PRELIMINARY
ENVIRONMENTAL AND HEALTH
IMPACT STATEMENT
ON THE EXPANSION OF
THE DU PONT CHAMBERS WORKS
COMMERCIAL HAZARDOUS WASTE FACILITY

New Jersey
Hazardous Waste Facilities Siting Commission

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New Jersey Hazardous Waste Facilities Siting Commission
CN 406 Trenton, New Jersey 08625

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EXECUTIVE SUMMARY

Background

E. I. Du Pont de Nemours & Company (Du Pont) is proposing an expansion of the existing hazardous waste management facility at its Chambers Works plant located in Deepwater, New Jersey. The expansion will include construction and operation of a 140 million BTU/hr rotary kiln incinerator and an approximately 1.8 million cubic yard secure landfill. Approximately 55 acres will be disturbed, including about 27 acres for the landfill, about 15 acres for the incinerator, and about 13 acres for the tank farm, roads, truck wash, etc. Both units are expected to begin operations in 1992. The proposed rotary kiln is designed to process approximately 35,000 tons of hazardous wastes annually, and will be used to treat wastes generated at Chambers Works and other Du Pont plants, as well as hazardous wastes from other commercial generators. The secure landfill will be used to dispose of ash from the incinerator, sludge from the existing wastewater treatment plant, and bulk hazardous wastes, such as contaminated rubble and contaminated asbestos, from Chambers Works and other Du Pont plants. Neither commercial nor containerized wastes will be accepted at the landfill.

The New Jersey Department of Environmental Protection (NJDEP) and the Hazardous Waste Facilities Siting Commission have determined that the proposed project is an expansion of an existing major commercial hazardous waste facility rather than the construction of a new facility. The project, therefore, is governed by N.J.S.A. 13:1E-87 and 13:1E-60, and does not fall within the purview of N.J.S.A. 13:1E-59, which imposes site designation requirements (i.e., siting criteria) on new major facilities. However, N.J.S.A. 13:1E-87 requires that an Environmental and Health Impact Statement (EHIS) be prepared to assess potential environmental and health impacts if an expansion of a major facility is greater than 50% of the existing capacity of the facility. Because the proposed project would increase the capacity of the existing Chambers Works facility by more than 50%, this requirement applies.

Several issues regarding potential impacts of this proposed project have been raised, and are addressed in this EHIS. Major issues include:

- Safety of transporting hazardous wastes to Chambers Works;
- Types of hazardous wastes that will be incinerated, and resultant air quality impacts and health risks;
- Impacts on wetlands; and
- On-site and off-site ground-water contamination and potential health risks.

However, only issues related to impacts of the proposed incinerator and landfill expansion are addressed. For example, this EHIS does not evaluate other proposed air emission sources in the area and the combined impacts of these sources and the proposed Chambers Works incinerator. The purpose of the EHIS is to provide decision-makers and other interested parties with detailed descriptions of the proposed expansion and to present key information on existing environmental conditions; to identify all environmental and public health impacts that are likely to result from the construction and operation of the project; and to present measures that would minimize adverse impacts during construction and operation of the proposed units.

Project Details

Waste Accepted for Incineration

The incinerator will process a wide variety of hazardous wastes. The largest projected waste streams include chemical process liquids and solids, spent halogenated solvents, ignitable wastes, phenylenediamine, nitrobody waste, chloraniline, waste paint, corrosives, and waste oil. Wastes which will not be accepted include polychlorinated biphenyls, polychlorinated dioxins and furans, radioactive wastes, infectious wastes, asbestos-containing wastes, and ignitable gases. Approximately 25% of the capacity is expected to be used for Chambers Works waste, 25% for other Du Pont operations wastes, and 50% for commercial wastes. These commercial wastes are first and foremost New Jersey wastes. As many as 700 Du Pont waste streams may be processed at the incinerator.

Du Pont has estimated that there will be between eight and ten shipments of hazardous waste to the incinerator per day. Of these shipments, five are expected to carry wastes from other Du Pont and non-Du Pont facilities. Wastes will be accepted 24 hours per day, although most shipments will arrive during the day shift.

Incinerator Waste Storage and Handling System

The waste storage and handling system includes liquids receiving areas for both rail car and tank truck unloading and sampling, tank farm areas for bulk storage of liquid and other pumpable wastes, storage areas for containerized wastes, and a laboratory. Du Pont does not plan on using the rail car area in the short-term but may decide to use it in the future. The tank truck unloading/sampling area has five bays: two for direct burning, two for unloading to the tank farm, and one bay at a remote location for fluoride waste unloading. The tank farm possesses 14 above-ground tanks with eight separate containment areas to prevent mixing of incompatible wastes in the event of a leak or spill from a tank. Eight tanks, with a total storage capacity of 140,000 gallons, will be constructed during the first stage of construction. Six additional tanks, with a total capacity of 80,000 gallons, will be constructed within five years of project approval. Containerized wastes will be housed in a fully enclosed, heated 46,000 sq ft building adjacent to the incinerator. Incompatible wastes will be segregated. Facilities for managing and feeding containers include conveyors, two 5000-gallon holding/blending tanks and a liquid removal station, a thaw box to heat drummed material when necessary, lifts, repackaging area for containers that do not meet specifications for direct feed to the kiln, and related systems needed to handle containerized wastes properly.

