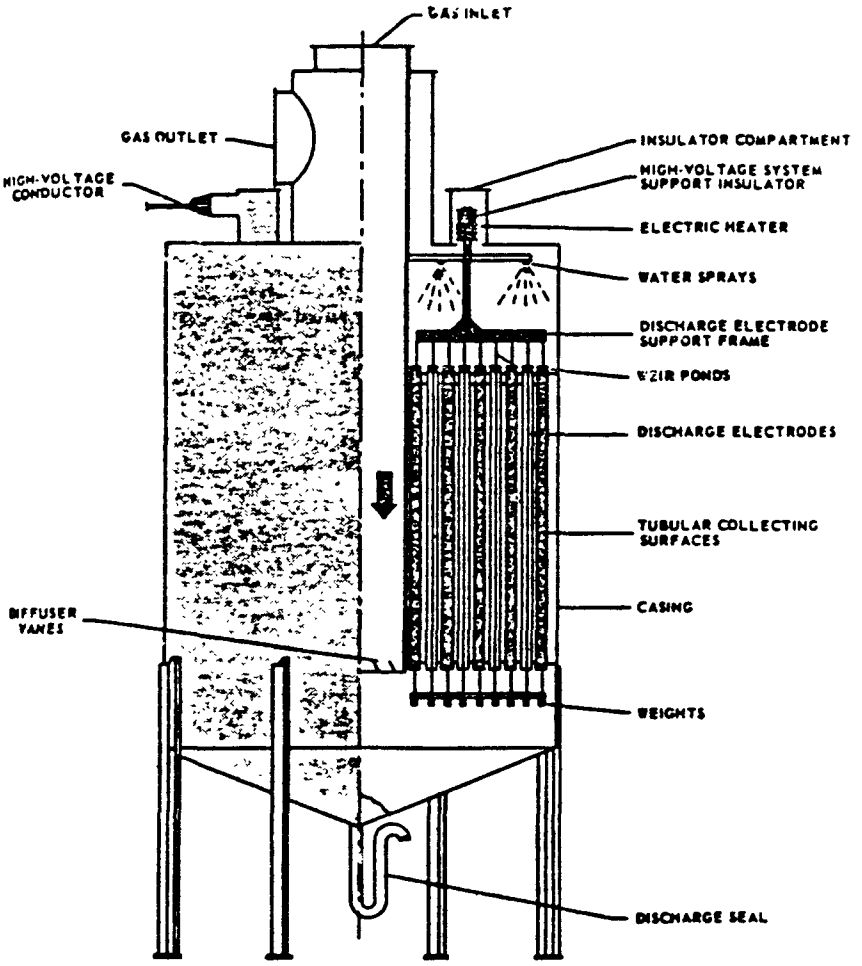


Figure 13 Tubular wet Electrostatic precipitator. (*Source: Joy Manufacturing Co.*)

Source: Brunner, 1986

slightly higher pressure (pulsed air) Figure 14 is a schematic of a bag filter with a shaker mechanism.

4 2 4 Quench Chamber

The quench chamber operates by passing the hot gases through a water spray Quench chambers usually precede scrubber equipment in the pollution control treatment sequence, and are used to reduce the temperature of hot gases leaving the incinerator. The chamber also serves to protect the downstream equipment from high temperature damage and it reduces water evaporation in downstream scrubbing equipment. Figure 15 depicts an upflow quench reactor.

4.2 5 Wet/Dry Scrubber (Spray Dryer)

In the wet/dry scrubber, hot gases are passed through a fine mist of a dilute alkali slurry. The water in the slurry absorbs acids from the flue gas and the acids react with the alkali solids in the slurry to form salts. Water is lost through evaporation, leaving the salts and any unreacted alkali behind as a dry powder. This particle-laden flow then goes to a fabric filter or an ESP to remove the particulates. Wet/dry scrubbers are considered cleaner control systems than wet scrubbers, mainly because the waste material is dry particulates and no further liquid treatment is required, which significantly reduces the waste volume.

4.2.6 Venturi Scrubber

In the venturi scrubber, a liquid is introduced into a constricted area. High velocity gas, from 200 to 600 ft/sec at the throat, is also introduced to shear the liquid into fine droplets and to allow large surface area for mass transfer From the expansion section of the venturi throat the gas enters a

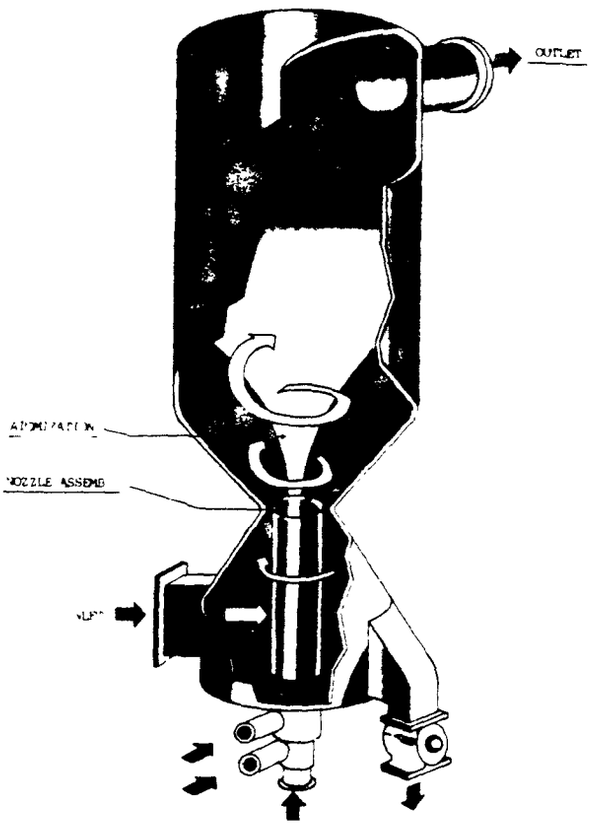


Figure 14 Upflow quench reactor.

Source: Brunner, 1986

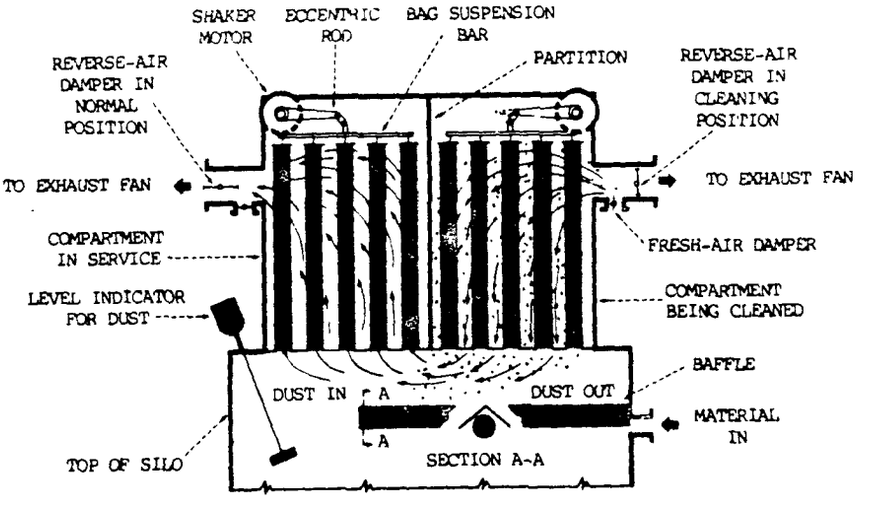


Figure 15 Bag filter with shaker mechanism.

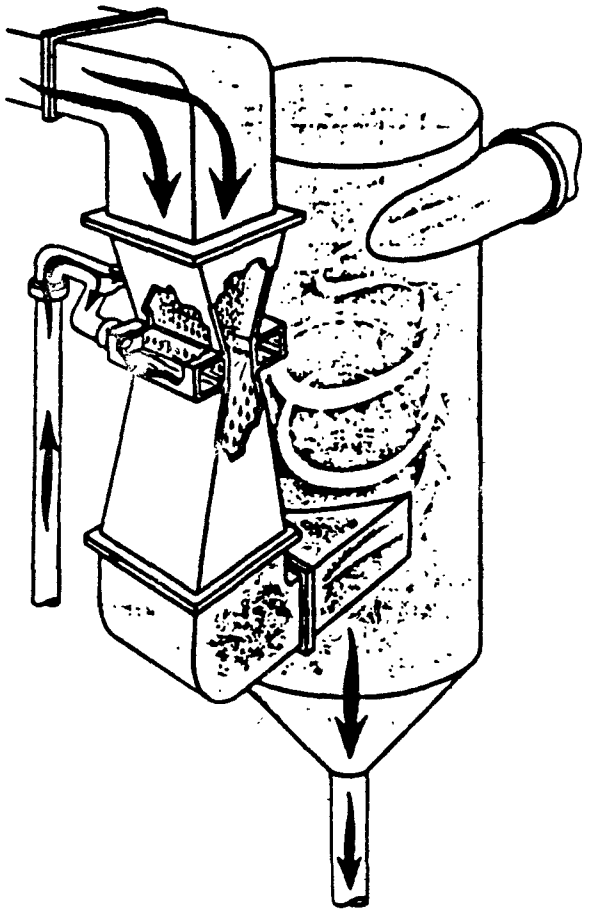


Figure 16 Venturi scrubber.

Source: Brunner, 1986

large chamber for separation of particles or for further scrubbing. Figure 16 illustrates a venturi scrubber where water is injected at its throat

4.3 Air Pollution Control Device Efficiency

Table 4 shows conservative estimated efficiencies of APCDs for controlling toxic metals emissions. Most toxic metals will condense as solids if incinerator combustion gases are cooled. As seen in the table, mercury is the least apt to condense prior to emission from the system stack as its degree of recovery above 400°F is generally slight. Quench chambers are frequently employed to cool flue gas prior to further treatment. Venturi scrubbers are frequently used while ESPs and WESPs are not widely used in hazardous waste incineration applications. Fabric filters have not been commonly used on hazardous waste incinerators as they are bulky and expensive, and require careful operation At most facilities where data indicate high gas and particulate removal efficiencies, there are usually two to four APCDs in series. The particular series will depend on the type of incinerator and the characteristics of the wastes incinerated. A number of typical APC series are listed below:

- Quench/wet scrubber
- Quench/spray dryer/cyclone/ESP
- Quench/spray dryer/cyclone/fabric filter
- Quench/wet scrubber/ionizing wet scrubber/mist eliminator
- Quench/WESP/venturi scrubber/packed tower scrubbers
- Quench/venturi scrubber/packed tower scrubbers; and
- Fabric filter/wet scrubber

4.4 Selection of an Air Pollution Control Device Series

Further waste characterization studies and more sampling is required before the proper selection of an APCD series can be made. However, high levels of lead have been found in the sampling to date and it does not appear that mercury will be a problem. Therefore, the combination of a venturi

TABLE 4
Air Pollution Control Devices (APCDs) and Their Conservatively Estimated Efficiencies for Controlling Toxic Metals

APCD	POLLUTANT				
	Ba, Be	Ag	Cr	As,Sb,Cd, Pb, Tl	Hg
*WS	50	50	50	40	30
*VS-20	90	90	90	20	20
*VS-60	98	98	98	40	40
ESP-1	95	95	95	80	0
ESP-2	97	97	97	85	0
ESP-4	99	99	99	90	0
*WESP	97	97	96	95	60
*FF	95	95	95	90	50
*PS	95	95	95	95	80
SD/FF; SD/C/FF	99	99	99	95	90
DS/FF	98	98	98	98	50
*FF/WS	95	95	95	90	50
ESP-1/WS; ESP-1/PS	96	96	96	90	80
ESP-4/WS' ESP-4/PS	99	99	99	95	85
*VS-20/WS	97	97	97	96	80
**WS/IWS	95	95	95	95	85
*WESP/VS-20/IWS	99	99	98	97	90
C/DS/ESP/FF; C/DS/C/ESP/FF	99	99	99	99	98
SD/C/ESP-1	99	99	98	95	85

* It is assumed that flue gases have been precooled in a quench. If gases are not cooled adequately, mercury recoveries will diminish, as will cadmium and arsenic to a lesser extent.
** An IWS is nearly always used with an upstream quench and packed horizontal scrubber.

C = Cyclone
WS = Wet Scrubber including: Sieve Tray Tower
Packed Tower
Bubble Cap Tower
PS = Proprietary Wet Scrubber Design
(A number of proprietary wet scrubbers have come on the market in recent years that are highly efficient on both particulates and corrosive gases. Two such units are offered by Calvert Environmental Equipment Co. and by Hydro-Sonic Systems, Inc.).
VS-20 = Venturi Scrubber, ca. 20-30 in W. G. Δp
VS-60 = Venturi Scrubber, ca. > 60 in W. G. Δp
ESP-1 = Electrostatic Precipitator; 1 stage
ESP-2 = Electrostatic Precipitator; 2 stages
ESP-4 = Electrostatic Precipitator; 4 stages
IWS = Ionizing Wet Scrubber
DS = Dry Scrubber
FF = Fabric Filter (Baghouse)
SD = Spray Dryer (Wet/Dry Scrubber)

Source: EPA Report 530/SW-90-041a, 1990

scrubber in series with a wet scrubber would appear to be adequate air pollution control for this application Further examination of the regulatory requirements and the waste characteristics is needed before any official selection and design of air pollution control equipment is implemented

5.0 Conclusion

The Delaware Sand and Gravel Landfill, an NPL site, is currently in the design phase of the remedial action Wastes and soils from two areas, the Drum Disposal and Ridge Areas, are to be disposed by incineration The total volume of material to be incinerated is expected to be between 25,000 yd^3 and 30,000 yd^3 depending on the actual boundaries and depths of wastes in the two disposal areas The estimated range of costs for the incineration portion of the project is between $8.4 million and $19.5 million. These figures do not include excavation and handling and storage costs.

Much more sampling and waste characterization is required before the final design of the incinerator and any air pollution control equipment is begun. The best incinerator for the job right now appears to be the rotary kiln This incinerator offers the most versatility of any of the incinerators currently on the market. It can handle solids, sludge and liquids at the same time with little or no pretreatment of the waste feed necessary It is the only incinerator that can operate in a slagging mode in which it can reduce steel drums to a molten slag, a glass-like substance, when cooled. Transportable rotary kilns have been proven to be effective in similar applications throughout the country.

There are many types of air pollution control devices currently on the market that will bring the stack emissions within any applicable regulations. Venturi scrubbers, quench chambers and wet scrubbers are the most common pieces of equipment used today For more complex applications, filter baghouses and electrostatic precipitators are available.

Incineration offers a permanent solution to the contamination problem occurring at the Delaware Sand and Gravel Landfill. It provides for the destruction of the hazardous or toxic components in the waste matrix and it reduces or eliminates the liabilities and risks pertaining to hazardous wastes

References

Bonner, T , Cornett, C., Desai, B , Fullenkamp, J., Hughes, T., Johnson, M., Kennedy, E , McCormick, R., Peters, J and Zanders, D Engineering Handbook for Hazardous Waste Incineration National Technical Information Service, Springfield, VA. June, 1981

Brunner, Calvin R Hazardous Air Emissions From Incineration. Chapman and Hall, New York, 1986

Brunner, Calvin R. Incineration Systems Van Nostrand Reinhold Company, New York, 1984.

Brunner, Calvin R Site Cleanup by Incineration. The Hazardous Materials Control Research Institute, Silver Springs, Maryland, 1988.

Cudahy, James, and Eicher, Anthony. "Thermal Remediation Industry: Markets, Technologies, Companies," Pollution Engineering, November, 1989.

Devinny, J., Everett, L., Lu, J., and Stollar, R. Subsurface Migration of Hazardous Wastes, Van Nostrand Reinhold, New York, 1990.

Dunn Geoscience Corporation, "Feasibility Study for the Delaware Sand & Gravel Landfill - Final Report " February, 1988.

Dunn Geoscience Corporation, "Remedial Investigation Report on the Delaware Sand & Gravel Landfill." December,1987

EPA Report # 530/SW-90-041a. Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerators: Volume IV of the Hazardous Waste Incineration Guidance Series, 1990.

Esposito, M., Taylor, M., Bruffey, C., and Thurnau, R. "Incineration of a Surrogate Superfund Soil Using a Pilot-Scale Rotary Kiln Incinerator," Unpublished draft report, 1988.

Ives, Jim and Young, Derrell. "Hazardous Waste Incineration System Used on Alaskan Site," Oil and Gas Journal, Oct. 30, 1989.

Johnson, L., Midgett, R , James, R., Thomason, M , and Manier, M. "Screening Approach for Principal Organic Hazardous Constituents and Products of Incomplete Combustion," JAPCA, vol. 39, 1989

Johnson, Nancy, and Cosmos, Michael. "Thermal Treatment Technologies for Haz Waste Remediation," Pollution Engineering, October, 1989.

Kinkhabwala, Minesh, and Mehta, Ronald. "Case Study: Transportable Incineration Technologies for Permanent Superfund Remediations," Hazardous Waste Management Magazine, Jan.-Feb., 1988.