Incinerator Kiln and Afterburner

The selected incinerator is the Deutsche Babcock Anlagen design, which includes a rotary kiln combustion unit and an afterburner (i.e., a secondary combustion) chamber. The incinerator is designed to accept solid, liquid and slurried wastes, including pumpable sludges, on a continuous basis. It will provide a destruction efficiency of more than 99.99 percent for all organic constituents in the feed stream. Natural gas or fuel oil will be used to start-up the incinerator, and high-BTU wastes and/or fuel will be used to maintain the temperature necessary to achieve the required destruction efficiency. The burn will be controlled to produce insert gases, ash and slag. Gases will pass through a series of air pollution control devices, which will provide a best available control technology (BACT), before discharge through a 213-foot high stack. Two induced draft fans will draw the gases through the incinerator and air pollution control system (APCS) to the stack. Ash and slag will be transported to the proposed secure landfill for disposal.

The rotary kiln is an inclined, refractory-lined cylindrical vessel with an internal diameter of 12.4 feet and a length of 39.2 feet. The rate of rotation will be variable depending on the waste feed characteristics and feed rate. The average design feed rate to the kiln is 10,000 pounds per hour. The actual feed rate will depend on the BTU value and other characteristics of the wastes. The design heat rate of the kiln during continuous operation is 80 million BTU per hour. A minimum of 20 percent of the heat load to the kiln will be supplied by high-BTU atomizable organic liquid waste or an auxiliary fuel to ensure that required temperatures are maintained. The rotary kiln will operate at temperatures between 1650 and 2000 degrees F. Exhaust gases from the kiln flow into the afterburner chamber where organic vapors are combusted.

The afterburner chamber is a vertical, refractory-lined vessel with inside dimensions of 17.7 feet by 20.5 feet and a height of 29 feet from the lowest burner. Atomizable organic liquid wastes may be fed directly into this chamber. The average design feed rate is 7500 pounds per hour, and the design heat rate is 60 million BTU per hour. The combustion temperature in the afterburner ranges between 2000 and 2400 degrees F.

Incinerator Waste Feed and Interlock Systems

Wastes will be fed to the rotary kiln as bulk liquid, pumpable sludge, containerized solids, and lab packs. Liquid wastes from tank trucks may be pumped directly to the kiln through a liquid waste burner. Liquid wastes from tank storage may be pumped to a waste burner or spray nozzle. Sludge wastes will be fed to the kiln through one of two sludge nozzles, depending on the viscosity of the waste. Containerized solids and lab packs will be fed to the kiln through the container chamber by a feed conveyor and chute.

Wastes may be fed to the afterburner chamber through two sets of burners and nozzles. There are two liquid waste nozzles, two burners with a fuel oil and liquid waste nozzle and two low NO_x burners. Liquid wastes are pumped from tank storage for all nozzles except one low NO_x burner which is direct from tank trucks. A fifth burner is for high fluoride containing wastes fed directly from tank trucks.

The incinerator system is equipped with process instrumentation that will interrupt waste and/or auxiliary fuel feeds to the incinerator in the event that incinerator or APCS operating parameters fall below or increase above the specified values required for waste destruction and control of emissions. Instrumentation includes temperature transmitters at the kiln and afterburner discharge ducts, flow transmitters on all combustion air, waste and fuel feed streams, and pressure transmitters in the afterburner chamber. The flow rate of the stack exhaust gas and the oxygen content of the afterburner exhaust gas will also be monitored. Waste feeds will be automatically stopped if the temperature in the kiln or afterburner decreases below a low set-point, when the pressure in the afterburner exceeds a high set-point, or when the burner flame or combustion air flow are lost. If the afterburner temperature begins to decrease, auxiliary fuel will be added to increase the temperature in the chamber. If the temperature continues to decrease, the waste feed will automatically cut off.

The APCS also contains various controls. Instrumentation monitors flow rates, pressure, temperature, and pH. If any of these parameters falls outside operating set-points, all waste feeds to the incinerator will be interrupted. In addition, if the flow of water to the saturator decreases below low set-point, auxiliary fuel flow will also be cut off. An emergency saturator water system will be activated to protect downstream equipment from high temperature conditions.

Emergency Vent System

The incinerator is equipped with an emergency pressure relief vent, which is located at the highest point of the afterburner discharge duct. The vent is designed to open only in the event of over-pressurization of the rotary kiln or afterburner to protect the incinerator system from possible explosions. The vent will open automatically if the pressure exceeds a high set-point. Upon activation, all waste feeds will be cut off by automatic control valves.

Other Incinerator Controls

Various controls have been developed to ensure that only wastes suitable for incineration are accepted and that wastes are properly handled. Before wastes can be shipped to Chambers Works, Chambers Works personnel will thoroughly analyze the wastes for pre-acceptance approval. Analytical results will be recorded on waste approval sheets and filed in the incinerator computer system. This system will be used to develop computer-generated feed menus. These menus will combine wastes to maintain optimum operating parameters and to comply with permitted emission limits. All wastes generated off-site must be re-analyzed every two years. All shipments, upon arrival, will be inspected for compliance with record-keeping and transportation requirements, and then the contents will be visually or analytically confirmed to be the same as the sample analyzed and approved during pre-acceptance.