Liddicoatt, Carol. Review of Alternative Incineration Technologies for the Southern Maryland Wood Preservers Superfund Site, Hollywood, Maryland, Unpublished Report by Dames & Moore, 1990.

Rawis, Rebecca. "Dioxin's Human Toxicity is Most Difficult Problem," C&EN, June 6, 1983

Santoleri, J "Rotary Kiln Incineration Systems: Operating Techniques for Improved Performance," Hazardous and Industrial Wastes - Proceedings of the Twenty-Second Mid-Atlantic Industrial Waste Conference, Drexel University, Philadelphia, PA, July 24-27, 1990.

Shacklette, H. and Boerngen, J. Element Concentrations in Soils and Other Surficial Materials of the Conterminous United States. U.S. Geological Survey Professional Paper 1270. United States Government Printing Office, Washington, 1984.

Shaub, Water and Tsang, Wing. "Dioxin Formation in Incinerators," Environmental Science & Technology, vol. 17, no. 12, 1983.

Shen, Thomas. "Hazardous Waste Incineration: Emissions and Their Control," Pollution Engineering, July, 1986.

Star, Alvin. "Cost Estimating for Hazardous Waste Incineration," Pollution Engineering, April, 1985

Timmons, D., Fitzpatrick, V., and Liikala, S. "Vitrification Tested on Hazardous Wastes," Pollution Engineering, June, 1990

Travis, C., Holton, G., Etnier, E., Cook, S., O'Donnell, F., Hetrick, D , and Dixon, E. "Potential Health Risk of Hazardous Waste Incineration," Journal of Hazardous Materials, vol 14, 1987.

Trenholm, Andrew, Lapp, Thomas, Scheil, George, Cootes, John, Klamm, Scott, and Cassady, Carolyn "Total Mass Emissions from a Hazardous Waste Incinerator," Journal of Hazardous Materials, vol. 18, 1988.

Vogel, Gregory, and Martin, Edward "Cost File - Waste Incineration Part 1: Equipment Sizes and Intergrated-Facility Costs," Chemical Engineering, September 5, 1983.

Vogel, Gregory, and Martin, Edward. "Cost File - Waste Incineration Part 2: Estimating Costs of Equipment and Accessories," Chemical Engineering, October 17, 1983.

Vogel, Gregory, and Martin, Edward. "Cost File - Waste Incineration Part 3: Estimating Capital Costs of Facility Components," Chemical Engineering, November 28, 1983

Worthy, Ward "Both Incidence, Control of Dioxin Are Highly Complex," C&EN, June 6, 1983.

Appendix A

Analytical Data of Water and Groundwater at Delaware Sand and Gravel Landfill

Table 5.17
Inorganic Analytical Results for Surface Water

Inorganic Analytical Results of April 1985
Delaware Sand and Gravel RI/FS Surface Water Sampling (1)

Sample Location	Iron	Manganese	Chromium	Silver	Zinc	Lead	Cadmium	Mercury	Arsenic	Selenium	Barium	Copper	Calcium	Nickel	Beryllium	Vanadium	Antimony	Thallium	Cobalt	Tin	Aluminum	Magnesium
1*	0.495	0.150	<0.100	<0.100	<0.100	<0.100	<0.100	<0.001	<0.030	<0.005	<0.100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1*	0.530	0.140	<0.100	<0.100	<0.100	<0.100	<0.100	<0.001	<0.030	<0.005	<0.100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	0.555	0.155	<0.100	<0.100	<0.100	<0.100	<0.100	<0.001	<0.030	<0.005	<0.100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	1.810	0.400	<0.100	<0.100	<0.100	<0.100	<0.100	<0.001	<0.030	<0.005	0.120	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	4.850	0.600	<0.100	<0.100	<0.100	<0.100	<0.100	<0.001	<0.030	<0.005	0.110	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	4.640	0.580	<0.100	<0.100	<0.100	<0.100	<0.100	<0.001	<0.030	<0.005	0.110	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6	4.000	0.390	<0.100	<0.100	<0.100	<0.100	<0.100	<0.001	<0.030	0.005	<0.100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7	0.435	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.001	<0.030	<0.005	<0.100	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	4.370	0.630	<0.100	<0.100	<0.100	<0.100	<0.100	<0.001	<0.030	<0.005	0.122	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Sample Location	pH	BOD	Chloride	Ammonia-N	Sulfate	TDS	TOC
1*	6.96	<2.4	27	0.10	23.5	151	7
1*	6.96	<2.4	27	0.10	23.5	137	9
2	6.91	<2.4	29	<0.10	28.0	161	8
3	7.15	<2.4	37	2.80	10.0	156	16
4	7.02	<2.4	43	2.55	14.5	192	24
5	6.61	<2.4	39	0.70	14.5	180	23
6	6.64	3.4	330	<0.10	64.5	733	12
7	6.94	<2.4	6	<0.10	14.5	49	<5
8	6.11	4.8	17	0.25	129.0	306	NA

Inorganic Analytical Results of April 1986
Delaware Sand and Gravel RI/FS Surface Water Sampling (1)

Sample Location	Iron	Manganese	Chromium	Silver	Zinc	Lead	Cadmium	Mercury	Arsenic	Selenium	Barium	Copper	Calcium	Nickel	Beryllium	Vanadium	Antimony	Thallium	Cobalt	Tin	Aluminum	Magnesium
1	0.190	0.135	<0.015	<0.010	<0.020	<0.010	<0.005	<0.001	<0.010	<0.005	NA	<0.025	NA	<0.040	<0.005	<0.050	<0.060	<0.010	<0.050	<0.040	<0.200	5.160
2	0.215	0.120	<0.015	<0.010	<0.020	<0.010	<0.005	<0.001	<0.010	<0.005	NA	<0.025	NA	<0.040	<0.005	<0.050	<0.060	<0.010	<0.050	<0.040	<0.200	5.220
3	0.390	0.170	<0.015	<0.010	<0.020	<0.010	<0.005	0.002	<0.010	<0.005	NA	<0.025	NA	<0.040	<0.005	<0.050	<0.060	<0.010	<0.050	<0.040	<0.200	5.190
4	<0.100	0.640	<0.015	<0.010	<0.020	<0.010	<0.005	<0.001	<0.010	<0.005	NA	<0.025	NA	<0.040	<0.005	<0.050	<0.060	<0.010	<0.050	<0.040	<0.200	<5.000
5	0.405	0.565	<0.015	<0.010	<0.020	<0.010	<0.005	<0.001	<0.010	<0.005	NA	<0.025	NA	<0.040	<0.005	<0.050	<0.060	<0.010	<0.050	<0.040	<0.200	<5.000
6	<0.100	0.044	<0.015	<0.010	<0.020	<0.010	<0.005	0.002	<0.010	<0.005	NA	<0.025	NA	<0.040	<0.005	<0.050	<0.060	<0.010	<0.050	<0.040	<0.200	9.540
7*	0.130	<0.015	<0.015	<0.010	<0.020	<0.010	<0.005	<0.001	<0.010	<0.005	NA	<0.025	NA	<0.040	<0.005	<0.050	<0.060	<0.010	<0.050	<0.040	<0.200	<5.000
7*	<0.100	<0.015	<0.015	<0.010	0.022	<0.010	<0.005	<0.001	<0.010	<0.005	NA	<0.025	NA	<0.040	<0.005	<0.050	<0.060	<0.010	<0.050	<0.040	<0.200	<5.000
8	3.100	0.610	<0.015	<0.010	0.115	<0.010	<0.005	<0.001	<0.010	<0.005	NA	<0.025	NA	<0.040	<0.005	<0.050	<0.060	<0.010	<0.050	<0.040	<0.200	15.160

1. Army Creek, West of Route 13
2. Army Creek, East of Route 13, Upstream of Weir
3. Army Creek, Pond Entrance
4. Army Creek, Pond Effluent
5. Army Creek, Under Railroad Bridge
6. Army Creek, Tidal Gate, East of Route 9
7. Gravel Pit Pond
8. Intermittent Stream East of DS&G

* Duplicate analyses
NA Sample not analyzed for this parameter.
(1) Units in ppm except pH (dimensionless).

Table 5.18

Inorganic Analytical Results for Stream Sediments

Inorganic Analytical Results of April 1985
Delaware Sand and Gravel Landfill RI/FS Stream Sediment Sampling
(in micrograms per gram) (1)

Sample Location	pH	Iron	Manganese	Chromium	Silver	Zinc	Lead	Cadmium	Mercury	Arsenic	Selenium	Barium	Copper	Calcium	Nickel	Beryllium	Vanadium	Antimony	Thallium	Cobalt	Tin	Aluminum	Magnesium
1*	6.96	17,909	167.00	18.49	<10.00	87.27	17.07	<10.00	<0.50	<3.00	<0.50	26.56	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1*	6.96	21,902	148.00	15.28	<10.00	28.53	21.40	<10.00	<0.50	<3.00	<0.50	42.80	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2	6.91	9,505	190.00	10.21	<10.00	90.92	142.00	<10.00	<0.50	<3.00	<0.50	38.31	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3	7.15	44,010	274.00	25.54	<10.00	274.00	175.00	<10.00	<0.50	9.26	0.71	234.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
4	7.02	18,530	398.00	<10.00	<10.00	70.75	25.41	<10.00	<0.50	<3.00	<0.50	79.72	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5	6.61	45,175	845.00	14.92	<10.00	143.00	70.63	<10.00	<0.50	5.47	<0.50	145.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
6	6.64	27,962	1320.00	14.93	<10.00	240.00	56.75	<10.00	0.63	13.54	<0.50	76.66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7	6.94	2,867	24.26	<10.00	<10.00	22.24	10.11	<10.00	<0.50	<3.00	<0.50	<10.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
8	6.11	18,259	87.02	11.57	<10.00	93.06	31.69	<10.00	<0.50	<3.00	<0.50	57.34	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Inorganic Analytical Results of April 1986
Delaware Sand and Gravel Landfill RI/FS Stream Sediment Sampling
(in micrograms per gram) (1)

Sample Location	% Moist.	Iron	Manganese	Chromium	Silver	Zinc	Lead	Cadmium	Mercury	Arsenic	Selenium	Barium	Copper	Calcium	Nickel	Beryllium	Vanadium	Antimony	Thallium	Cobalt	Tin	Aluminum	Magnesium
1	33.7	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	12.26	NA	NA	<0.50	NA	<6.03	<1.00	NA	NA	NA	NA
2	36.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.56	NA	NA	<0.48	NA	<5.87	<0.97	NA	NA	NA	NA
3	64.0	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	21.23	NA	NA	0.49	NA	<5.95	<0.99	NA	NA	NA	NA
4	89.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	47.92	NA	NA	1.96	NA	<5.94	<0.99	NA	NA	NA	NA
5	26.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	6.35	NA	NA	<0.48	NA	<5.86	<0.97	NA	NA	NA	NA
6	63.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	43.15	NA	NA	0.81	NA	<5.87	<0.97	NA	NA	NA	NA
7*	38.6	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.54	NA	NA	<0.50	NA	<6.10	<1.01	NA	NA	NA	NA
7*	27.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<2.47	NA	NA	<0.49	NA	<5.94	<0.99	NA	NA	NA	NA
8	58.5	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	13.35	NA	NA	0.63	NA	<6.02	<1.00	NA	NA	NA	NA

1. Array Creek, West of Route 13
2. Array Creek, East of Route 13, Upstream of Weir
3. Array Creek, Pond Entrance
4. Array Creek, Pond Effluent
5. Array Creek, Under Railroad Bridge
6. Array Creek, Tidal Gate, East of Route 9
7. Gravel Pit Pond
8. Intermittent Stream East of DS&G

* Duplicate analyses
NA Sample not analyzed for this parameter.
(1) Units in micrograms per gram, except percent moisture (%) and pH (dimensionless).

Table 5.19

DNREC Inorganic Analytical Results of March, 1985
Delaware Sand and Gravel Landfill RI/FS Groundwater Sampling
(milligrams per liter, unless otherwise noted)

Well #	BOD	Spec. Cond. (umhos /cm)	pH	Cl	NH4-N	SO4	TDS	TOC	Metals (micrograms per liter) Fe	Mn	Cr	Ag	Zn	Pb	Ni	Cd	Hg	As	Se	Ba
3a *	<2.4	75	5.7	27.5	0.50	24.5	85	14	9990	470	<100	<100	.260	<100	<100	<100	<1.0	<30	<5.0	420
3a *	<2.4	73	5.8	12.5	0.35	37.0	57	11	10070	505	<100	<100	.255	<100	<100	<100	<1.0	<30	<5.0	460
23	<2.4	54	5.8	<5.0	<0.10	10.0	51	7	<100	<100	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	110
24	<2.4	85	6.0	10.0	<0.10	10.0	61	14	<100	<100	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	<100
25	<2.4	300	5.5	35.0	2.10	10.0	161	9	12960	300	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	120
26	<2.4	145	5.0	16.5	0.20	<5.0	84	21	27240	320	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	140
33	2.4	272	6.0	39.5	1.75	5.0	145	19	545	<100	<100	<100	195	<100	<100	<100	<1.0	<30	<5.0	205
34	3.2	124	5.6	17.5	0.15	10.0	74	20	4570	130	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	185
45	<2.4	153	5.7	27.0	<0.10	5.0	99	14	<100	<100	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	165
49	<2.4	72	5.6	7.5	0.15	5.0	47	13	210	<100	<100	<100	135	<100	<100	<100	<1.0	<30	<5.0	120
58 *	<2.4	59	6.8	8.0	<0.10	<5.0	43	8	<100	<100	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	<100
58 *	<2.4	58	6.9	8.0	<0.10	<5.0	42	7	<100	<100	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	<100
61	<2.4	97	5.4	11.5	0.25	<5.0	66	18	140	<100	<100	<100	140	<100	<100	<100	<1.0	<30	<5.0	240
62	<2.4	62	5.5	11.0	<0.10	50.0	78	24	<100	<100	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	140
AMC-2 *	<2.4	131	5.7	13.0	<0.10	10.0	88	19	<100	<100	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	160
AMC-2 *	<2.4	134	5.9	14.0	<0.10	10.0	92	18	<100	<100	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	225
AMC-7	<2.4	105	5.6	12.5	<0.10	<5.0	77	<5	<100	<100	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	155
AMC-63	<2.4	248	5.3	55.0	<0.10	<5.0	143	11	<100	<100	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	200
B-4	<2.4	115	6.0	14.0	<0.10	40.0	73	17	18740	2365	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	450
B-5	<2.4	104	5.8	14.0	0.15	5.0	72	9	315	<100	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	180
DGC-01d	<2.4	240	6.6	21.0	2.90	30.0	117	27	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-01s	33.0	406	6.5	10.0	0.15	64.0	856	42	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-02d	<2.4	129	6.8	18.0	<0.10	14.0	72	13	130	<100	<100	<100	100	<100	NA	<100	<1.0	<30	<5.0	<100
DGC-02s	51.0	432	6.8	59.0	1.30	100.0	285	72	35000	2900	<100	<100	140	<100	NA	<100	<1.0	<30	<5.0	<100
DGC-03d	<2.4	108	6.6	14.0	<0.10	8.0	66	13	<100	<100	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	<100
DGC-03s	74.0	516	6.6	84.0	2.60	48.0	398	124	51000	12800	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	450
RW-1	<2.4	224	6.5	27.0	0.60	15.0	122	24	1770	405	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	150
RW-10	<2.4	167	5.9	22.0	1.35	10.0	99	24	295	345	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	175
RW-11	<2.4	220	6.3	22.0	2.85	12.0	118	33	4640	510	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	195
RW-12	<2.4	121	5.3	17.0	0.15	10.0	80	43	130	105	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	250
RW-13	3.1	123	6.0	15.0	0.10	5.0	81	19	4510	370	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	120
RW-14 *	<2.4	456	6.5	38.0	16.50	17.0	196	57	6400	690	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	210
RW-14 *	<2.4	460	6.4	40.0	19.50	17.0	189	57	5960	640	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	280
27	<2.4	338	6.3	38.0	7.00	10.0	162	45	4880	390	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	255
28	4.0	552	6.5	66.5	9.00	24.0	289	63	22620	1210	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	360
29	13.5	928	6.9	102.0	10.50	63.0	523	117	32040	2280	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	475
31	7.4	266	6.4	30.0	2.05	15.0	170	31	12880	1190	<100	<100	<100	<100	NA	<100	<1.0	<30	<5.0	265
PW-2 *	<2.4	214	8.1	8.0	0.30	73.0	33	18	235	<100	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	175
PW-2 *	<2.4	214	8.3	8.0	0.25	60.0	139	21	260	<100	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	140
TW-1	<2.4	182	5.5	38.0	<0.10	<5.0	112	<5	205	<100	<100	<100	<100	<100	<100	<100	<1.0	<30	<5.0	125

* Duplicate analyses
NA Sample not analyzed for this parameter.