Safeguards to ensure that no incompatible wastes will be mixed in pipelines or tanks include waste analysis, qualitative compatibility testing, labeling of lots, dedicated pumps for classes of liquids, and flushing of empty lines and tanks prior to refilling. For example, if wastes are to be unloaded into the blend tanks, the wastes will be analyzed for compatibility with the tank contents prior to unloading. Samples from blend and bulk storage tanks will be verified prior to incineration to monitor and ensure optimum feed composition. In addition, waste containers that are to be fed directly to the kiln must not hold any free-standing liquid, must weigh less than 600 pounds, and must not release more than 2.5 million BTU per container. Wastes that are not compatible with one of the four designated storage areas are not placed in storage, but fed directly to the kiln. Wastes that are not compatible with the incinerator feed equipment are refused.

Waste tanks will be equipped with submerged anti-static fill lines to reduce the potential for explosion. Tanks will also be blanketed by nitrogen to prevent explosive mixtures of gas from developing in the vapor spaces. All unloading to the tanks will also be done under a nitrogen blanket. Any emissions during unloading will be vented to the afterburner or to a set of carbon adsorbers. Pressure settings of the tank vents will be set at a level to assure that the tanks only vent during filling. Additionally, each tank will be protected by a rupture disk and a relief valve.

Other controls will be in place to prevent fires, explosions, and the release of hazardous materials. For example, ample spill containment will be provided at the tank farm, container storage area, and truck and rail car unloading areas. Tanks will have level indicators and high level shut-offs, and sumps will have alarms which will be activated when liquids collect within. Fire protection will consist of fire resistant construction, in-place automatic suppression systems, water supply, and equipment for manual firefighting. Other emergency response equipment will also be available and readily accessible. In addition, several administrative and operational procedures and systems are already in place, including area-specific RCRA training programs, a comprehensive safety program, inspection and maintenance programs, and contingency plans and procedures for chemical releases and fires. Furthermore, Chambers Works maintains fire, spill, and emergency medical response teams that are available on a 24-hour basis.

Landfill Design

The landfill will be located adjacent to the Delaware River on 'Carneys Point. Approximately 165 cubic yards of hazardous waste will be disposed of daily. All wastes will be contained above grade in an earthen vault-like structure, the top of which will reach 100 feet high. The design consists of four cells surrounded by a containment dike with rip-rap protection. To prevent ground-water contamination, the bottom of each cell possesses a liner system with two reinforced synthetic rubber liners, a leachate collection system, and a leak detection system. The landfill also includes a ground-water monitoring system to detect contaminant releases should any of the controls fail, and a well system to collect any contaminated ground water. In addition, the landfill will include a truck-wash station to decontaminate trucks before they leave the area. Leachate, any intercepted ground water, and wash water will be pumped to the Chambers Works wastewater treatment plant (WWTP) for processing.

As the cells are filled, the dike elevation will be raised by application of the side slope cover. After the cells are filled, the landfill will be covered by an impervious cap. Both the slide slope cover and cap will include a three-foot thick layer of clay and a reinforced synthetic rubber liner to provide a barrier to infiltration and thereby minimize leachate generation.

Landfill Operations and Controls

Wastes will be hauled and dumped at the landfill 24 hours per day, 7 days per week, and wastes will be spread/compacted during daylight hours 7 days per week. Most of the wastes will come from the Chambers Works WWTP and the proposed incinerator. Acceptance of wastes generated at other Du Pont facilities will involve waste characterization prior to shipping and verification upon arrival. Drummed or other packaged wastes will be transferred to bulk solids containers. If wastes contain free water, the landfill operator will instruct the transporter to deposit the load at the dewatering pad where free water will be collected; collected water will flow to the wastewater treatment plant. When the bulk solids are dewatered and pass the filter test, they will be transported to the landfill. Each shipment will be logged at the landfill office, and the waste type and quantity received will be recorded. The location of each shipment will also be indicated on a map of the landfill using the shipment log number.

Recertification of all active waste streams will be performed annually. The process will include complete recharacterization by the generator and evaluation by the Chambers Works Environmental Affairs Group for compliance with current regulations. Wastes will also be recharacterized if waste streams change as a result of process modifications or EPA promulgates additional land disposal restriction treatment standards.

Du Pont will perform routine inspections of the landfill throughout its active life. Inspections will detect malfunctions, deterioration, operating errors, or discharge early enough to repair or remediate the problem before it threatens human health or the environment. Analytical results from well sampling will be compiled and submitted to the New Jersey Division of Water Resources quarterly. In addition, the landfill will be inspected weekly by representatives of the NJDEP and the local health department.

Post-closure activities will consist of ground-water monitoring, pumping and treatment of leachate generated after closure, maintenance of the final cover system to control erosion and liner damage, and inspection of the cover system and monitoring wells. Ground water will be sampled on a quarterly basis from those wells used during active operations. It is anticipated that approximately 100,000 gallons of leachate will be generated annually and need treatment. The cover system will be inspected for structural deterioration, ponding and erosion condition of vegetation, and vandalism. Monitoring wells will be inspected for structural deterioration, vandalism, and general condition. Site security will also be maintained. Du Pont will restrict use of the property such that the integrity and proper functioning of the ground-water monitoring wells and cover system will not be disturbed.

Project Impacts

Construction Activities

Construction activities will not create any significant impacts and most will be temporary (Section 5.1). The only permanent impact will be the loss of open space and the associated loss of wildlife habitat. Approximately 55 acres of terrestrial habitat will be lost as a result of the incinerator and landfill construction. However, the value of the habitat is low. The proposed landfill site is the former site of a nitrocellulose factory, and in many places, there are old roads and foundations which are of little or no value to wildlife. Areas that are vegetated are relatively disturbed and have limited plant diversity, which in turn limits the wildlife species that can be supported. A total of 0.25 acre or less of wetland aquatic habitat, which have been classified by the New Jersey Bureau of Wetlands as being of moderate value, will be lost. However, the impacts will be limited by the relatively small size and isolated nature of the wetlands to be filled. The incinerator site is the former site of a nitrocellulose waste dump, which was only recently decontaminated (i.e., decontamination was completed in 1987).

Air quality impacts will be minor and temporary. Fugitive dust will be generated by vehicular traffic and during preparation of the incinerator site, excavation of the landfill site, and other construction activities. However, it is expected that dust control measures, such as water application and covering soil piles, will be used. In addition, emissions from construction equipment will be minimized by keeping the equipment properly maintained.

No adverse impacts to surface-water quality are expected from construction activities. Activities will adhere to required construction techniques (e.g., covering soil piles, use of silt curtains, and seeding), and therefore, will not create erosion and increase sediment loading to area drainageways and the Delaware River.

Heavy equipment operation and additional vehicular traffic associated with construction activities will generate some noise. However, the community will not be impacted. Increases in noise levels will be imperceptible because receptors are far enough away, existing noise sources in the community (e.g., existing traffic) predominate, and/or structures on Du Pont property between the construction sites and receptors will act as noise barriers.

No socioeconomic impacts (e.g., changes in demographics, unemployment, the local economy, and demands on public services and utilities) will be associated with the construction of the proposed units. The peak construction workforce (approximately 300 people over a 9 to 12 month period) will be relatively small, and any associated migration of people into the area will be insignificant. Project expenditures in the local area also are expected to be limited and not disruptive.

No known cultural or historic resources exist at the proposed landfill and incinerator sites. Therefore, no impacts are anticipated.

Routine Operations

Surface-Water Quality Impacts. No adverse impacts to surface-water quality are expected from routine operation of either the incinerator or landfill (Section 4.1.1). The incinerator complex has been designed to prevent stormwater run-on and runoff and to contain all spills through the use of spill containment curbs. Wastewater generated by the incinerator's air pollution control system (i.e., the only wastewater generated in the incinerator system), wastewaters from cooling water blowdown, rain that falls into the secondary containment area, and any liquid spill material compatible with wastewater treatment plant (WWTP) limits will be conveyed to the WWTP. Expected quantities represent an extremely small percentage of the 40 million gallons treated and discharged each day from the WWTP. Contaminants in the incinerator stack emissions may reach area surface waters by deposition, but contaminant concentrations are expected to be very low and are not expected to affect water quality adversely .

Discharges from landfilling activities also will be controlled, including leachate generated by stormwater infiltrating through the wastes and wash-water runoff from the truck wash station. Both of these wastes will be collected and pumped to the WWTP for processing. Quantities also will represent only an extremely small percentage of the flow processed daily at the WWTP. Run-on will be prevented by the perimeter containment dike. The quality of area surface waters could be affected by subsurface leakage from the landfill and exfiltration of contaminated ground water, but this is unlikely and various controls will be installed at the landfill to prevent ground-water contamination.

Although both units will be located within the 100-year floodplain, floodwaters should not impact either unit. The incinerator's waste storage building will be constructed on fill material that will be raised to the 100-year flood event elevation (i.e., to 12.3 ft Chambers Works Datum [CWD]). The landfill will include a perimeter clay containment/starter dike that will have a minimum top elevation at 17 ft CWD, which is 4.7 ft above the 100-year flood event elevation. The dike also will include rip-rap protection that will have a top elevation at 14.5 ft CWD, which is 2.0 ft above the 100-year flood event elevation. Therefore, floodwaters are not expected to wash away wastes in the landfill or waste drums from the incinerator's waste storage area.

Ground-Water Quality Impacts. The proposed incinerator complex and landfill have been designed to protect ground water, and therefore, **no adverse impacts to ground water are anticipated** (Section 4.1.2). The incinerator complex will consist of an impermeable concrete pad surrounded by curbing to contain liquid spills. Therefore, spills will not be able to percolate to ground water. Particulate contaminants from stack emissions will be deposited onto the ground, but concentrations of these contaminants are considered insignificant and would not be expected to percolate down to the drinking water aquifer (Potomac-Raritan-Magothy) system in any concentrations that would pose a health risk.

The landfill design includes various control features to prevent the release of hazardous waste constituents to the subsurface environment. These features include a complex liner system, a leachate collection system, and a leak detection system. The landfill also includes a ground-water monitoring system to detect contaminant releases from the structure should any of the controls fail, and a well system to intercept any contaminated ground water. Leachate and any intercepted ground water will be pumped to the Chambers Works WWTP for processing.