Table 5.20

DNREC Organic Analytical Results of March 1985
Delaware Sand and Gravel Landfill RI/FS Groundwater Sampling
(micrograms per liter)

Well #	1,2-dichloro ethane	1,1-dichloro ethene	benzene	toluene	ethyl benzene	1,1-dichloro ethane	chloroform	tri chloro ethene	chloro benzene	1,2-dichloro ethene
3a *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
3a *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
23	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
24	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
25	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
26	3.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
33	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
34	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
45	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
49	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
58 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
58 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
61	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
62	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	180.0	<5.0	<5.0
AWC-2 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
AWC-2 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
AWC-7	11.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
AWC-63	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
B-4	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
B-5	20.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
DGC-01d	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
DGC-01s	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
DGC-02d	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
DGC-02s	23.0	<5.0	3100.0	7300.0	390.0	8.2	<1.0	28.0	14.0	28.0
DGC-03d	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
DGC-03s	93.0	<5.0	1700.0	8000.0	1400.0	11.0	5.0	320.0	33.0	<1.0
RW-1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
RW-10	51.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
RW-11	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
RW-12	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
RW-13	<5.0	<5.0	30.0	83.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
RW-14 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
RW-14 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
27	<5.0	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
28	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
29	<5.0	<5.0	<5.0	16.0	59.0	<5.0	<5.0	<5.0	24.0	<5.0
31	<5.0	<5.0	130.0	360.0	24.0	<5.0	<5.0	<5.0	<5.0	<5.0
PW-2 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
PW-2 *	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
TW-1	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

* Duplicate analyses

Table 5.21
Indicator Parameter Analytical Results of April, 1986
Delaware Sand and Gravel Landfill RI/FS Groundwater Sampling
(milligrams per liter unless otherwise noted)

Well #	Lab	Alkalinity as CaCO3	Hardness	Chloride	Total Nitrogen	Ammonia as N	Sulfate	TSS	TDS	DOC	Specific Cond. (umhos/cm)	DGC Field Measurements				
												pH	Eh (mv)	Temp. (C)	Dissolved Oxygen (% saturation)	Specific Conductance (umhos/cm)
3A	DNREC	15.0	18.0	10.6	0.84	0.43	<5.00	363.0	101.0	23.3	NA	6.54	60	13	NA	80
25 **	DNREC	28.0	28.0	5.8	0.40	<0.10	20.60	55.0	48.0	13.1	NA	7.50	-85	14	NA	79
25 **	DNREC	28.0	32.0	5.7	0.20	0.14	19.50	42.0	46.0	10.1	NA	NA	NA	NA	NA	NA
26	DNREC	44.0	36.0	18.1	0.79	0.22	20.00	114.0	84.0	29.7	NA	3.70	428	12	NA	120
33	DNREC	4.0	54.0	34.3	0.55	0.23	11.84	29.0	152.0	19.3	NA	6.66	164	12	NA	150
34	DNREC	129.0	124.0	32.7	3.56	3.49	13.00	38.0	226.0	49.4	NA	6.70	42	10	NA	40
37	DNREC	81.0	80.0	7.5	9.90*	2.63	70.60	3437.0	119.0	24.4	NA	7.70	44	18	NA	140
38	DNREC	79.0	64.0	28.8	0.82*	2.52	46.30	120.0	149.0	44.8	NA	7.40	-150	17	NA	300
40	DNREC	45.0	34.0	13.9	8.20*	8.07	19.80	274.0	93.0	46.9	NA	7.20	-126	19	NA	130
45 **	DNREC	13.0	42.0	27.1	0.70	0.04	7.90	50.0	138.0	6.2	NA	NA	NA	15	NA	100
45 **	DNREC	12.0	40.0	27.5	1.03	0.07	8.00	41.0	120.0	6.6	NA	NA	NA	NA	NA	NA
56 **	DNREC	11.0	44.0	16.0	0.20	0.13	12.90	16.0	88.0	18.1	NA	4.47	249	17	19.7	100
56 **	DNREC	12.0	44.0	15.8	0.20	0.10	12.80	17.0	86.0	17.4	NA	NA	NA	NA	NA	NA
57	DNREC	10.0	20.0	9.0	0.95	0.22	15.00	100.0	61.0	14.2	NA	4.28	381	19	17.6	58
58	DNREC	9.0	28.0	7.1	0.30	<0.10	8.60	38.0	52.0	11.9	NA	6.67	395	22	25.6	70
61	DNREC	19.0	26.0	12.1	0.61	0.43	10.70	64.0	121.0	15.5	NA	6.20	200	11	10.0	60
62 **	DNREC	12.0	18.0	6.0	0.69	0.28	17.50	182.0	109.0	29.0	NA	3.35	476	10	24.2	40
62 **	DNREC	11.0	12.0	8.9	0.65	0.38	18.00	180.0	92.0	37.7	NA	NA	NA	NA	NA	NA
TW-1	DNREC	19.0	30.0	32.3	0.70	0.52	7.90	99.0	138.0	9.2	NA	7.20	84	10	13.7	100
TW-4	DNREC	27.0	30.0	10.8	2.12	1.29	14.00	193.0	124.0	8.3	NA	7.70	103	10	NA	60
RW-1 **	DNREC	40.0	42.0	23.6	0.60	0.30	10.90	0.0	100.0	53.4	NA	7.20	83	16	NA	140
RW-1 **	DNREC	41.0	52.0	23.5	0.60	0.29	11.10	0.0	103.0	24.2	NA	NA	NA	NA	NA	NA
RW-10	DNREC	24.0	44.0	22.6	1.62	1.58	<5.00	1.0	107.0	38.1	NA	6.20	175	12	NA	115
RW-11	DNREC	55.0	56.0	24.0	7.80	3.71	6.00	3.0	154.0	35.8	NA	NA	NA	11	NA	150
RW-12 **	DNREC	110.0	62.0	34.4	3.97*	10.35	18.00	2.0	209.0	50.7	NA	5.90	-18	12	NA	245
RW-12 **	DNREC	110.0	64.0	34.1	3.92*	10.35	23.00	2.0	170.0	53.1	NA	NA	NA	NA	NA	NA
RW-13	DNREC	21.0	34.0	16.8	1.28	0.48	8.30	4.0	133.0	25.4	NA	6.30	142	10	NA	70
RW-14 **	DNREC	107.0	76.0	27.3	4.00*	11.71	23.00	2.0	163.0	46.5	NA	6.45	-5	11	NA	225
RW-14 **	DNREC	102.0	98.0	26.6	0.85*	11.93	20.00	0.0	153.0	33.3	NA	NA	NA	NA	NA	NA
27	DNREC	102.0	54.0	40.7	9.48	9.38	18.00	10.0	185.0	47.6	NA	NA	NA	10	NA	250
28 **	DNREC	116.0	70.0	46.2	3.83*	8.37	29.00	15.0	188.0	46.7	NA	6.39	-71	12	NA	290
28 **	DNREC	117.0	68.0	46.4	3.80*	8.20	32.00	12.0	199.0	45.9	NA	NA	NA	NA	NA	NA
29	DNREC	241.0	116.0	81.0	4.01*	12.94	38.00	19.0	374.0	82.1	NA	7.00	-78	13	NA	500
31	DNREC	64.0	46.0	23.8	2.16	2.04	23.00	3.0	121.0	39.3	NA	NA	NA	14	NA	205
31	EA	53.6	50.0	25.0	2.30	1.45	<5.00	90.0	<5.0	2.4	221	NA	NA	NA	NA	NA

* These data are unusable due to laboratory quality control violations.
** Duplicate analyses
NA Sample not analyzed for this parameter.

Table 5.21
(CONTINUED)
Indicator Parameter Analytical Results of April, 1986
Delaware Sand and Gravel Landfill RI/FS Groundwater Sampling
(milligrams per liter unless otherwise noted)

Well #	Lab	Alkalinity as CaCO3	Hardness	Chloride	Total Nitrogen	Ammonia as N	Sulfate	TSS	TDS	DOC	Specific Cond. (umhos/cm)	DGC Field Measurements				
												pH	Eh (mv)	Temp. (C)	Dissolved Oxygen (% saturation)	Specific Conductance (umhos/cm)
DGC-01d	DNREC	75.0	58.0	10.7	3.11#	3.44	-	82.0	94.0	29.1	NA	6.40	60	14	NA	125
DGC-01s	DNREC	41.0	50.0	20.3	0.49#	0.79	18.00	111.0	2010.0	46.1	NA	5.35	240	12	NA	160
DGC-02d	DNREC	79.0	32.0	12.2	0.45	0.45	18.00	187.0	146.0	12.4	NA	NA	NA	13	NA	125
DGC-02s	DNREC	112.0	90.0	46.4	2.02	1.55	55.00	182.0	275.0	76.4	NA	NA	NA	13	NA	280
DGC-02s	EA	71.2	130.0	45.0	1.50	1.02	13.00	220.0	120.0	42.0	361				NA	
DGC-03d	DNREC	18.0	36.0	12.8	0.55	0.11	6.00	42.0	111.0	28.9	NA	NA	NA	10	NA	80
DGC-03s	DNREC	138.0	146.0	106.5	7.25	4.50	29.00	103.0	457.0	124.0	NA	NA	NA	10	NA	420
DGC-04 ##	DNREC	140.0	90.0	52.7	3.40	2.30	60.60	205.0	406.0	240.0	NA	NA	NA	10	NA	3220
DGC-04 ##	DNREC	144.0	90.0	52.9	3.38	2.23	50.60	196.0	414.0	241.0	NA					
DGC-05	DNREC	54.0	56.0	35.4	1.33	1.12	55.40	168.0	125.0	26.1	NA	6.48	-80	16	13.0	210
DGC-06	DNREC	90.0	106.0	63.2	2.75	2.22	29.00	223.0	309.0	86.7	NA	NA	NA	13	NA	300
DGC-06	EA	62.5	140.0	58.0	2.30	1.44	6.00	250.0	190.0	51.3	406					
DGC-07d##	DNREC	30.0	34.0	14.5	1.55	0.99	86.00	334.0	104.0	22.7	NA	NA	NA	10	NA	85
DGC-07d##	DNREC	26.0	36.0	15.1	1.62	1.03	86.00	321.0	101.0	21.5	NA					
DGC-07s##	DNREC	172.0	200.0	55.3	1.04	0.28	34.00	110.0	375.0	82.6	NA	NA	NA	11	NA	530
DGC-07s##	DNREC	168.0	176.0	55.1	1.06	0.26	38.00	69.0	371.0	83.4	NA					
DGC-08d	DNREC	22.0	32.0	14.0	0.62	0.57	-	25.0	74.0	21.2	NA	6.48	105	13	NA	130
DGC-08s	DNREC	119.0	134.0	57.1	1.60	1.52	29.00	82.0	265.0	59.8	NA	NA	NA	11	NA	325
DGC-09d##	DNREC	52.0	54.0	15.4	0.68	0.27	18.00	35.0	141.0	50.5	NA	7.15	-162	11	NA	140
DGC-09d##	DNREC	53.0	56.0	15.7	0.49	0.33	18.00	51.0	152.0	7.8	NA					
DGC-09s	DNREC	54.0	50.0	29.2	2.06	1.10	23.00	1340.0	124.0	13.8	NA	6.50	-45	12	NA	14
DGC-10d	DNREC	107.0	374.0	14.0	1.08	0.70	47.50	242.0	1566.0	21.7	NA	11.75	71	13	35.0	3250
DGC-10s	DNREC	18.0	26.0	17.3	2.28	1.65	101.10	429.0	145.0	17.8	NA	6.59	157	12	42.0	70
DGC-11d	DNREC	87.0	94.0	4.8	1.29	0.47	21.20	110.0	166.0	25.7	NA	7.46	99	13	70.1	130
DGC-11s	DNREC	190.0	112.0	15.1	2.76	2.23	142.50	1068.0	266.0	NA	NA	7.11	79	11	36.0	145
DGC-12d	DNREC	32.0	28.0	6.4	0.31	0.68	40.00	169.0	85.0	13.5	NA	NA	NA	14	NA	200
DGC-12s	DNREC	465.0	76.0	58.6	1.72	0.27	6.00	88.0	578.0	12.6	NA	NA	NA	13	NA	1325
DGC-13	DNREC	46.0	84.0	9.8	1.04	0.23	75.00	2426.0	222.0	NA	NA	5.36	154	12	NA	150
DGC-13	EA	60.5	130.0	15.0	0.40	-	72.00	200.0	1100.0	1.9	286					
AMC-2	DNREC	11.0	36.0	11.3	0.39	<10.00	<5.00	2.0	85.0	23.9	NA	NA	NA	14	NA	85
AMC-7	DNREC	80.0	30.0	12.4	0.39	<0.10	<5.00	0.0	78.0	28.0	NA	NA	NA	13	NA	70
AMCB-3	DNREC	73.0	38.0	50.4	0.39	<0.10	<5.00	0.0	152.0	18.6	NA	NA	NA	14	NA	150
AMCB-3	EA	11.8	40.0	49.0	<0.10	<0.01	5.00	100.0	<5.0	<0.3	220	NA	NA	NA	NA	NA
B-4	DNREC	32.0	34.0	19.0	3.00	0.00	26.00	95.0	113.0	35.3	NA	6.09	-37	13	NA	160
B-5	DNREC	24.0	24.0	10.6	0.44	0.40	11.66	76.0	81.0	9.0	NA	7.25	27	12	NA	60

\# These data are unusable due to laboratory quality control violations.
Duplicate analyses
\- Non-detectable
NA Sample not analyzed for this parameter.

Table 5.22

Inorganic Analytical Results of April, 1986
Delaware Sand and Gravel Landfill RI/FS Groundwater Sampling
(micrograms per liter)