Air Quality Impacts. The impacts of air pollutant emissions from the proposed incinerator on air quality are not expected to be significant based on an evaluation of emission estimates and air quality modeling results (Section 4.2). Expected emissions from the incinerator were found to be within existing and proposed standards and guidelines. The modeled ambient air concentrations of criteria pollutants (i.e., particulate matter, sulfur dioxide, nitrogen oxides, carbon monoxide, and lead), metals, organic compounds, and acid gases from the incinerator also were found to be well within regulatory standards and guidelines, most of which are health-based. In addition, air pollution control systems applied to the incinerator are expected to be in compliance with Federal and State emission control regulations and guidelines (e.g., use of best available control technology, 99% removal of hydrochloric acid emissions, and 99.99% destruction of organic compounds), subject to verification during the required incinerator trial burn.

The impacts of air pollutant emissions from the proposed landfill on air quality are not expected to be significant based on evaluation of air quality monitoring data from the existing landfill operation, waste characterization data, and proposed landfill operating procedures. Ambient air quality modeling of particulate and organic compound emissions from the landfill was not conducted. There will be no volatile organic emissions from the proposed landfill because materials disposed of in the landfill will not contain volatile organic substances. Fugitive particulate emissions, including metals, are expected to be similar to those from the existing landfill; emissions from the existing landfill are well within regulatory standards and guidelines. Operating controls at the existing landfill have proven effective in controlling fugitive emissions and are expected to be equally effective at the proposed landfill expansion.

The air quality impacts analysis evaluates the cumulative impacts of the expansion projects on the area's ambient air quality. The dispersion modeling conducted predicts the incremental increase from existing ambient air concentrations resulting from the proposed incinerator and landfill expansion, based on emission estimates. Existing ambient concentrations are based on current ambient air quality data for southern New Jersey and northern Delaware, and these data represent the contribution and impacts from existing emission sources in the region.

Ecological Impacts. No impacts on aquatic and terrestrial systems associated with the landfill and incinerator operations are expected (Section 4.3). The landfill design features and operating controls are adequate to prevent migration of chemicals from the landfill. The design of the incinerator and its operating controls are also sufficient to prevent chemical releases from spills and other operational incidents. In addition, emission concentrations at the incinerator will not be large enough to cause adverse impacts.

Potential impacts of emissions on the aquatic environment were assessed by estimating the maximum concentrations of various chemical in surface water resulting from aerial deposition and comparing these concentrations with ambient water quality criteria established by EPA for the protection of aquatic life. Maximum concentrations were based on the maximum rate of aerial deposition. Comparisons reveal that the estimated concentrations in water for this worst-case exposure are below the criteria by at least a factor of 1000. Chemical concentrations in on-site wetland areas or other surface-water areas located away from the maximum deposition point would be less because the deposition rates in these areas are also less. Thus, it is unlikely that any adverse effects will be experienced by aquatic organisms due to emissions from the incinerator.

It is also unlikely that terrestrial wildlife species will be impacted, including bald eagles and peregrine falcons, which are federally endangered bird species and known to occur near Chambers Works. In evaluating the most toxic chemicals to wildlife species, estimated maximum concentrations resulting from incinerator emissions and deposition, and their potential bioaccumulation in the terrestrial and aquatic foodchains, exposures are insignificant. In the case of bald eagles and peregrine falcons, exposures would be even less than exposures to species that have small home ranges. Because these eagles and falcons have home ranges of at least several square miles, they will spend some time foraging in both uncontaminated and contaminated areas. Given the estimated low environmental concentrations of the chemicals released from the incinerator and the large home ranges of these species, the potential for exposures that may result in adverse effects, such as decreased reproduction, is expected to be negligible.

National wildlife refuges and other wildlife areas in the vicinity of Chambers Works would not be impacted by incinerator emissions. For example, chemical deposition rates at the Supawna Meadows and Killcohook National Wildlife Refuges, which are located more than five miles to the south-southwest of the incinerator site, would be less than 1/10th of the maximum rate predicted. No adverse effects to wildlife are expected to occur in these areas since none are expected even at the maximum deposition point.

Public Health Impacts. An extensive risk assessment was conducted to determine whether emissions from the proposed incinerator would pose a threat to human health. No health risk assessment associated with emissions from the proposed landfill was performed because the landfill does not have continuous point source emissions, and because no fugitive emissions of hazardous pollutants are expected (based on evaluation of air quality monitoring data from the existing landfill operation waste characterization data and proposed landfill operating procedures). The assessment is based on guidelines recommended by EPA and the NJDEP Division of Environmental Quality. Exposure scenarios and assumptions were selected to reflect maximum plausible risk and thus provide conservative health risk estimates. Actual risks could be considerably lower. For example, emissions were based on a "worst-case" waste mixture including all the chemicals that are likely to be incinerated and to be of greatest concern in terms of potential health effects (16 chemicals). It was also assumed that emissions would occur 24 hours per day, 365 days per year and that exposures would occur over a 70-year period. In addition, exposures were assumed to occur at the point where concentrations in the environment would be the greatest. Two means of exposure, or exposure pathways, were used to determine total intake into the body (i.e., dose): direct inhalation of airborne chemicals and incidental ingestion of soil.