Well #	Lab	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	Sn	V	Zn
3a	CLP	529	<26	<10	96	<1.0	<5.0	1530 J	<5.0	<7.0	4.3 UJ	6860	<5.0	519	225	<0.1	6.5	894	<5.0	<3.0	4870 UJ	<10	<16	<5.0	23 UJ
26	CLP	<19	<26	<10	39	<1.0	<5.0	6030 J	<5.0	<7.0	4.3 UJ	23600	<5.0	2460	234	<0.1	7.5	1420	<5.0	<3.0	9490 J	<10	<16	<5.0	25 UJ
33	CLP	<23	<26	<10	59	<0.4	<4.0	13000	<4.0	<6.0	7.9	60	<5.0	4750	85	<0.1	14.0	2730	<5.0	<4.0	20900	<10	<18	<5.0	72
45	CLP	<19	<26	<10	56	<1.0	<5.0	9210 J	<5.0	<7.0	5.8 UJ	21	<5.0	3600	52 J	<0.1	<6.0	2570	<5.0	<3.0	9680 J	<10	<16	<5.0	34 J
58	CLP	<23	<26	<10	17	<0.4	<4.0	5620	<4.0	<6.0	7.1	50	<5.0	1640	27	<0.1	8.7	1590	<5.0	<4.0	4520	<10	<18	<5.0	74
61	CLP	<23	<26	<10	73	<0.4	<4.0	6570	<4.0	7.7	5.6	275	<5.0	2300	148	<0.1	7.6	2060	<5.0	<4.0	5720	<10	<18	<5.0	55
62	CLP	<23	<26	<10	14	<0.4	<4.0	3940	<4.0	9.2	6.4	30	<5.0	788	64	<0.1	13.0	1800	<5.0	<4.0	4670	<10	<18	<5.0	62
AMC-2	CLP	<19	<26	<10	61	<1.0	<5.0	7780 J	<5.0	<7.0	9.8 UJ	26	<5.0	3890	5.7 J	<0.1	<6.0	1580	<5.0	<3.0	6970 J	<10	<16	<5.0	9.2 UJ
AMC-7	CLP	<19	<26	<10	58	<1.0	<5.0	6680 J	<5.0	<7.0	8.9 UJ	<16	<5.0	2980	<4.0	<0.1	<6.0	1310	<5.0	<3.0	5740 J	<10	<16	<5.0	11 UJ
AMC-63 *	CLP	<19	<26	<10	72	<1.0	<5.0	8100 J	8.0	<7.0	23 UJ	46	11.0	3600	5.6	<0.1	<6.0	1380	<5.0	<3.0	23100 J	<10	<16	<5.0	14 UJ
AMC-63 *	EA	70	<5	<5	NA	<2.0	<0.5	NA	<2.0	<8.0	20	60	10.0	3750	<10	<0.2	9.0	NA	<2.0	<0.5	NA	<2	<10	<50.0	90
AMC-63 *	CLP	<19	<26	<10	72	<1.0	<5.0	8070 J	9.5	<7.0	24 UJ	46	11.0	3630	4.5	<0.1	7.9	1430	<5.0	<3.0	23100 J	<10	<16	<5.0	12 UJ
B-4	CLP	48	<26	<10	389	<1.0	<5.0	5130 J	9.8	54.0	3.8 UJ	20800	<5.0	1730	1640	<0.1	23.0	2520	<5.0	<3.0	8740 J	<10	<16	<5.0	34
B-5	CLP	<23	<26	<10	14	<0.4	<4.0	5670	<4.0	<6.0	<4.0	489	<5.0	1810	43	<0.1	<6.0	1940	<5.0	<4.0	7330	<10	<18	<5.0	19
DGC-01d	CLP	801	<26	<10	36	<1.0	<5.0	13500 J	6.5	<7.0	5.6 UJ	1090	<5.0	4260	409	<0.1	<6.0	3870	<5.0	<3.0	8770 J	<10	<16	<5.0	20 UJ
DGC-01s	CLP	110	<26	<10	152	<1.0	<5.0	13900 J	8.0	32.0	5.1 UJ	2630	<5.0	4410	207	<0.1	19.0	9260	<5.0	<3.0	9780 J	<10	<16	<5.0	69
DGC-02d	CLP	38	<26	<10	40	<1.0	<5.0	7740 J	<5.0	<7.0	3.6 UJ	51	<5.0	1940	6.5 J	<0.1	<6.0	25200	<5.0	<3.0	20600 J	<10	<16	<5.0	5.3 UJ
DGC-02s *	EA	60	<5	10	NA	<2.0	<0.5	NA	<2.0	15.0	<5.0	38000	<10.0	8000	1770	<0.2	10.0	NA	<2.0	<0.5	NA	<2	<10	<50.0	40
DGC-02s *	CLP	40	<26	<10	123	<1.0	<5.0	18700	6.1	11.0	7.7	39800	<5.0	8510	1780	<0.1	<6.0	6020	<5.0	<3.0	27900 J	<10	<16	<5.0	32 J
DGC-03d	CLP	<19	<26	<10	68	<1.0	<5.0	9310 J	9.3	<7.0	<3.0	180	<5.0	3090	104 J	<0.1	<6.0	2910	<5.0	<3.0	7600 J	<10	<16	<5.0	32 J
DGC-03s	CLP	38	<26	<10	1560	<1.0	<5.0	24000	9.0	37.0	4.5	31800	<5.0	13200	8520	<0.1	7.6	26400	<5.0	<3.0	47900 J	<10	75	<5.0	27 J
DGC-04 *	CLP	20	<26	<10	216	<1.0	<5.0	22900	8.5	47.0	3.6	78800	5.7	10700	3030	<0.1	15.0	4070	<5.0	<3.0	33000 J	<10	<16	<5.0	59 J
DGC-04 *	CLP	20	<26	<10	209	<1.0	<5.0	22400	6.4	47.0	<3.0	78400	<5.0	10500	3010	<0.1	12.0	4000	<5.0	<3.0	31500 J	<10	<16	<5.0	43 J
DGC-05	CLP	<23	<26	<10	669	<0.4	<4.0	7480	<4.0	110.0	<4.0	41000	<5.0	5470	7970	<0.1	31.0	2460	<5.0	<4.0	16900	<10	<18	<5.0	17
DGC-06 *	CLP	26	<26	<10	686	<1.0	<5.0	18900	5.8	106.0	4.3	37500	12.0	9940	6610	<0.1	6.4	3080	<5.0	<3.0	30200 J	<10	<16	<5.0	32 J
DGC-06 *	EA	50	<5	<5	NA	<2.0	<0.5	NA	<2.0	106.0	<5.0	36000	<10.0	9450	6740	<0.2	18.0	NA	<2.0	<0.5	NA	<2	<10	<50.0	50
DGC-07d	CLP	20	<26	<10	95	<1.0	<5.0	8460 J	<5.0	<7.0	7.1 UJ	77	<5.0	1920	174 J	<0.1	<6.0	1460	<5.0	4.0	11200 J	<10	<16	<5.0	47 J
DGC-07s	CLP	40	<26	<10	511	<1.0	<5.0	48700	5.6	95.0	3.7	14800	1370.0	20000	5120	<0.1	27.0	3000	<5.0	<3.0	21600 J	<10	<16	<5.0	42 J
DGC-08d	CLP	<19	<26	<10	185	<1.0	<5.0	6670 J	8.3	51.0	10 UJ	1520	<5.0	1280	564	<0.1	13.0	3540	<5.0	<3.0	8180 J	<10	<16	<5.0	23 UJ
DGC-08s	CLP	<19	<26	<10	729	<1.0	<5.0	23200 J	<5.0	127.0	3.0 UJ	33000	<5.0	15900	9390 J	<0.1	<6.0	4050	<5.0	<3.0	28200 J	<10	<16	<5.0	12 UJ
DGC-09d	CLP	<19	<26	<10	34	<1.0	<5.0	15800 J	9.0	<7.0	4.2 UJ	47	<5.0	2870	174	<0.1	7.9	4610	<5.0	<3.0	17600 J	<10	<16	<5.0	21 UJ
DGC-09s *	CLP	32	<26	<10	413	<1.0	<5.0	11800 J	7.5	17.0	5.7 UJ	1530	<5.0	4670	340	<0.1	14.0	4000	<5.0	<3.0	17200 J	<10	<16	<5.0	49
DGC-09s *	CLP	<19	<26	<10	27	<1.0	<5.0	15700 J	6.7	<7.0	4.0 UJ	47	<5.0	2800	186	<0.1	<6.0	4610	<5.0	<3.0	17800 J	<10	<16	<5.0	22 UJ
DGC-10d	CLP	213	<26	<10	1640	<0.4	<4.0	157000	23.0	<6.0	7.3	25	<5.0	<389	3.3	<0.1	<6.0	410000	<5.0	<4.0	147000	<10	<18	6.7	26
DGC-10s	CLP	<23	<26	<10	162	<0.4	<4.0	7770	<4.0	<6.0	4.7	230	<5.0	1610	38	<0.1	<6.0	6800	<5.0	<4.0	8720	<10	<18	<5.0	71
DGC-11d	CLP	44	<26	<10	115	<0.4	<4.0	33800	<4.0	<6.0	8.2	160	<5.0	2140	33	<0.1	<6.0	5720	<5.0	<4.0	6080	<10	<18	<5.0	33
DGC-12d	CLP	<19	<26	<10	84	<1.0	<5.0	7980 J	8.0	<7.0	7.0 UJ	696	<5.0	1780	80	<0.1	<6.0	1880	<5.0	<3.0	9710 J	<10	<16	<5.0	43
DGC-12s	CLP	38	<26	<10	715	<1.0	<5.0	92400 J	9.5	<7.0	5.4 UJ	63	<5.0	<295	<4.0	<0.1	<6.0	78100	<5.0	<3.0	74700 J	<10	<16	<5.0	8.9 UJ
DGC-13	EA	48000	<5	8	NA	2.0	<1.0	NA	<2.0	11.0	24	41000	30.0	10200	480	<0.2	66.0	NA	<2.0	1.0	NA	<2	<10	60.0	60
RW-10 *	CLP	<19	<26	<10	103	<1.0	<5.0	8220 J	8.3	19.0	4.4 UJ	416	<5.0	4350	270	<0.1	9.6	2950	<5.0	<3.0	10600 J	<10	<16	<5.0	9.5 UJ
RW-10 *	CLP	77	<26	<10	104	<1.0	<5.0	8360 J	9.5	24.0	5.6 UJ	490	<5.0	4690	270	<0.1	11.0	3080	<5.0	<3.0	11000 J	<10	<16	<5.0	9.4 UJ
RW-11	CLP	<19	<26	<10	177	<1.0	<5.0	10300 J	<5.0	15.0	4.3 UJ	6550	<5.0	6130	607 J	<0.1	<6.0	5330	<5.0	<3.0	14500 J	<10	<16	<5.0	12 UJ
RW-12	CLP	25	<26	<10	169	<1.0	<5.0	11300 J	9.0	8.9	4.7 UJ	9850	16.0	6240	698	<0.1	<6.0	9060	<5.0	<3.0	26000 J	<10	<16	<5.0	16 UJ
RW-13	CLP	<23	<26	<10	72	0.5	<4.0	7640	<4.0	10.0	4.5	3600	<5.0	2950	302	<0.1	<6.0	1770	<5.0	<4.0	9380	<10	<18	<5.0	14
RW-14	CLP	29	<26	<10	150	<1.0	<5.0	11700 J	8.0	9.5	5.5 UJ	5840	<5.0	7390	431	<0.1	6.0	9130	<5.0	<3.0	15200 J	<10	<16	<5.0	30
27	CLP	<19	<26	<10	211	<1.0	<5.0	8440 J	<5.0	22.0	3.5 UJ	11200	<5.0	6600	618 J	<0.1	<6.0	12300	<5.0	<3.0	26200 J	<10	<16	<5.0	10 UJ
28	CLP	<19	<26	<10	256	<1.0	<5.0	11700 J	7.3	31.0	5.4 UJ	16700	<5.0	7200	1120	<0.1	6.2	9050	<5.0	<3.0	36700 J	<10	<16	<5.0	7.3 UJ
29	CLP	<19	<26	<10	272	<1.0	<5.0	17900 J	6.0	25.0	4.9 UJ	23000	<5.0	12400	2550	<0.1	<6.0	13900	<5.0	<3.0	78100 J	<10	<16	<5.0	7.3 UJ
31 *	EA	50	<5	<5	NA	<2.0	<0.5	NA	<2.0	<8.0	<5.0	11000	<10.0	4340	910	<0.2	4.0	NA	<2.0	<0.5	NA	<2	<10	<50.0	<50
31 *	CLP	19	<26	<10	108	<1.0	<5.0	8610 J	8.3	7.2	3.3 UJ	10500	<5.0	4350	833	<0.1	<6.0	3310	<5.0	<3.0	16400 J	<10	<16	<5.0	9.9 UJ

* Duplicate analyses
NA Sample not analyzed for this parameter.

Table 5.23

Organic Analytical Results of April, 1986
Delaware Sand and Gravel Landfill RI/FS Groundwater Sampling
(micrograms per liter)

Well #	Lab	Acetone	1,1-dichloroethane	2-butanone (MEK)	1,2-dichloroethene	ethyl benzene	total xylenes	bis (2-ethylhexyl) phthalate	benzene	toluene	bis (2-chloroethyl) ether	methylene chloride	trichloroethene (TCE)	vinyl chloride	4-methyl 2-pentanone (MIBK)	2-methyl phenol (o-cresol)
3a	CLP	8 UJ	<5	9 UJ	<5	<5	3 J	3 UJ	<5	3 J	<10	<5	<5	<10	<10	<10
26	CLP	15 UJ	<5	15 UJ	<5	<5	<5	<10	<5	<5	<10	2 UJ	<5	<10	<10	<10
33	CLP	8 UJ	<5	11 UJ	<5	<5	<5	8 UJ	<5	<5	<10	<5	<5	<10	<10	<10
45	CLP	11 UJ	<5	10 UJ	<5	3 J	11	9 UJ	7	38	<10	<5	2 J	<10	3 J	10
58	CLP	10 UJ	<5	6 UJ	<5	<5	<5	17 UJ	<5	<5	3 J	<5	<5	<10	<10	<10
61	CLP	7 UJ	<5	11 UJ	<5	<5	<5	6 UJ	<5	<5	<10	<5	1 J	1 J	<10	<10
62	CLP	8 UJ	<5	10 UJ	<5	<5	<5	23 UJ	<5	<5	<10	2 UJ	140	<10	<10	<10
AMC-2	CLP	8 UJ	<5	10 UJ	<5	<5	<5	<10	<5	<5	<10	<5	<5	<10	<10	<10
AMC-7	CLP	7 UJ	<5	9 UJ	<5	<5	<5	<10	<5	<5	<10	<5	<5	<10	<10	<10
AMC-83 *	EA	<40	<2	<20	<2	<2	<10	<20	<2	<2	<2	<20	<2	<2	<10	-
AMC-83 *	CLP	9 UJ	<5	10 UJ	<5	<5	<5	<10	<5	<5	<10	<5	<5	<10	<10	<10
AMC-83 *	CLP	10 UJ	<5	9 UJ	<5	<5	<5	<10	<5	<5	<10	<5	<5	<10	<10	<10
B-4	CLP	9 UJ	<5	10 UJ	<5	<5	<5	<10	<5	<5	<10	1 UJ	<5	<10	<10	<10
B-5	CLP	101 P	<5	17 UJ	<5	<5	4 J	4 UJ	1 J	1 J	<10	10 UJ	<5	<10	1 J	<10
BGC-01d	CLP	7 UJ	<5	9 UJ	<5	<5	<5	5 UJ	<5	<5	<10	<5	<5	<10	<10	<10
BGC-01s	CLP	6 UJ	<5	9 UJ	<5	<5	4 J	3 UJ	<5	<5	6 J	1 UJ	<5	<10	<10	<10
BGC-02d	CLP	17 UJ	<5	11 UJ	<5	1 J	4 J	8 UJ	7	43	<10	<5	<5	<10	<10	<10
BGC-02s *	CLP	1900 UJ	<250	1100 UJ	<250	160 J	760	2 UJ	690	5100	310	<250	<250	<500	310 J	25
BGC-02s *	EA	1700	<20	920	21	160	690	<20	670	5200	310	<200	<20	<20	330	-
BGC-03d	CLP	20 UJ	<5	12 UJ	<5	1 J	4 J	7 UJ	<5	<5	<10	<5	<5	<10	4 J	<10
BGC-03s	CLP	1500 UJ	<250	1200 UJ	180 J	690	1100	10 UJ	630	7800	220	<250	<250	<500	650	380
BGC-04 *	CLP	1500 UJ	<250	1000 UJ	<250	220 J	1000	12 UJ	1500	8400	1000	17000	<250	<500	500	63
BGC-04 *	CLP	1500 UJ	<250	1000 UJ	<250	230	1100	8 UJ	1500	8700	140	18000	<250	<500	500	67
BGC-05	CLP	53 UJ	2 J	10 UJ	1 J	5 J	24	2 UJ	18	51	<10	<5	<5	<10	<10	<10
BGC-06 *	CLP	3200 UJ	<250	1200 UJ	<250	230 J	310	3 UJ	89 J	2300	55	64 UJ	<250	<500	<500	3 J
BGC-06 *	EA	1200	<40	450	<40	250	310	<20	97	2300	50	<400	<40	<40	210	-
BGC-07d	CLP	23 UJ	<5	14 UJ	<5	<5	1 J	6 UJ	<5	<5	<10	1 UJ	<5	<10	<10	<10
BGC-07s	CLP	520 UJ	<50	350 UJ	14 J	140	260	7 UJ	1100	1900	56	<50	130	18 J	63 J	<10
BGC-08d	CLP	8 UJ	<5	8 UJ	<5	<5	2 J	2 UJ	<5	<5	<10	2 UJ	<5	<10	<10	<10
BGC-08s	CLP	72 UJ	<25	57 UJ	<25	70	190	4 UJ	460	390	240	<25	<25	<50	<50	<10
BGC-09c	CLP	3 UJ	<5	4 UJ	<5	<5	<5	<10	<5	<5	<10	<5	<5	<10	<10	<10
BGC-09d	CLP	11 UJ	<5	6 UJ	<5	<5	<5	15 UJ	<5	<5	<10	1 UJ	<5	<10	<10	<10
BGC-09s *	CLP	470	<5	92 P	<5	10	21	5 UJ	11	30	17	3 UJ	<5	<10	11	<10
BGC-09s *	CLP	650	<5	110 P	<5	8	18	<10	10	25	<10	2 UJ	<5	<10	8 J	<10
BGC-10d	CLP	21 UJ	<5	10 UJ	<5	<5	3 J	5 UJ	<5	2 J	<10	<5	<5	<10	<10	<10
BGC-10s	CLP	120 P	<5	8 UJ	<5	<5	<5	<10	<5	<5	<10	2 UJ	1 J	<10	<10	<10
BGC-11d	CLP	8 UJ	<5	8 UJ	<5	<5	<5	3 UJ	<5	<5	<10	<5	<5	<10	<10	<10
BGC-11s	CLP	15 UJ	<5	7 UJ	<5	<5	<5	<10	<5	<5	<10	<5	<5	<10	<10	<10
BGC-12d	CLP	9 UJ	<5	11 UJ	<5	<5	<5	<10	<5	<5	<10	2 UJ	<5	<10	<10	<10
BGC-12s	CLP	17 UJ	<5	12 UJ	<5	<5	<5	4 UJ	<5	<5	<10	1 UJ	<5	<10	<10	<10
BGC-13 *	CLP	9 UJ	<5	10 UJ	<5	<5	<5	<10	<5	<5	<10	2 UJ	<5	<10	<10	<10
BGC-13 *	EA	<40	<2	<20	<2	<2	<10	<20	<2	<2	<2	<20	<2	<2	<10	-
RW-10 *	CLP	4 UJ	<5	5 UJ	<5	<5	<5	2 UJ	<5	<5	<10	<5	<5	<10	<10	<10
RW-10 *	CLP	4 UJ	<5	<10	<5	<5	<5	<10	<5	<5	<10	1 UJ	<5	<10	<10	<10
RW-11	CLP	8 UJ	<5	9 UJ	<5	<5	<5	3 UJ	<5	<5	6 J	<5	<5	<10	<10	<10
RW-12	CLP	8 UJ	<5	10 UJ	<5	<5	<5	<10	7	5	3 J	<5	<5	<10	<10	<10
RW-13	CLP	16 UJ	<5	10 UJ	<5	1 J	30	2 UJ	<5	<5	4 J	<5	<5	<10	8 J	<10
RW-14	CLP	6 UJ	<5	13 UJ	<5	<5	<5	2 UJ	<5	<5	<10	3 UJ	<5	<10	<10	<10
27	CLP	7 UJ	2 J	9 UJ	<5	<5	<5	2 UJ	1 J	<5	4 J	<5	<5	<10	<10	<10
28	CLP	8 UJ	<5	9 UJ	<5	<5	<5	<10	3 J	<5	14	<5	<5	<10	<10	<10
29	CLP	8 UJ	2 J	9 UJ	2 J	4 J	<5	<10	9	<5	32	<5	2 J	<10	<10	<10
31 *	CLP	18 UJ	<5	7 UJ	<5	10	49	3 UJ	6	8	11 UJ	<5	<5	<10	6 J	4 J
31 *	EA	<40	<2	<20	<2	8	43	<20	14	16	13	<20	<2	<2	<10	-

* Duplicate analyses
\- Analytical data is not available.
J Estimated quantity because quality control criteria were not met.
P Preliminary: Blank contamination precludes confirmation of compound presence and quantity.
UJ A compound was detected but not in high enough concentrations to confirm its presence.

Table 5.23 (cont'd)

Organic Analytical Results of April, 1986
Delaware Sand and Gravel Landfill RI/FS Groundwater Sampling
(micrograms per liter)

Well #	Lab	di-n butyl phthalate	1,2-dichloro ethane	chloro benzene	1,4-dichloro benzene	styrene	4-methyl phenol (p-cresol)	benzoic acid	naph-thalene	diethyl phthalate	phenol	benzyl alcohol	1,2-dichloro benzene	chloro-form	tetra chloro ethene (PCE)	2,4-dimethyl phenol	2,4-dichloro phenol
3a	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
26	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
33	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
45	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
58	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
61	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
62	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
AMC-2	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
AMC-7	CLP	<10	9	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
AMC-63 *	EA	<2	<2	<2	<2	-	-	-	<2	<2	<2	-	<2	<2	<2	<2	<4
AMC-63 *	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
AMC-63 *	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
B-4	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
B-5	CLP	<10	5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-01d	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-01s	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-02d	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-02s *	CLP	<10	<250	<250	<10	68 J	41	210	2 J	5 J	68	3 J	<10	<250	<250	4 J	<10
DGC-02s *	EA	<2	<20	<20	<2	-	-	-	3	2	93	-	<2	<20	<20	6	<4
DGC-03d	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-03s	CLP	<50	<250	<250	<50	<250	25 J	88 J	<50	<50	<10	<50	10 J	<250	<250	<50	<50
DGC-04 *	CLP	<60	2600	<250	<60	120 J	210	<300	<60	<60	1200	<60	<60	<250	<250	<60	13 J
DGC-04 *	CLP	<40	2800	<250	<40	125 J	260	<200	6 J	8 J	1700	16 J	<40	<250	<250	6 J	16 J
DGC-05	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-06 *	CLP	<10	<250	<250	<10	<250	<10	64	2 J	<10	<10	<10	<10	<250	<250	<10	<10
DGC-06 *	EA	<2	76	<40	<2	-	-	-	<2	<2	12	-	<2	<40	<40	<2	<4
DGC-07d	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-07s	CLP	<10	590	24 J	<10	<50	<10	14 J	7 J	<10	<10	<10	<10	13 J	12 J	<10	<10
DGC-08d	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-08s	CLP	<10	<25	10 J	<10	<25	<10	<50	<10	<10	<10	<10	<10	<25	<25	<10	<10
DGC-09c	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-09d	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-09s *	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-09s *	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-10d	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-10s	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-11d	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-11s	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-12d	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-12s	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-13 *	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
DGC-13 *	EA	<2	<2	<2	<2	-	-	-	<2	<2	<2	-	<2	<2	<2	<2	<4
RW-10 *	CLP	<10	33	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
RW-10 *	CLP	<10	30	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
RW-11	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
RW-12	CLP	<10	<5	5	3 J	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
RW-13	CLP	<10	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
RW-14	CLP	<10	<5	5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
27	CLP	<10	<5	2 J	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
28	CLP	<10	6	5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
29	CLP	<10	7	22	9 J	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
31 *	CLP	2 J	<5	<5	<10	<5	<10	<50	<10	<10	<10	<10	<10	<5	<5	<10	<10
31 *	EA	<2	<2	<2	<2	-	-	-	<2	<2	<2	-	<2	<2	<2	<2	<4

* Duplicate analyses
- Analytical data is not available.
J Estimated quantity because quality control criteria were not met.

Appendix B

Analytical Data of Soils at
Delaware Sand and Gravel Landfill

Table 5.10
Inorganic Analytical Results of the April, 1985
Delaware Sand and Gravel Landfill RI/FS Surface Soil Sampling
(in micrograms per gram)

Soil Sample #	Fe	Mn	Cr	Ag	Zn	Pb	Cd	Hg	As	Se	Ba	Cu	Ca	Ni	Be	V	Sb	Tl	Co	Sn	Al	Mg
S1	67,449	550	23.98	<10	67.86	29.08	<10	<0.40	4.08	<0.50	121.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S2	10,828	224	13.73	<10	20.36	10.89	<10	<0.40	<3.00	<0.50	53.50	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S3*	28,342	300	15.32	<10	44.06	33.52	<10	<0.40	<3.00	<0.50	73.28	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S3*	22,634	307	13.89	<10	51.72	26.69	<10	<0.40	<3.00	<0.50	73.75	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S4	30,880	466	18.72	<10	43.52	20.75	<10	<0.40	<3.00	<0.50	96.66	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S5	14,314	354	13.31	<10	31.56	22.68	<10	<0.40	<3.00	<0.50	69.53	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S6	36,388	693	20.62	<10	63.38	41.25	<10	<0.40	<3.00	<0.50	108.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S7	37,223	412	19.98	<10	60.94	24.98	<10	<0.40	<3.00	<0.50	103.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S8	56,573	290	23.81	<10	63.14	40.89	<10	<0.40	3.73	<0.50	110.00	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S9	18,824	251	13.89	<10	28.77	23.81	<10	<0.40	<3.00	<0.50	88.29	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S10	14,176	151	10.66	<10	22.29	14.53	<10	<0.40	<3.00	<0.50	36.82	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S11	19,405	349	10.30	<10	24.34	16.38	<10	<0.40	<3.00	<0.50	41.67	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S12	15,656	598	11.11	<10	78.89	17.68	<10	<0.40	<3.00	<0.50	45.45	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S13	62,546	139	<10.00	<10	16.48	<10.00	<10	<0.40	<3.00	<0.50	21.48	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S14	7,659	123	<10.00	<10	39.65	67.69	<10	<0.40	3.09	<0.50	12.57	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
S15	11,616	380	11.18	<10	42.17	35.06	<10	<0.40	3.76	<0.50	88.92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

* Duplicate analyses were performed on this sample. The results presented are the highest between the duplicates.
NA Sample not analyzed for this parameter.

Table 5.11
Inorganic Analytical Results of April, 1986
Delaware Sand and Gravel Landfill RI/FS Surface Soil Sampling
(milligrams per kilogram)

Sample Site	Percent Moisture	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	Sn	V	Zn
B-01	10.0	2070	(14	(5.6	23.0	0.82	(2.8	479	15.0	(3.9	23 J	8300	50 J	221	141 J	(0.056	13.0	(301	(2.8	(1.7	(363	(5.6	(8.9	11.0	50 J
B-01d	24.0	4070	(17	(6.6	8.8	(0.66	(3.3	(232	6.9	210	24	2460	8.6 J	(194	43	0.130	8.3	(357	(3.3	(2.0	(430	(6.6	(11.0	3.9	62.0
B-01s	24.0	3190	(17	(6.6	9.3	(0.66	(3.3	(232	11.0	214	48	6660	12 J	(194	30	0.160	9.7	(357	(3.3	(2.0	(430	(6.6	(11.0	(3.3	65.0
B-02d	16.0	2210	(15	(6.0	36.0	(0.60	(3.0	1730	27.0	30	76	37100	19 J	974	517	0.071	28.0	743	(30.0	(1.8	(389	(6.0	(9.5	5.1	32.0
B-02s	18.0	8280	(16	6.1	86.0	0.68	(3.0	1980	44.0	428	50	27000	60 J	3990	157	2.700	20.0	1180	(3.0	(1.8	(398	(6.1	(9.8	39.0	120
B-03d	22.0	8860	(17	(6.4	86.0	(0.64	(3.2	372	138.0	82 J	304 J	33400	100 J	2260	619 J	0.910	32.0	443	(3.2	(1.9	(419	(6.4	14 J	61.0	104 J
B-03s	20.0	2260	(16	(6.3	42.0	0.68	(3.1	270	38.0	245 J	133 J	21900	55 J	923	172 J	0.650	8.9	458	(3.1	2.1	(408	(6.3	(10.0	14.0	57 J
B-04d	14.0	447	(15	(5.8	26.0	(0.58	(2.9	233	20.0	351 J	73 J	21700	14 J	(172	118 J	(0.058	5.4	(315	(2.9	1.8	(380	(5.8	(9.3	3.1	11 J
B-04s	36.0	277	(20	(7.8	18.0	(0.78	(3.9	(275	11.0	260 J	519 J	2950	70 J	(230	9.4 J	0.190	7.1	(423	(3.9	(2.3	(510	(7.8	(12.0	(3.9	5.1 J
B-05d	24.0	12300	(18	12.0	82.0	1.20	(3.4	1580	45.0	37 J	51 J	24300	19 J	5900	258 J	(0.068	24.0	1410	(3.4	(2.0	(441	(6.8	(11.0	36.0	117 J
B-05s	6.0	3790	(14	(5.3	48.0	(0.53	(2.7	1150	24.0	57 J	55 J	12800	54	1260	702 J	1.280	13.0	449	(2.7	(1.6	605 J	(5.3	(8.5	17.0	117 J
B-06d	16.0	11900	(15	(6.0	63.0	1.00	(3.0	749	24.0	5.6 J	14 J	22600	9.5 J	2210	167 J	(0.060	9.6	508	(3.0	2.1	477 J	(6.0	(9.5	35.0	30 J
B-06s	16.0	9250	(15	(6.0	54.0	1.30	(3.0	446	22.0	8.2 J	9.6 J	18500	14 J	945	283 J	(0.060	6.5	411	(3.0	2.7	678 J	(6.0	(9.5	32.0	23 J
B-07d	12.0	264	(15	(5.7	40.0	(0.57	(2.8	(200	9.2	(4.0	15 J	2820	12 J	(168	46 J	0.200	(3.4	(308	(2.8	(1.7	(371	(5.7	(9.1	(2.8	6.8 J
B-07s	6.0	1480	(14	(5.3	58.0	1.00	(2.7	414	33.0	15 J	66 J	28000	31 J	211	1190 J	1.020	12.0	404	(2.7	1.6	560 J	(5.3	(8.5	6.9	25 J
R-01d	14.0	2410	(15	(5.8	18.0	(0.58	(2.9	309	6.0	(4.1	5.1	5850	5.7 J	182	130	(0.058	3.9	(315	(2.9	(1.7	(380	(5.8	(9.3	17.0	31.0
R-01s	18.0	6200	(16	(6.1	40.0	(0.61	(3.0	1210	11.0	6.3	9.5	13600	110	545	242	(0.061	10.0	377	(3.0	(1.8	(398	(6.1	(9.8	30.0	50.0
R-02d	15.0	8590	(15	(5.9	45.0	(0.59	(2.9	(207	11.0	12	7.0	15500	7.1 J	494	468	(0.059	7.8	(319	(2.9	(1.8	(384	(5.9	(9.4	29.0	21.0
R-02s	13.0	3520	(15	(5.7	19.0	(0.57	(2.9	(202	6.7	(4.0	6.7	8040	11 J	212	141	(0.057	5.0	(312	(2.9	(1.7	(375	(5.7	(9.2	19.0	17.0
R-03d	20.0	4800	(16	(6.3	33.0	(0.63	(3.1	255	8.5	4.4	7.6	8590	8.1 J	321	136	(0.063	4.9	(339	(3.1	(1.9	(408	(6.3	(10.0	22.0	16.0
R-03s	24.0	9380	(17	7.9	47.0	1.00	(3.3	745	13.0	10	8.9	18200	25 J	671	577	(0.066	11.0	456	(3.3	(2.0	(430	(6.6	(11.0	38.0	34.0
R-04d	20.0	10500	(16	(6.3	52.0	0.94	(3.1	245	14.0	8.6	13	16900	7.5 J	547	273	(0.063	13.0	384	(3.1	(1.9	(408	(6.3	(10.0	39.0	35.0
R-04s	18.0	6000	(16	(6.1	31.0	(0.61	(3.0	326	9.7	6.3	7.3	11100	7.3 J	357	196	(0.061	6.8	(330	(3.0	(1.8	(398	(6.1	(9.8	24.0	18.0
R-05d	22.0	11200	(17	(6.4	65.0	1.20	(3.2	354	16.0	9.6	8.6	22900	9.6 J	689	461	(0.064	10.0	402	(3.2	(1.9	(419	(6.4	(10.0	45.0	29.0
R-05s	18.0	7110	(16	(6.1	34.0	(0.61	(3.0	364	11.0	6.5	8.8	14200	11 J	467	305	(0.061	7.2	369	(3.0	(1.8	(398	(6.1	(9.8	29.0	23.0
R-06	10.0	4850	(14	(5.6	47.0	(0.56	(2.8	(196	6.4	(3.9	7.5	9790	9.4 J	285	132	(0.056	4.7	(301	(2.8	(1.7	(363	(5.6	(8.9	16.0	16.0
R-07 e	NA	10200	89	16.0	8020.0	0.83	23.0	10300	222.0	23 J	393 J	123000	4750	1850	1540 J	(0.062	158.0	776	(3.1	3.7	889 J	(6.3	116 J	44.0	6380 J
R-07 s	20.0	8920	122	92.0	4450.0	0.79	29.0	21100	158.0	8.3	2200	44000	5400	1550	384	0.075	125.0	569	(3.1	(1.9	1140	(6.3	229	93.0	9140
R-08	19.0	24200	(16	27.0	185.0	0.89	(3.1	3560	24.0	8.9	219	32800	420	820	392	(0.062	19.0	1210	(3.1	(1.9	(403	(6.2	19.0	52.0	309
R-09d e	28.0	10800	(18	(6.9	58.0	0.79	(3.5	976	16.0	7.1	9.5	17900	13 J	625	237	(0.069	13.0	438	(3.5	(2.1	(453	(6.9	(11.0	40.0	40.0
R-09d e	32.0	6560	(19	(7.4	55.0	(0.74	(3.7	1090	13.0	7.1	12	15600	9.6 J	537	286	(0.074	12.0	(399	(3.7	(2.2	(480	(7.4	(12.0	33.0	41.0
R-09s	31.0	10700	(19	(7.2	75.0	1.40	(3.6	546	19.0	11	13	23000	29 J	700	580	(0.072	11.0	481	(3.6	(2.2	(473	(7.2	(12.0	52.0	39.0
R-10	18.0	15200	(16	6.7	64.0	1.40	(3.0	265	17.0	9.1	7.9	19300	9.8 J	622	260	(0.061	13.0	570	(3.0	(1.8	(398	(6.1	(9.8	42.0	28.0
R-11	20.0	13700	(16	(6.3	68.0	1.40	(3.1	282	17.0	10	11	22100	10 J	762	351	(0.063	12.0	540	(3.1	(1.9	(403	(6.3	(10.0	43.0	34.0
R-12	20.0	14600	(16	8.1	70.0	1.20	(3.1	(220	22.0	5.1	29	27600	20 J	683	222	(0.063	14.0	472	(3.1	2.3	(408	(6.3	(10.0	50.0	32.0
R-13d	13.0	4180	25	(5.7	29.0	0.69	(2.9	1190	7.7	6.1	6.8	10000	10 J	440	233	(0.057	6.1	(312	(2.9	(1.7	(375	(5.7	(9.2	19.0	26.0
R-13s	14.0	3220	(15	(5.8	28.0	(0.58	(2.9	402	8.8	5.0	6.4	8880	12 J	382	264	(0.058	5.1	(315	(2.9	(1.7	(380	(5.8	(9.3	19.0	19.0
R-14d	12.0	7370	(15	(5.7	37.0	0.67	(2.8	(200	11.0	(4.0	21	12800	6.2 J	312	115	(0.057	5.7	(308	(28.0	(1.7	(371	(5.7	(9.1	24.0	15.0
R-14s	39.0	344	239	(82.0	121.0	(0.82	(4.1	1090	81.0	8.4	17100	117000	172	(242	345	1.500	15.0	870	(41.0	(2.5	1690 J	(82.0	(13.0	(4.1	(1.6
R-15	12.0	9970	(16	(6.0	41.0	0.93	(3.0	(212	14.0	8.7	8.2	14900	6.6 J	473	289	0.072	10.0	387	(3.0	1.8	(393	(6.0	(9.6	32.0	23.0
R-16	19.0	14400	(16	(6.2	88.0	1.40	(3.1	237	18.0	8.9	8.8	22800	9.3 J	719	381	(0.062	12.0	526	(3.1	(1.9	(403	(6.2	(9.9	47.0	31.0
R-17	20.0	14600	(16	6.2	89.0	1.40	(3.1	261	19.0	9.4	25	24500	18 J	683	412	(0.063	13.0	480	(3.1	(1.9	(408	(6.3	(10.0	55.0	32.0

s,d 's' suffix implies 0-1' sampling interval; 'd',suffix implies 2-3' sampling interval; no designation implies single sample at location from 0-1'
e Duplicate analyses
J Estimated quantity because quality control criteria were not met
NA Sample not analyzed for this parameter.