The results of this assessment indicate that the incinerator emissions will have no significant impact on public health (Section 4.4). Doses of all chemicals with non-carcinogenic effects were calculated to be far below the doses that cause adverse health effects. Risks (i.e., hazard indices) were several orders of magnitude below the threshold for chronic (long-term) effects. The highest risk for a chemical with carcinogenic effects was an upper bound limit for polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran compounds (PCDDs/PCDFs) of $1x10^{-7}$ (i.e, 0.1 cases per million). The maximum risks for hexavalent chromium, cadmium, and arsenic are $3x10^{-7}$, $4x10^{-7}$, and $6x10^{-7}$, respectively. Risks estimated for all other chemicals were about 10 to 10,000 times lower. No acute (short-term) effects are expected.

Worker Health and Safety Impacts. No significant impacts to worker health and safety were identified (Section 4.5). Operations will be covered under the plant-wide health and safety program, and this program, together with proposed designs and other operational controls, is sufficiently comprehensive in scope to protect workers. For example, employees receive more than eight hours per year of health and safety training for their specific job areas. Chambers Works also has a written hazards communications program that complies with the Occupational Safety and Health Administration's standard. In addition, Chambers Works has an "Emergency and Disaster Manual" for the different operation areas throughout the plant.

Socioeconomic Impacts. Impacts to the communities immediately surrounding Chambers Works due to operation of the proposed incinerator and landfill will be negligible (Section 4.6). Very few new workers will be hired. Operation of the incinerator will only require 50 production and maintenance personnel, and some of these will come from the existing Chambers Works labor pool. No additional personnel will be required for the new landfill. Therefore, no changes in the area's demography or economy are expected. Demands on local services also will be minimal. For example, the increased demand for electricity (10,000 KVA) will be met by Atlantic Electric. The increase in traffic flow from additional personnel and waste shipments along routes extending 10 miles from the facility gates will range from 0.10% to 1.30%. This change in traffic flow will result in an estimated increase in accidents ranging from 0.02% to 1.28%. Both of these increases are minor and present insignificant impacts.

The incinerator stack (213 feet high) and the landfill (100 feet high after closure) will not be visible from Route 130 due to existing woodlands, but some residents further away will be able to see the incinerator and closed landfill from a distance. However, both units will be part of an existing industrial landscape.

Residential property values should not be impacted by the proposed expansion projects. Any actual effect on property values related to Du Pont operations, the existing hazardous waste facility, and any related environmental contamination should already be accounted for in nearby residential property values and should not be further affected by the expansion.

Perhaps the most significant socioeconomic impact likely to result from the expansion projects is the increase in the gross receipts tax to be paid to Carneys Point Township. Du Pont will have to pay a 5% tax on the gross receipts for incinerating waste from outside the plant. An estimate of gross receipts expected from incineration is $20 million. Thus, based on this estimate, Carneys Point Township will receive approximately $1 million per year in additional revenue.

Noise Impacts. Operation of the proposed incinerator will increase noise levels in the community (Section 4.7). Noise levels will exceed New Jersey night-time noise limits and may be noticeable during the day. The major source of operational noise is the two Robinson Industries RB 1216 induced draft fans located between the air pollution control (scrubber) system and the emission stack. <u>However, Du Pont plans to control this noise</u> after the incinerator is constructed and control alternatives can be better evaluated. A duct muffler between the fans and the stack should be effective in achieving sufficient attenuation, and current designs include the space for such a muffler.

Low frequency infrasound also could be generated by the combustion process at the rotary kiln and cause window and wall rattle in nearby residences. However, as soon as operations commence, Du Pont plans to characterize the sound frequencies generated by the combustion process and control them if they could cause adverse impacts.

Operations at the proposed landfill will increase noise levels in the community slightly, but the increase will not be noticeable. The increase in truck traffic to Chambers Works, associated with the proposed incinerator, will have no impact on ambient noise levels in the community.

<u>Foreseeable Occurrences</u>

Despite the expected effectiveness of state-of-the-art engineered and operational controls in preventing accidents, some foreseeable occurrences could still occur and cause potential adverse impacts on the environment and public health. Such occurrences are representative of the types of accidents that are most likely given the operations to be conducted and site characteristics. Foreseeable accidents are not likely to occur, but are conceivable and more likely to occur than the credible worst-case accidents addressed later.

Examples of foreseeable occurrences associated with operations at the proposed incinerator include:

- Leaking drums due to corrosion or damage,
- Spills from overturned or punctured drums,
- Feedline rupture due to puncture, rapid pressurization, or corrosion,
- Leaks from damaged or partially closed valves,
- Spills from overfilled containers, and
- Fires involving spilled wastes.

Such occurrences can result from human error, system/equipment malfunction, and/or physical phenomenon (e.g., static spark igniting flammable vapors). Impacts would affect incinerator personnel and the incinerator. Because of the incinerator's isolated location, it is unlikely that other parts of Chambers Works would be impacted. Off-site impacts would be extremely unlikely and minimal at best. Impacts also would be lessened or eliminated by in-place response equipment, systems, and procedures, and thus should be relatively minor (e.g., minor damage to equipment, requiring repair or replacement; slightly injured, exposed, or contaminated personnel; temporary shut-down of operations; etc.). Depending upon the circumstances, there is always the possibility of personnel receiving moderate to serious injuries that would require on-site or off-site medical treatment, but such cases would be uncommon, especially in light of Du Pont's training program and its safety record.