Table 5.12

Organic Analytical Results of April, 1986
Delaware Sand and Gravel Landfill RI/FS Surface Soil Sampling
(micrograms per kilograms)

Sample Site	Percent Moisture	Methylene Chloride	Acetone	2-butanone (MEK)	tri-chloro-ethene	4-methyl-2-pentanone (MIBK)	2-hexanone	tetra-chloro-ethene	Toluene	Ethyl Benzene	Total Xylenes	Napthalene	di-benzo-furan	phen-anthrene	di-n-butyl phthalate
B-01	0	2 UJ	<10	<10	<5	<10	<10	<5	<5	<5	<5	<3700	<3700	<3700	<3700
B-01d	32	<7	<15	<15	250	63	<15	66	120	<7	90	<29000	<29000	<29000	<29000
B-01s	20	4 UJ	25 UJ	14	3 J	<13	<13	<6	3 UJ	<6	<6	<25000	<25000	<25000	<25000
B-02d	22	5 UJ	21 UJ	<13	<6	<13	<13	<6	<6	<6	<6	<26000	<26000	<26000	<26000
B-02s	6	1 UJ	55 UJ	<11	23 JN	<11	<11	<5	20	<5	11	<21000	<21000	<21000	<21000
B-03d	17	1 UJ	19 UJ	<12	<6	<12	<12	<6	1 UJ	<6	<6	<24000	<24000	<24000	<24000
B-03s	22	6 UJ	21 UJ	<13	<6	<13	<13	<6	1 UJ	<6	4 J	<26000	<26000	<26000	<26000
B-04d	13	5 UJ	23 UJ	<11	<6	<11	<11	<6	1 UJ	<6	5	<23000	<23000	<23000	<23000
B-04s	29	3 UJ	180 UJ	<14	<7	<14	<14	<7	1 UJ	<7	13	<140000	<140000	<140000	<140000
B-05d	28	3 UJ	15 UJ	<14	<7	<14	<14	<7	<7	<7	<7	<460	<460	93	<460
B-05s	11	2 UJ	<11	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	<370	<370
B-06d	14	2 UJ	15 UJ	<12	<6	<12	<12	<6	<6	<6	<6	<390	<390	<390	<390
B-06s	5.21	2 UJ	<11	<11	<5	<11	<11	<5	<5	<5	<5	<410	<410	<410	<410
B-07d	10	3 UJ	12 UJ	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	<370	<370
B-07s	6	2 UJ	13 UJ	<11	<5	<11	<11	<5	<5	<5	<5	<350	<350	<350	<350
R-01d	15	1 UJ	9 UJ	<12	<6	<12	<12	<6	<6	<6	<6	<390	<390	<390	<390
R-01s	15	4 UJ	9 UJ	<12	<6	<12	<12	<6	<6	<6	<6	<390	<390	<390	240 J
R-02d	18	2 UJ	<12	<12	<6	<12	<12	<6	<6	<6	<6	<410	<410	<410	<410
R-02s	16	1 UJ	<12	<12	<6	<12	<12	<6	<6	<6	<6	<400	<400	<400	<400
R-03d	25	5 UJ	<13	<13	<7	<13	<13	<7	<7	<7	<7	<440	<440	<440	<440
R-03s	23	6 UJ	<13	<13	<6	<13	<13	<6	1 UJ	<6	<6	<430	<430	<430	<430
R-04d	21	1 UJ	6 UJ	<13	1 UJ	<13	<13	<6	<6	<6	<6	<420	<420	<420	<420
R-04s	25	1 UJ	<13	<13	1 UJ	<13	<13	<7	<7	<7	<7	<440	<440	<440	<440
R-05d	12	1 UJ	<11	<11	1 UJ	<11	<11	<6	<6	<6	<6	<380	<380	<380	<380
R-05s	21	4 UJ	<13	<13	<6	<13	<13	<6	<6	<6	<6	<420	<420	<420	<420
R-06	10	2 UJ	<11	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	<370	<370
R-07 #	10	3 UJ	<11	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	74 J	160
R-07 #	9	2 UJ	11 UJ	<11	<5	<11	<11	<5	<5	<5	<5	110 J	<370	62 JN	<370
R-08	10	2 UJ	<11	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	<370	<370
R-09d #	38	3 UJ	15 UJ	<16	<8	<16	<16	<8	<8	<8	<8	<540	<540	<540	<540
R-09d #	36	2 UJ	<16	5 J	<8	<16	<16	<8	<8	<8	<8	<520	<520	<520	<520
R-09s	29	1 UJ	46 UJ	46	<7	63	90	<7	<7	1 J	<7	<470	<470	<470	<470
R-10	18	2 UJ	<12	<12	<6	<12	<12	<6	1 UJ	<6	<6	<410	<410	<410	<410
R-11	24	1 UJ	11 UJ	<13	<7	<13	<13	<7	3 UJ	<7	<7	<440	<440	<440	<440
R-12	21	3 UJ	<13	4 J	<6	<13	<13	<6	1 UJ	<6	<6	<420	<420	<420	<420
R-13d	10	1 UJ	<11	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	<370	300 J
R-13s	10	2 UJ	<11	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	<370	410
R-14d	16	1 UJ	<12	<12	<6	<12	<12	<6	<6	<6	<6	<400	<400	<400	<400
R-14s	7	2 UJ	<11	<11	<5	<11	<11	<5	<5	<5	<5	<18000	14000	<18000	<18000
R-15	10	2 UJ	<11	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	<370	<370
R-16	10	2 UJ	<11	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	<370	<370
R-17	10	1 UJ	<11	<11	<6	<11	<11	<6	<6	<6	<6	<370	<370	<370	<370

s,d 's' suffix implies 0-1' sampling interval; 'd' suffix implies 2-3 sampling interval; no designation implies single sample at location from 0-1 .
Duplicate analyses
J Estimated quantity because quality control criteria were not met
N Tentative identification
UJ A compound was detected but not in high enough concentrations to confirm its presence.

Table 5.12 (cont'd)

Organic Analytical Results of April, 1986
Delaware Sand and Gravel Landfill RI/FS Surface Soil Sampling
(micrograms per kilogram)

Sample Site	Fluoranthene	Pyrene	butyl-benzyl-phthalate	bis (2-ethyl hexyl) phthalate	beta-BHC	gamma-BHC	heptachlor-epoxide	methoxychlor	PCB-1254	PCB-1260	Phenol	benzo(a) pyrene	dichloro benzene isomer	1,1,1-trichloroethane
B-01	<3700	<3700	<3700	<3700	<190	<190	<190	<1900	<3700	<3700	<3700	<3700	NA	<5
B-01d	<29000	<29000	<29000	17400 J	<250	<250	680 R	<2500	<4900	<4900	<29000	<29000	122 J	<7
B-01s	<25000	<25000	<25000	12500 J	<42	130 R	140 R	<420	<830	<830	<25000	<25000	NA	5 JN
B-02d	<26000	<26000	<26000	<26000	<850	<850	<850	<8500	<17000	<17000	<26000	<26000	NA	<6
B-02s	<21000	<21000	<21000	<21000	<180	34 R	<180	<1800	<3500	<3500	<21000	<21000	43 J	<5
B-03d	<24000	<24000	<24000	87000	<78	<78	<78	<780	7600	<1600	<24000	<24000	NA	<6
B-03s	<26000	<26000	<26000	<26000	<210	<210	<210	<2100	<4100	<4100	<26000	<26000	NA	<6
B-04d	<23000	<23000	<23000	<23000	<190	<190	<190	<1900	<3700	<3700	<23000	<23000	NA	<6
B-04s	<140000	<140000	<140000	<140000	<140	<140	<140	<1400	<2800	<2800	<140000	<140000	NA	<7
B-05d	<460	46	<460	<460	<230	<230	<230	<2300	<4700	<4700	<460	<460	NA	<7
B-05s	<370	<370	<370	300	<37	<37	<37	<370	<750	<750	<370	<370	NA	<6
B-06d	<390	<390	<390	<390	<3.9	<3.9	<3.9	<39	<78	<78	<390	<390	NA	<6
B-06s	<410	<410	<410	<410	<4.1	<4.1	<4.1	<41	<81	<81	<410	<410	NA	<5
B-07d	<370	<370	<370	<370	<37	<37	<37	<370	<740	<740	<370	<370	NA	<6
B-07s	<350	<350	<350	<350	<18	<18	<18	<180	<350	<350	<350	<350	NA	<5
R-01d	<390	<390	<390	<390	<3.9	<3.9	<3.9	<39	<78	<78	<390	<390	NA	<6
R-01s	<390	<390	<390	<390	<3.9	<3.9	<3.9	<39	<78	210	<390	<390	NA	<6
R-02d	<410	<410	<410	<410	<4.1	<4.1	<4.1	<41	<81	<81	<410	<410	NA	<6
R-02s	<400	<400	<400	<400	<4.0	<4.0	<4.0	<40	<79	<79	<400	<400	NA	<6
R-03d	<440	<440	<440	<440	<4.4	<4.4	<4.4	<44	<89	<89	<440	<440	NA	<7
R-03s	<430	<430	<430	<430	<4.3	<4.3	<4.3	<43	<87	<87	<430	<430	NA	<6
R-04d	<420	<420	<420	<420	<4.2	<4.2	<4.2	<42	<84	<84	<420	<420	NA	<6
R-04s	<440	<440	<440	<440	<4.4	<4.4	<4.4	<44	<89	<89	<440	<440	NA	<7
R-05d	<380	<380	<380	<380	<3.8	<3.8	<3.8	<38	<76	<76	<380	<380	NA	<6
R-05s	<420	<420	<420	<420	<4.2	<4.2	<4.2	<42	<84	<84	<420	<420	NA	<6
R-06	<370	<370	<370	<370	<3.7	<3.7	<3.7	<37	<74	<74	<370	<370	NA	<6
R-07 *	110 J	37 J	1400	330 J	<37	<37	<37	<370	1500	<740	50 JN	66 J	NA	<6
R-07 *	<370	<370	<370	180	<3.7	<3.7	<3.7	<37	220 J	<73	34 JN	<370	NA	<5
R-08	<370	<370	<370	<370	<3.7	<3.7	<3.7	<37	<74	<74	<370	<370	NA	<6
R-09d *	<540	<540	<540	<540	<5.4	3.9 R	<5.4	<54	190	<110	<540	<540	NA	<8
R-09d *	<520	<520	<520	<520	<5.2	2.7 R	<5.2	<52	150	<100	<520	<520	13 JN	<8
R-09s	<470	<470	<470	<470	<4.7	5.1 R	<4.7	<47	<94	<94	<470	<470	NA	<7
R-10	<410	<410	<410	<410	8 R	3.7 R	<4.1	<41	<81	<81	<410	<410	NA	<6
R-11	<440	<440	<440	<440	42 R	7.7 R	<4.4	<44	<88	<88	<440	<440	NA	<7
R-12	<420	<420	<420	<420	<4.2	<4.2	<4.2	<42	97	<84	<420	<420	NA	<6
R-13d	<370	<370	<370	<370	<3.7	<3.7	<3.7	<37	<74	<74	160 JN	<370	NA	<6
R-13s	<370	<370	<370	<370	<3.7	<3.7	<3.7	<37	<74	<74	160 JN	<370	NA	<6
R-14d	<400	<400	<400	<400	<4.0	<4.0	<4.0	<40	<79	<79	<400	<400	NA	<6
R-14s	<18000	<18000	<18000	<18000	<720	<720	<720	<7200	49000	<14000	<18000	<18000	NA	2 JN
R-15	<370	<370	<370	<370	<3.7	<3.7	<3.7	<37	<74	<74	<370	<370	NA	<6
R-16	<370	<370	<370	<370	<3.7	<3.7	<3.7	<37	<74	<74	<370	<370	NA	<6
R-17	<370	<370	<370	<370	<3.7	<3.7	<3.7	<37	<74	<74	<370	<370	NA	<6

s,d 's' suffix implies 0-1' sampling interval; 'd' suffix implies 2-3' sampling interval; no designation implies single sample at location from 0-1'.
* Duplicate analyses
J Estimated quantity because quality control criteria were not met
N Tentative identification
R Quality Control criteria indicates that data are unusable. (Compound may or may not be present.)
NA Sample not analyzed for this compound.

Table 5.15
Inorganic Analytical Results of February/March, 1986
Delaware Sand and Gravel Landfill RI/FS Soil Boring Sampling
(milligrams per kilogram)

Well #	Samp. #	Depth (ft)	Zone Sampled	Percent Moisture	Al	Sb	As	Ba	Be	Cd	Ca	Cr	Co	Cu	Fe	Pb	Mg	Mn	Hg	Ni	K	Se	Ag	Na	Tl	Sn	V	Zn
DGC-04	S-6	6-8	C	33.5	48700	<38	8.8	146	2.6	<3.0	720	36.0	22	<12	46900	6.8	1260	984	<0.14	24	474	<3.0	<5.3	<2030	<4.5	<20	101	42
DGC-04	S-7	12-14	C	40.1	33400	<42	18.0	116	<2.5	<3.3	808	30.0	31	<13	53900	18.0	1410	1060	<0.16	28	532	<3.3	<5.8	<2250	<5.0	<23	71	39
DGC-04	S-10	18-20	C	14.6	7030	<29	<4.7	<39	<1.8	<2.3	<350	15.0	<12	<9.4	28100	4.1	289	86	<0.11	<12	<293	<2.3	<4.1	<1580	<3.5	<16	23	<10
DGC-04	S-12	25-27	C	10.3	3300	<28	<4.5	<37	<1.7	<2.2	<333	4.8	<11	<8.9	11900	4.7	188	33	<0.11	<11	<279	<2.2	<3.9	<1510	<3.3	<15	<17	<9.5
DGC-04	S-13	30-32	C	13.5	6320	<29	<4.6	<39	<1.7	<2.3	<346	7.1	<12	<9.2	14700	2.9 J	433	130	<0.11	<12	<289	<2.3	<4.0	<1560	<3.5	<16	<17	18
DGC-04	S-16	45-47	UPcc	18.8	1040	<31	<4.9	<41	<1.8	<2.5	500	6.6	<12	9.9	2270	8.0 J	247	8.7	<0.12	<12	310	<2.5	<4.3	<1660	<3.7	<17	18	<10
DGC-04 *	S-17	50-52	UPcc	14.8	2120	<29	<4.7	<39	2.3	<2.3	691	69.0	<12	39	11800	7.0 J	240	42	<0.11	13	569	<2.3	<4.1	<1580	<3.5	<16	92	18
DGC-04 *	S-17	50-52	UPcc	15.4	1380	<30	<4.7	<40	<1.8	<2.4	762	20.0	<12	28	3910	7.1 J	237	17	<0.11	<12	398	<2.4	<4.1	<1600	<3.5	<16	37	<10
DGC-05	S-2	5-7	C	14.2	5670	<29	<4.7	<39	<1.7	<2.3	<348	6.5	<12	<9.3	20400	2.9	181	121 J	<0.11	<12	<291	<2.3	<4.1	<1570	<3.5	<16	<17	<10
DGC-05 *	S-3	10-12	C	12.3	2500	<29	<4.6	<38	<1.7	<2.3	<341	9.0	<11	<9.1	39800	2.3	<136	38 J	<0.11	<11	<285	<2.3	<4.0	<1540	<3.4	<15	<17	<9.7
DGC-05 *	S-3	10-12	C	12.8	2560	<29	<4.6	<38	<1.7	<2.3	<343	6.2	<11	<9.2	23300	1.7	<136	81 J	<0.11	<11	<287	<2.3	<4.0	<1550	<3.4	<15	<17	<9.7
DGC-05	S-4	15-17	C	13.8	2310	<29	<4.6	<39	<1.7	<2.3	<347	<4.6	<12	<9.3	8680	2.3	169	40 J	<0.11	<12	<290	<2.3	<4.1	<1570	<3.5	<16	<17	<9.9
DGC-05	S-9	40-42	UPcc	15.2	898	<29	<4.7	<40	<1.8	<2.4	<353	8.6	<12	16	4900	2.4	<140	26 J	<0.11	<12	<295	<2.4	<4.1	<1590	<3.5	<16	22	<10
DGC-06	S-5	8-10	C	16.1	11600	<30	8.9	49	<1.8	<2.4	<356	18.0	<12	<9.5	18800	8.9	677	173 J	<0.11	<12	<298	<2.4	<4.2	<1610	<3.6	<16	28	26
DGC-06	S-7	12-14	C	15.2	5070	<29	5.3	<40	<1.8	<2.4	<353	14.0	<12	<9.4	10400	4.7	166	62 J	<0.11	14	<295	<2.4	<4.1	<1590	<3.5	<16	18	10
DGC-06	S-10	18-20	C	14.7	3990	<29	<4.7	<39	<1.8	<2.3	<351	27.0	<12	<9.4	22600	3.5	322	341 J	<0.11	22	<293	<2.3	<4.1	<1580	<3.5	<16	25	17
DGC-06	S-12	25-27	C	17.8	7230	<30	<4.9	<41	<1.8	<2.4	<364	14.0	<12	<9.7	24900	6.7	628	268 J	<0.12	13	402	<2.4	<4.3	<1640	<3.6	<16	33	31
DGC-06	S-13	30-32	C/UPcc	11.2	1550	<28	<4.5	<38	<1.7	<2.3	393	9.3	<11	11	9730	3.9	177	41 J	<0.11	<11	<282	<2.3	<3.9	<1520	<3.4	<15	32	<9.6
DGC-06	S-17	50-52	uUP	19.5	353	<31	<5.0	<42	<1.9	<2.5	<371	<5.0	<12	<10	3530	1.9	<148	129 J	<0.12	<12	<311	<2.5	<4.3	<1680	<3.7	<17	<19	<11
DGC-06	S-18	55-57	uUP	19.3	1090	<31	<5.0	<42	<1.9	<2.5	<371	12.0	<12	11	69900	1.9	<147	892 J	<0.12	<12	<310	<2.5	<4.3	<1670	<3.7	<17	<19	17
DGC-07	S-4	15-17	C	32.6	36100	<37	12.0	95	<2.2	<3.0	545	44.0	<15	<12	73000	15.0	1050	332	<0.14	24	462	<3.0	<5.2	<2000	<4.5	<20	86	43
DGC-07	S-5	20-22	C	13.5	3180	<29	<4.6	<39	<1.7	<2.3	<346	<4.6	<12	<9.2	12400	2.3	240	68	<0.11	<12	<289	<2.3	<4.0	<1560	<3.5	<16	<17	11
DGC-07	S-7	30-32	C	17.7	6630	<30	<4.9	<41	<1.8	<2.4	<363	11.0	<12	18	52100	3.6	291	52	<0.12	16	<304	<2.4	<4.3	<1640	<3.6	<16	<18	27
DGC-07 *	S-15	70-72	uUP	30.5	603	<36	<5.8	<48	<2.2	<2.9	<430	<5.8	<14	<12	2030	2.9	<171	24	<0.14	<14	<360	<2.9	<5.0	<1940	<4.3	<19	<22	<12
DGC-07 *	S-15	70-72	uUP	19.5	234	<31	<5.0	<42	<1.9	<2.5	<371	<1.9	<12	<9.9	816	<1.2	<148	12	<0.12	<12	<310	<2.5	<4.3	<1680	<3.7	<17	<19	<11
DGC-08	S-2	5-7	C	37.1	53100 J	<16	<16.0	137	<2.8	12.0	385	37.0	24	12	47300 J	19.0	1270	646 J	<0.02	26	785	<20	<1.0	184 UJ	<2.4	49	77	44 J
DGC-08	S-3	10-12	C	34.2	80400 J	<16	<15.0	135	<2.7	13.0	302	38.0	26	11	47500 J	16.0	1500	742 J	0.2 J	33	956	<19	<1.0	147 UJ	<2.3	67	74	51 J
DGC-08 *	S-4	15-17	C	16.3	1840 J	<12	<3.2	20	<2.1	<3.0	91	<1.6	<8.4	6	5180 J	<1.6	181	278 J	0.1 J	<9.6	188	<2.2	<0.8	179 UJ	<1.8	<18	8.4	9 J
DGC-08 *	S-4	15-17	C	12.9	3160 J	<12	<3.1	23	<2.0	4.6	167	<1.5	<8.0	<4.9	8020 J	<1.5	333	122 J	0.1 J	<9.2	520	<2.1	<0.8	156 UJ	<1.7	<17	16	8.6 J
DGC-08	S-10	45-47	UPcc	17.2	639 J	<12	<3.3	14	<2.1	<3.0	180	<1.7	<8.5	<5.2	310 J	<1.6	41 UJ	1.8 J	0.1 J	9.7	479	<2.2	<0.8	115 UJ	<1.8	<18	<5.9	<5.2
DGC-09	S-2	5-7	C	19.0	20700 J	<13	<3.3	67	<2.2	6.2	664 UJ	25.0	9.2	<5.3	25300 J	9.3	2220	248 J	0.2 J	17	1090	<2.3	<0.8	150 UJ	<1.9	<19	43	29 J
DGC-09	S-3	10-12	C	15.0	23400 J	<12	<3.2	72	<2.1	4.7	417 UJ	17.0	<8.2	7.6	22200 J	7.6	1650	108 J	0.2 J	15	1300	<2.2	<0.8	135 UJ	<1.8	<18	38	26 J
DGC-09	S-5	20-22	C	14.3	4870 J	<12	<3.2	21	<2.0	<2.9	756	1.5	<8.2	<5.0	6170 J	3.3	209	30 J	<0.01	<9.3	347	<2.2	<0.8	256 UJ	<1.8	<18	9.9	5.3 J
DGC-09	S-18	85-87	uUP	21.8	281 J	<13	<3.5	34	<2.2	<3.2	181 UJ	<1.7	<9.0	<5.0	2730 J	5.7	18	<1.8	<0.01	<10	192	<2.4	<0.8	143 UJ	<1.9	<19	7.0	8.4 J
DGC-13	S-1	0-2	C	6.0	7590	-	5.1 J	76	-	-	563	9.5	-	-	8120	14.0 J	762	573	-	-	-	-	-	-	-	5.5 UJ	-	17 UJ
DGC-13	S-2	5-7	C	3.0	11300	-	11.0 J	44	-	-	828	18.0	-	9.1	10400	8.8 J	1380	34	-	-	977	-	-	-	-	5.5 UJ	29	19 UJ
DGC-17	S-2	20-22	C	2.0	2880	-	1.8 J	-	-	-	61	-	-	-	1270	1.7 J	-	12	-	-	-	-	5.9 J	-	-	7.3 UJ	-	-
DGC-17	S-4	35-37	C	9.0	11900	-	6.7 J	59	-	-	545	15.0	-	9.8	11100	6.7 J	1850	108	-	16	1420	-	-	565	-	8.8 UJ	21	41 UJ

* Duplicate analyses
\- Non-detectable; detection limits not specified.
UJ A compound was detected but not in high enough concentrations to confirm its presence.
J Estimated quantity because quality control criteria were not met

C Columbia Formation
UPcc Upper Potomac confining clay
uUP upper Upper Potomac Hydrologic Zone

Table

Organic Analytical Results of February/March 1986
Delaware Sand and Gravel Landfill RI/FS Soil Boring Sampling
(micrograms per kilogram)

Well Number	Sample Number	Depth (ft)	Zone Sampled	Percent Moisture (%)	Toluene	Methylene Chloride	Acetone	2-butanone (MEK)	4-methyl-2-pentanone (MIBK)	Ethyl Benzene	Total Xylene	1,2-dichloroethane	Chloroform	1,1,1-trichloroethane	Phenol	bis-(2-chloroethyl) ether	2-methyl phenol	4-methyl phenol	di-n-butyl phthalate	bis (2-ethylhexyl) phthalate	Napthalene	benzoic acid	benzo anthracene
BGC-04	S-1	0-2	C	31.0	<7.0	7.0 UJ	<14	<14	<14	<7.0	<7.0	<7.0	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-2	2-4	C	33.7	<8.0	8.0 UJ	16 UJ	<15	<15	<8.0	<8.0	<8.0	<8.0	<8.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-3	4-6	C	26.1	<7.0	7.0 UJ	<14	<14	<14	<7.0	<7.0	<7.0	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-4	6-8	C	32.9	<7.0	7.0 UJ	22 UJ	<15	<15	<7.0	<7.0	<7.0	<7.0	<7.0	<620	<620	<620	<620	930 UJ	<620	<620	<3000	<620
BGC-04	S-5	8-10	C	31.0	<7.0	23 UJ	<14	<14	<14	<7.0	<7.0	<7.0	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-6	10-12	C	32.6	<7.0	8.0 UJ	24 UJ	<15	<15	<7.0	<7.0	<7.0	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-7	12-14	C	28.5	<7.0	8.0 UJ	<14	<14	<14	<7.0	<7.0	<7.0	<7.0	<7.0	<580	<580	<580	<580	1100 UJ	<580	<580	<2800	<580
BGC-04	S-8	14-16	C	31.9	<7.0	9.0 UJ	<15	<15	<15	<7.0	<7.0	<7.0	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-9	16-18	C	29.4	<7.0	7.0 UJ	14 UJ	<14	<14	<7.0	<7.0	<7.0	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-10	18-20	C	8.5	<5.0	5.0 UJ	<11	<11	<11	<5.0	<5.0	<5.0	<5.0	<5.0	<440	<440	<440	<440	810 UJ	<440	<440	<2200	<440
BGC-04	S-11	20-22	C	2.39	<5.0	5.0 UJ	13 UJ	<10	<10	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-12	25-27	C	14.2	<6.0	6.0 UJ	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<480	<480	<480	<480	850 UJ	480 UJ	<480	<2400	<480
BGC-04	S-13	30-32	C	15.4	390	47 UJ	95 UJ	<118	<118	150	1100	<59	<59	<59	<24000	<24000	<24000	<24000	24000 UJ	24400 UJ	4200 J	<116000	<24000
BGC-04	S-15	40-42	UPcc	16.0	140	580 P	3600	140 P	36 P	<60	<60	<60	<60	<60	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-16	45-47	UPcc	19.0	<12	12	2100	890	93	<12	<12	25	<12	<12	1300	390 J	<520	250 J	690 UJ	260 J	<520	<2600	<520
BGC-04	S-17	50-52	UPcc	14.2	<58	58 UJ	884 P	541 P	47 P	<58	<58	<58	<58	<58	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04 ◆	S-18	53-57	UPcc	17.0	6 P	76 P	920	370	140	<6.0	<6.0	170	<6.0	<6.0	1600	560	<500	330 J	770 UJ	180 J	<500	<2400	<500
BGC-04 ◆	S-18	55-57	UPcc	19.4	4 P	23 P	480	160	69	<6.0	<6.0	40	<6.0	<6.0	2100	650	<520	410 J	2600 UJ	520 UJ	<520	<2600	<520
BGC-04	S-19	60-62	UPcc	41.0	17 P	80 P	2600	702	270	<17	<17	160	<17	<17	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-20	65-67	uUP	16.6	<6.0	10 UJ	120 P	20 P	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-21	70-72	uUP	19.8	5 P	24 UJ	110 P	29 P	12 UJ	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-22	75-77	uUP	15.6	<6.0	6.0 UJ	120 P	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-23	80-82	uUP	14.8	<6.0	7.0 UJ	45 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-04	S-24	85-87	UPdc	5.8	<5.0	5.0 UJ	14 UJ	<11	<11	<5.0	<5.0	<5.0	<5.0	<5.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-1	0-2	C	12.7	<5.5	5.5 UJ	15 UJ	<11	<11	<5.5	<5.5	<5.5	<5.5	<5.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05 ◆	S-2	5-7	C	9.3	<5.5	<5.5	<11	<11	<11	<5.5	<5.5	<5.5	<5.5	<5.5	<460	<460	<460	<460	600 UJ	460 UJ	<460	<2200	<460
BGC-05 ◆	S-2	5-7	C	17.0	<6.0	<6.0	13 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<500	<500	<500	<500	500 UJ	500 UJ	<500	<2400	<500
BGC-05	S-3	10-12	C	14.5	<6.0	6.0 UJ	28 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<480	<480	<480	<480	620 UJ	480 UJ	<480	<2400	<480
BGC-05	S-4	15-17	C	15.1	<6.0	6.0 UJ	18 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<480	<480	<480	<480	760 UJ	480 UJ	<480	<2400	<480
BGC-05	S-5	20-22	C	33.6	<7.5	7.5 UJ	17 UJ	<15	<15	<7.5	<7.5	<7.5	<7.5	<7.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-6	25-27	C	8.15	<5.5	5.5 UJ	18 UJ	<11	<11	<5.5	<5.5	<5.5	<5.5	<5.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-8	35-37	uUP ?	18.4	<6.0	8.0 UJ	24 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-9	40-42	UPcc	16.5	28	<6.0	56 P	<12	25	<6.0	<6.0	<6.0	<6.0	<6.0	<500	<500	<500	<500	650 UJ	500 UJ	<500	<2400	<500
BGC-05	S-10	45-47	uUP	18.1	<6.0	6.0 UJ	165	18 P	<12	<6.0	<6.0	<6.0	<6.0	14.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-11	50-52	uUP	18.9	<6.0	9.6 UJ	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-12	55-57	uUP	18.96	<6.0	6.0 UJ	17 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	14.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-13	60-62	uUP	13.4	<6.0	<6.0	25 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-14	65-67	uUP	16.2	<6.0	<6.0	12 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-15	70-72	uUP	15.9	<6.0	<6.0	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-16	75-77	uUP/UPdc	17.3	<6.0	<6.0	14 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-05	S-17	80-82	UPdc	15.0	<6.0	<6.0	19 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-1	0-2	C	15.2	<6.0	6.0 UJ	12 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-2	2-4	C	12.4	<6.0	6.0 UJ	33 P	<11	19	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-3	4-6	C	12.4	<11	40 P	87 P	24 P	100	<11	<11	190	<11	<11	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-5	8-10	C	15.1	1900	165 P	1500	2600	2100	200	700	1200	<59	<59	<480	180 J	570	190 J	1900 UJ	610 UJ	<480	<2400	<480
BGC-06	S-7	12-14	C	18.1	<61	61 UJ	1900	3700	2600	<61	<61	<61	<61	<61	<500	<500	320 J	<500	780 UJ	500 UJ	<500	<2600	<500
BGC-06	S-8	14-16	C	9.74	61	89 P	704	1080 N	875	<28	<28	650	<28	<28	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-9	16-18	C	12.6	<57	57 UJ	927	1121	515	<57	<57	137	<57	<57	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-10	18-20	C	14.4	<29	44 P	1500	2200	1200	<29	<29	600	<29	<29	620	<480	400 J	<480	1400 UJ	480 UJ	<480	<2400	<480
BGC-06	S-11	20-22	C	14.3	<58	82 UJ	2089	3600 N	2474	<58	<58	1085	<58	<58	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-12	25-27	C	19.5	<62	99 UJ	4400	7600	3100	<62	<62	970 N	<62	<62	1600 N	150 J	1400	240 J	<520	1500 UJ	340 J	<2600	<520
BGC-06	S-13	30-32	C/UPcc	16.9	<6.0	7.0 UJ	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<480	<480	<480	<480	2400 UJ	480 UJ	<480	<2400	<480
BGC-06	S-14	35-37	UPcc	14.9	<6.0	6.0 UJ	12 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-15	40-42	UPcc	15.9	39	68 P	152	60 NP	6 P	<6.0	<6.0	46 N	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-16	45-47	uUP	16.4	30	42 UJ	1316	592	66 P	<30	<30	<30	<30	<30	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-17	50-52	uUP	19.6	<6.0	9.0 UJ	320	200	72	<6.0	<6.0	29.0	<6.0	<6.0	<500	<500	<500	<500	990 UJ	500 UJ	<500	<2600	<500
BGC-06	S-18	55-57	uUP	20.2	<6.0	6.0 UJ	49 P	28 P	6 P	<6.0	<6.0	<6.0	<6.0	<6.0	<520	<520	<520	<520	3600 UJ	520 UJ	<520	<2600	<520
BGC-06	S-19	60-62	uUP	14.9	7 J	12 UJ	266 P	102 NP	7 P	<12	<12	<12	<12	<12	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-20	65-67	uUP	19.8	<6.0	19 P	39 P	50 P	25	<6.0	<6.0	39.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-21	70-72	uUP	17.4	<6.0	7.0 UJ	50 P	64 P	35	<6.0	<6.0	41.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06 ◆	S-22	75-77	uUP	11.5	1 P	16 P	103 P	132 NP	71	<6.0	<6.0	79.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06 ◆	S-22	75-77	uUP	16.9	12 P	55 P	159 P	236 P	99	<12	<12	113.0	<12	<12	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-23	80-82	uUP	15.2	65 P	725 P	248 P	200 P	136	<29	<29	613.0	<29	<29	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-06	S-24	85-87	UPdc	15.6	<6.0	6.0 UJ	13 UJ	<12	2 UJ	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA

◆ Duplicate analyses
NA Sample not analyzed for this compound.
N Tentative identification

C Columbia Formation
UPcc Upper Potomac confining clay

Table (continued)