A foreseeable occurrence at the landfill would be leachate leaking through the landfill liner system and bypassing the leak detection system. Such leakage could contaminate the ground water and the Delaware River. However, the probability of such an occurrence is very low. The landfill is designed to prevent such leakage, and the environmental controls at the landfill, including the liners, will be installed pursuant to rigorous specifications to ensure that design objectives are met. Installation will be observed daily by an inspector for adherence to specification requirements. In addition, impacts would be lessened by the proposed ground-water monitoring program. This monitoring program should detect leaks soon after occurrence so that remedial action, including pumping out contaminated ground water, can be taken in a timely manner to prevent further contamination.

Impacts could also occur from minor on-site and off-site transportation spills. Depending on the chemical(s) being transported, the health effects on the driver and other unprotected people in the area potentially affected by a resultant vapor cloud could range from minor to severe. However, the area potentially affected by a minor spill would be small. An on-site spill would not likely result in any major disruption in normal operations at Chambers Works or encompass any residential areas. The vapor cloud from an off-site spill would not likely go beyond the immediate area of the roadway. Spills which occur on-site will be responded to by Chambers Works' Transportation Emergency Response (TERP) Team and/or other Chambers Works response teams. Spills which occur off-site will be responded to by the TERP Team as well as by local emergency responders. The TERP Team will respond to releases occurring within 300 miles of Chambers Works.

Worst-Case Credible Accidents

Three worst-case accidents could conceivably occur as a result of the proposed expansion projects, including:

- the incinerator venting to the atmosphere,
- a large spill and fire involving the tank farm, and
- a large off-site transportation spill.

The incinerator would vent to the atmosphere only in the event of an extreme high pressure in the incinerator kiln or afterburner. Emissions from such an emergency venting would not be controlled by the air pollution control system, however, emissions to the atmosphere would be limited to the time required for material already in the incinerator at the time of the vent to burn out. No additional material would be fed into the incinerator after the vent because all feed systems would automatically shut off. Ambient air concentrations that would result from a likely venting scenario were modeled, based on estimated emissions and stable (stagnant) atmospheric conditions, and were found to be insignificant. These ambient air concentrations do not pose any significant health threat based on a comparison with permissible short-term concentration levels.

A large chemical spill and fire at the tank farm would only occur if a series of unlikely events were to take place. However, if such a fire were to occur, the incinerator and surrounding area (i.e., an area within at least 0.5 mile of the tank) would have to be evacuated, and all incinerator operations would be shut down. Other parts of Chambers Works might have to be shut down and evacuated if downwind of the fire. Fleeing workers and emergency responders also could be injured, with injuries ranging from minor to fatal. Other possible impacts affecting Chambers Works include property damage and environmental contamination. Based on modeled ambient air concentrations, impacts to off-plant areas would be minimal. There should be few if any health and safety hazards to residents and motorists in downwind areas. However, local government officials could decide to take protective actions to ensure the health and safety of citizens and travelers. Such actions could involve traffic and crowd control and evacuation or in-place sheltering, which could be quite disruptive. Some off-plant areas also could require minor decontamination (e.g., hosing down surfaces with water and wiping off surfaces with clothes) to remove settled air pollutants (primarily smoke particles).

A large off-site transportation spill could have adverse health impacts on the driver and other unprotected people in the area, ranging from minor to severe, depending on the chemical(s) being transported. Based on modeled ambient air concentrations resulting from a spill scenario, an area within 0.5 mile of the spill might have to be evacuated, including residential areas.

CONCLUSION

The proposed incinerator and landfill will not create any significant adverse impacts that cannot be mitigated. Various engineered and administrative controls will be in place to control air emissions and to prevent accidental releases of hazardous materials to the environment. The proposed units have also been designed to comply with existing regulations. If any regulations or standards applicable to the incinerator are not achieved during trial burns, Du Pont will be required to make the necessary modifications to comply. For example, operation of the incinerator will increase noise levels in the community and resultant ambient levels will exceed New Jersey night-time noise limits, but Du Pont plans to install a muffler system after the incinerator is operating (i.e, when noise generated and appropriate controls can be studied). In addition, construction will not create any significant impacts, and minor impacts will be temporary.

TABLE OF CONTENTS

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

TABLE OF CONTENTS
(continued)

LIST OF EXHIBITS

LIST OF EXHIBITS
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PRINCIPAL AUTHORS

ICF Technology Incorporated prepared the Environmental and Health Impact Statement under Contract No. 11A. Resumes of principal authors are presented in Appendix G.