Organic Analytical Results of February/March 1986

Delaware Sand and Gravel Landfill RI/FS Soil Boring Sampling

(micrograms per kilogram)

Well Number	Sample Number	Depth (ft)	Zone Sampled	Percent Moisture (%)	Toluene	Methylene Chloride	Acetone	2-butanone (MEK)	4-methyl-2-pentanone (MIBK)	Ethyl Benzene	Total Xylene	1,2-dichloroethane	Chloroform	1,1,1-trichloroethane	Phenol	bis-(2-chloroethyl) ether	2-methyl phenol	4-methyl phenol	di-n-butyl phthalate	bis (2-ethylhexyl) phthalate	Napthalene	benzoic acid	benzo anthracene
BGC-07	S-1	0-2	C	25.2	<7.0	<7.0	13 UJ	<13	<13	<7.0	<7.0	<7.0	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-2	5-7	C	31.8	<7.0	<7.0	24 UJ	<15	<15	<7.0	<7.0	<7.0	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-3	10-12	C	25.5	<7.0	<7.0	30 UJ	<13	<13	<7.0	<7.0	<7.0	<7.0	<7.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-4	15-17	C	33.3	<7.0	13 UJ	62 UJ	<15	<15	<7.0	<7.0	<7.0	<7.0	<7.0	<620	<620	<620	<620	4900 UJ	<620	<620	<3200	<620
BGC-07	S-5	20-22	C	14.5	<6.0	6.0 UJ	36 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<480	<480	<480	<480	2500 UJ	480 UJ	<480	<2400	<480
BGC-07	S-6	25-27	C	14.1	<6.0	<6.0	12 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-7	30-32	C	16.0	<6.0	6.0 UJ	20 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<500	<500	<500	<500	900 UJ	500 UJ	<500	<2400	<500
BGC-07	S-8	35-37	UPcc	11.5	<6.0	<6.0	11 UJ	<11	<11	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-9	40-42	UPcc	13.6	<6.0	6.0 UJ	12 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-10	45-47	UPcc	17.8	<6.0	<6.0	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-11	50-52	uUP	19.2	6.0 UJ	7.0 UJ	22 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-12	55-57	uUP	20.5	<6.0	10 UJ	15 UJ	<13	<13	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-13	60-62	uUP	20.6	<6.0	6.0 UJ	17 UJ	<13	<13	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07 •	S-14	65-67	uUP	20.1	<13	<13	970	550	66	<13	<13	<13	<13	<13	<520	<520	<520	<520	1000 UJ	520 UJ	<520	<2600	<520
BGC-07 •	S-14	65-67	uUP	17.4	<30	<30	1100	910	<61	<30	<30	<30	<30	<30	<500	<500	<500	<500	1100 UJ	<500	<500	<2400	<500
BGC-07	S-15	70-72	uUP	20.9	6.0 UJ	7.0 UJ	260	110	15	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-16	75-77	uUP	21.6	NA	<6.0	790	450	59	6.0	17.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-17	80-82	uUP	12.5	<6.0	6.0 UJ	<11	<11	<11	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-18	85-87	uUP	10.3	<6.0	<6.0	<11	<11	<11	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-19	90-92	uUP	17.9	<6.0	7.0 UJ	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-20	95-97	uUP	19.5	<6.0	<6.0	12 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-21	100-102	UPdc	18.4	<6.0	<6.0	17 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-22	105-107	UPdc	10.6	<6.0	<6.0	<11	<11	<11	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-23	110-112	UPdc	14.1	<6.0	6.0 UJ	23 UJ	<11	<11	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07 •	S-24	115-117	UPdc	13.9	<6.0	6.0 UJ	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07 •	S-24	115-117	UPdc	15.6	<6.0	<6.0	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-25	120-122	UPdc	15.1	<6.0	6.0 UJ	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-26	125-127	UPdc	19.0	<6.0	6.0 UJ	12 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-27	130-132	lUP	16.4	<6.0	7.0 UJ	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-28	135-137	lUP	11.7	<6.0	6.0 UJ	<11	<11	<11	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-29	140-142	lUP	10.9	<6.0	<6.0	<11	<11	<11	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-07	S-30	145-147	MP	17.6	<6.0	6.0 UJ	12 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-1	0-2	C	29.0	<6.9	9.9 UJ	13 UJ	<14	<14	<6.9	<6.9	<6.9	<6.9	<6.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08 •	S-2	5-7	C	38.0	<8.0	26 UJ	21 UJ	<16	<16	<8.0	<8.0	<8.0	<8.0	<8.0	<550	<550	<550	<550	<550	<550	<550	<2700	<550
BGC-08 •	S-2	5-7	C	36.0	9.0 J	23 UJ	9.5 UJ	<15	<15	<7.7	<7.7	<7.7	<7.7	<7.7	<530	<530	<530	<530	74 J	<530	<530	<2600	<530
BGC-08	S-3	10-12	C	29.0	3.5 J	22 UJ	13 UJ	<14	<14	<7.0	<7.0	<7.0	<7.0	<7.0	<470	<470	<470	<470	150 J	230 J	<470	<2400	<470
BGC-08	S-4	15-17	C	9.8	4.0 UJ	18 UJ	8.7 UJ	<11	<11	<5.4	<5.4	<5.4	<5.4	<5.4	<370	<370	<370	<370	48 J	70 J	<370	<1800	<370
BGC-08	S-5	20-22	C	11.0	4.6 J	29 UJ	7.8 UJ	<11	<11	<5.6	<5.6	<5.6	<5.6	<5.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-6	25-27	C	15.0	<5.8	6.6 UJ	8.5 UJ	<12	<12	<5.8	<5.8	<5.8	<5.8	<5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-8	35-37	UPcc	12.0	2.7 J	12 UJ	14 UJ	<11	<11	<5.7	<5.7	<5.7	<5.7	<5.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-9	40-42	UPcc	18.0	3.2 J	12 UJ	20 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-10	45-47	UPcc	19.0	3.2 J	10 UJ	9.8 UJ	<12	<12	<6.2	<6.2	<6.2	<6.2	<6.2	<420	<420	<420	<420	180 J	76 J	<420	<2100	<420
BGC-08	S-11	50-52	UPcc	19.0	<6.2	7.1 UJ	5.6 UJ	<12	<12	<6.2	<6.2	<6.2	<6.2	<6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-12	55-57	uUP	17.0	2.6 J	11 UJ	16 UJ	<12	<12	<5.9	<5.9	<5.9	<5.9	<5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-13	60-62	uUP	19.0	<6.2	11 UJ	22 UJ	<12	<12	<6.2	<6.2	<6.2	<6.2	<6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-14	65-67	uUP	20.0	2.5 J	9.3 UJ	15 UJ	<12	<12	<6.2	<6.2	<6.2	<6.2	<6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-15	70-72	uUP	17.0	<6.0	5.9 UJ	15 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-16	75-77	uUP	19.0	<6.2	13 UJ	13 UJ	<12	<12	<6.2	<6.2	<6.2	<6.2	<6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-17	80-82	uUP	20.0	<6.2	5.8 UJ	16 UJ	<12	<12	<6.2	<6.2	<6.2	<6.2	<6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-18	85-87	UPdc	16.0	<5.9	8.8 UJ	34 UJ	<12	<12	<5.9	<5.9	<5.9	<5.9	<5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-19	90-92	UPdc	15.0	<5.8	6.7 UJ	140	<12	<12	<5.8	<5.8	<5.8	<5.8	<5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-20	95-97	UPdc	16.0	<5.9	9.0 UJ	80 UJ	<12	<12	<5.9	<5.9	<5.9	<5.9	<5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-21	100-102	UPdc	18.0	<6.1	10 UJ	62 UJ	<12	<12	<6.1	<6.1	<6.1	<6.1	<6.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-22	105-107	lUP	20.6	<12	20 UJ	79 UJ	<24	<24	<12	<12	<12	<12	<12	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-23	110-112	lUP	22.0	<5.9	13 UJ	260	<12	<12	<5.9	<5.9	<5.9	<5.9	<5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-24	115-117	lUP	14.0	<18	33 UJ	200	<36	<36	<18	<18	<18	<18	<18	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-25	120-122	MPc	15.0	<5.8	13 UJ	200	<12	<12	<5.8	<5.8	<5.8	<5.8	<5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-26	125-127	MPc	13.0	<5.7	10 UJ	160	<11	<11	<5.7	<5.7	<5.7	<5.7	<5.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
BGC-08	S-27	130-132	MPc	16.0	<5.9	10 UJ	130	<12	<12	<5.9	<5.9	<5.9	<5.9	<5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA

• Duplicate analyses
NA Sample not analyzed for this compound.
N Tentative identification
UJ A compound was detected but not in high enough concentrations to confirm its presence.
J Estimated quantity because quality control criteria were not met.

C Columbia Formation
UPcc Upper Potomac confining clay
uUP upper Upper Potomac Hydrologic Zone
MPdc Upper Potomac dividing clay
lUP lower Upper Potomac Hydrologic Zone
MP Middle Potomac clay

Table (continued)

Organic Analytical Results of February/March 1986

Delaware Sand and Gravel Landfill RI/FS Soil Boring Sampling

(micrograms per kilogram)

Well Number	Sample Number	Depth (ft)	Zone Sampled	Percent Moisture (%)	Toluene	Methylene Chloride	Acetone	2-butanone (MEK)	4-methyl-2-pentanone (MIBK)	Ethyl Benzene	Total Xylene	1,2-dichloroethane	Chloroform	1,1,1-trichloroethane	Phenol	bis-(2-chloroethyl) ether	2-methyl phenol	4-methyl phenol	di-n-butyl phthalate	bis (2-ethylhexyl) phthalate	Napthalene	benzoic acid	benzo anthracene
DGC-09	S-1	0-2	C	17.0	<26	41 UJ	1200	<52	<52	<26	<26	<26	<26	<26	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-2	5-7	C	18.0	<22	25 UJ	260	<44	<44	<22	<22	<22	<22	<22	<410	<410	<410	<410	<410	<410	<410	<2000	<410
DGC-09	S-3	10-12	C	17.0	<20	23 UJ	260	<40	<40	<20	<20	<20	<20	<20	<400	<400	<400	<400	<400	<400	<400	<2000	<400
DGC-09	S-4	13-17	C	19.0	<6.1	5.7 UJ	240	<12	<12	<6.1	<6.1	<6.1	<6.1	<6.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-5	20-22	C	12.0	<5.7	12 UJ	160 J	<11	<11	<5.7	<5.7	<5.7	<5.7	<5.7	<380	<380	<380	<380	<380	<380	<380	<1900	<380
DGC-09	S-6	25-27	C	18.0	<15	19 UJ	380	<30	<30	<15	<15	<15	<15	<15	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-7	30-32	UPcc	17.0	<6.0	12 UJ	220	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-8	33-37	UPcc	14.0	<5.8	36 UJ	130	<12	<12	<5.8	<5.8	<5.8	<5.8	<5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-9	40-42	UPcc	13.0	<5.6	8.2 UJ	64 UJ	<11	<11	<5.6	<5.6	<5.6	<5.6	<5.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-10	45-47	UPcc	15.0	<5.9	7.7 UJ	98 UJ	<12	<12	<5.9	<5.9	<5.9	<5.9	<5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-11	50-52	UPcc	13.0	<5.6	24 UJ	190	<11	<11	<5.6	<5.6	<5.6	<5.6	<5.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-12	55-57	UPcc	15.0	<5.8	37 UJ	95	<12	<12	<5.8	<5.8	<5.8	<5.8	<5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-13	60-62	UPcc	15.0	<5.8	13 UJ	85 UJ	<12	<12	<5.8	<5.8	<5.8	<5.8	<5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-14	65-67	UPcc	15.0	<5.8	8.8 UJ	23 UJ	<12	<12	<5.8	<5.8	<5.8	<5.8	<5.8	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-15	70-72	UPcc	12.0	<5.7	21 UJ	87 UJ	<11	<11	<5.7	<5.7	<5.7	<5.7	<5.7	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09 e	S-16	75-77	UPcc	19.0	<6.2	6.6 UJ	100 UJ	<12	<12	<6.2	<6.2	<6.2	<6.2	<6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09 e	S-16	75-77	UPcc	19.0	<17	19 UJ	200	<30	<34	<17	<17	<17	<17	<17	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-17	80-82	uUP	21.0	<6.3	8.3 UJ	74 UJ	<13	<13	<6.3	<6.3	<6.3	<6.3	<6.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-18	85-87	uUP	21.0	<30	58 UJ	1600 J	360 J	20 J	<30	<30	<30	<30	<30	120 J	<420	<420	<420	<420	62 J	<420	67 J	42 J
DGC-09	S-19	90-92	uUP	18.0	20	9.4 UJ	310	21	15	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-20	95-97	uUP	21.0	<6.3	10 UJ	260	<13	<13	<6.3	<6.3	<6.3	<6.3	<6.3	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-21	100-102	uUP	15.0	<5.9	25 UJ	440	<12	<12	<5.9	<5.9	<5.9	<5.9	<5.9	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-22	105-107	uUP	17.0	<16	20 UJ	340	<33	<33	<16	<16	<16	<16	<16	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-23	110-112	uUP	19.0	<16	20 UJ	440	<32	<32	<16	<16	<16	<16	<16	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09 e	S-24	115-117	uUP	19.0	<6.1	27 UJ	240	<12	<12	<6.1	<6.1	<6.1	<6.1	<6.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09 e	S-24	115-117	uUP	19.0	<17	70 UJ	285	<33	<33	<17	<17	<17	<17	<17	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-25	120-122	uUP	6.0	<5.4	7.6 UJ	90 UJ	<11	<11	<5.4	<5.4	<5.4	<5.4	<5.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-26	125-127	uUP	10.0	<5.4	11 UJ	34 UJ	<11	<11	<5.4	<5.4	<5.4	<5.4	<5.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-27	130-132	UPdc	8.0	<5.4	6.2 UJ	240	<11	<11	<5.4	<5.4	<5.4	<5.4	<5.4	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-28	135-137	UPdc	22.0	<12	63 UJ	360	<24	<24	<12	<12	<12	<12	<12	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-29	140-142	UPdc	19.0	<6.1	12 UJ	220	<12	<12	<6.1	<6.1	<6.1	<6.1	<6.1	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-30	145-147	UPdc	17.0	<6.0	6.0 UJ	150 J	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-31	150-152	lUP	12.0	<5.6	8.5 UJ	130	<11	<11	<5.6	<5.6	<5.6	<5.6	<5.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-32	155-157	lUP	12.0	<5.6	5.2 UJ	38 UJ	<11	<11	<5.6	<5.6	<5.6	<5.6	<5.6	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-33	160-162	lUP	20.0	<6.2	8.9 UJ	27 UJ	<12	<12	<6.2	<6.2	<6.2	<6.2	<6.2	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-09	S-34	165-167	MPc	17.0	<6.0	14 UJ	200	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-13	S-1	0-2	C	15.0	<6.0	15 UJ	20 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<396	<396	<396	<396	140 J	55 J	<396	<1920	<396
DGC-13	S-2	5-7	C	17.0	<6.0	17 UJ	96 P	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<396	<396	<396	<396	91 J	57 J	<396	<1920	<396
DGC-13	S-3	10-12	C	15.0	<6.0	8.0 UJ	160 J	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-15	S-1	5-7	C	18.5	<6.0	6.0 UJ	12 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-15	S-2	13-15	C	11.4	<6.0	6.0 UJ	14 UJ	<11	<11	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-15	S-3	21-23	C	15.6	<6.0	6.0 UJ	<12	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-16	S-1	13-15	C	15.4	<6.0	<6.0	16 UJ	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-16	S-2	21-23	C	9.66	<5.5	<5.5	15 UJ	<11	<11	<5.5	<5.5	<5.5	<5.5	<5.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-16	S-3	29-31	C	11.9	<5.5	<5.5	<11	<11	<11	<5.5	<5.5	<5.5	<5.5	<5.5	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-17	S-2	20-22	C	10.0	<5.0	9.0 UJ	25 UJ	<11	<11	<5.0	<5.0	<5.0	<5.0	<5.0	<363	<363	<363	<363	77 J	57 J	<363	<1760	<363
DGC-17	S-3	30-32	C	14.0	<6.0	10 UJ	190 J	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	NA	NA	NA	NA	NA	NA	NA	NA	NA
DGC-17	S-4	35-37	C	20.0	<6.0	33 UJ	170 J	<12	<12	<6.0	<6.0	<6.0	<6.0	<6.0	<396	<396	<396	<396	150 J	38 J	<396	<1920	<396

e Duplicate analyses

NA Sample not analyzed for this compound.

U Tentative identification

UJ This compound was detected but not in high enough concentrations to confirm its presence.

J Estimated quantity because quality control criteria were not met.

P Preliminary: Blank contamination precludes confirmation of compound presence or quantity.

C Columbia Formation

UPcc Upper Potomac confining clay

uUP upper Upper Potomac Hydrologic Zone

UPdc Upper Potomac dividing clay

lUP lower Upper Potomac Hydrologic Zone

MPc Middle Potomac clay