Section 1

SECTION 1

BACKGROUND

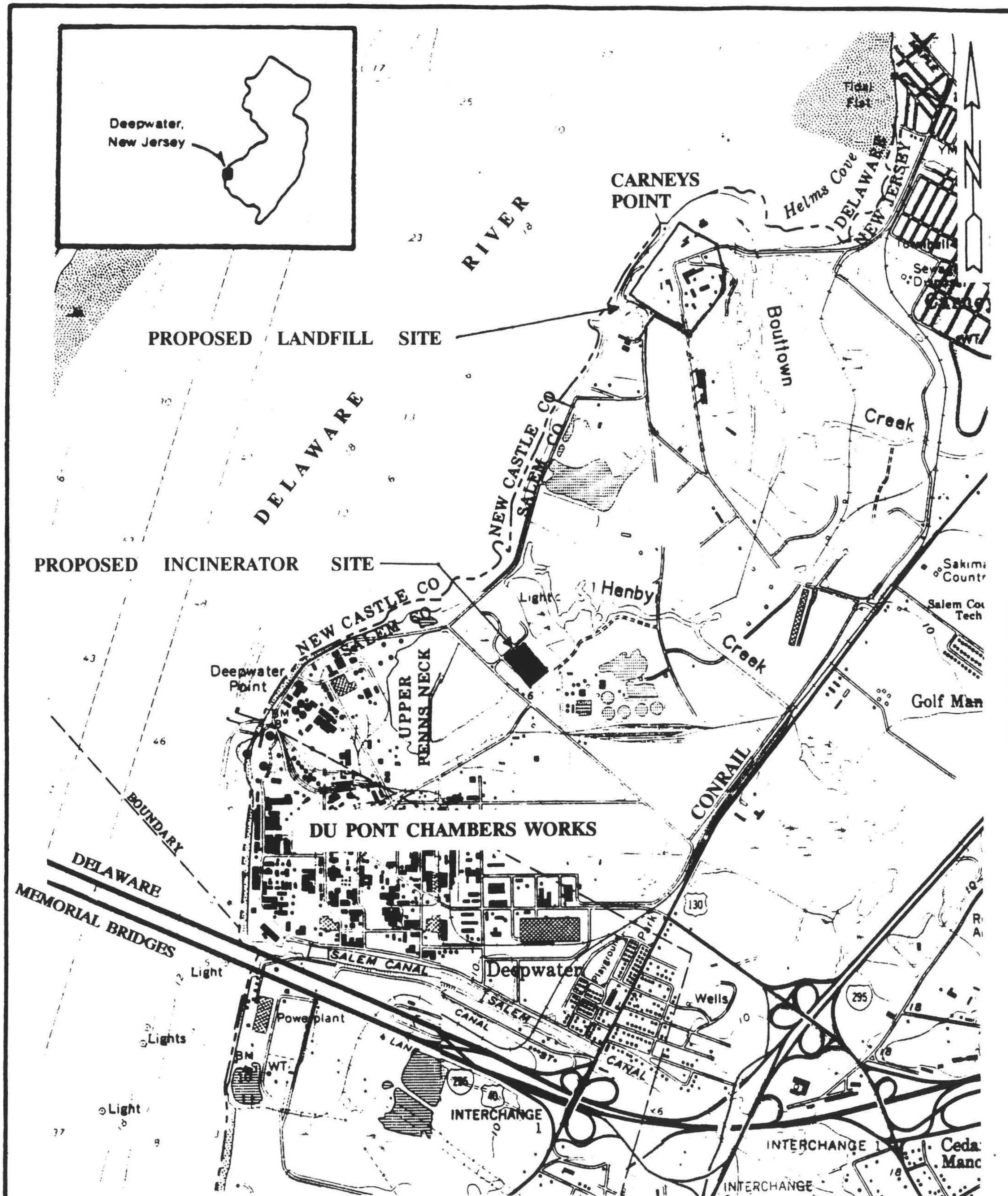
1.1 DESCRIPTION OF CHAMBERS WORKS AND EXISTING HAZARDOUS WASTE MANAGEMENT UNITS

Chambers Works is a complex, multi-product, chemical manufacturing plant, owned and operated by E.I. Du Pont de Nemours & Company (Du Pont) in Deepwater, New Jersey. The plant is located largely within the 100-year floodplain of the Delaware River and overlies the Potomac-Raritan-Magothy aquifer system. Chambers Works is bounded on the west and northwest by the Delaware River, on the south by the Delaware Memorial Bridge, and on the east and northeast by the track bed of the Pennsylvania-Reading Seashore Line (see Exhibit 1-1). In addition to a number of industrial and manufacturing areas, the 1455-acre property contains wetlands and wooded areas. Land uses in the vicinity of the plant are agricultural, industrial, commercial, and moderate density residential.

Chemical manufacturing began at Chambers Works in 1893, when a small gun powder plant was built on the tip of the area known as Carneys Point (see Exhibit 1-1). In 1914, the Carneys Point Works operation expanded south to Chambers Works, and by 1917, dyes and explosives were also being manufactured at the plant. In the late 1970s, all manufacturing operations were suspended at Carneys Point Works; however, Chambers Works continues to operate, using more than 2000 separate chemical processes, in 70 manufacturing buildings, to produce approximately 750 finished products. Current products include organic intermediates; tetraethyl lead; fluorinated hydrocarbons; textile treating chemicals; petroleum chemicals; and other chemicals, such as mineral acids, prescription drugs, and a variety of specialty chemicals.[1]

Hazardous wastes are generated at the Chambers Works plant in the form of wastewater, spent solvents, sludges, ash, and solids. A few wastes are shipped off-site for disposal or recycling (e.g., polychlorinated biphenyls (PCBs) and elemental mercury); however, most hazardous wastes are treated and disposed of on-site in one of the existing hazardous waste management units described below.[2]

- The chemical waste landfill ("C" landfill) accepts dewatered sludge and drummed waste solids from various operations at Chambers Works and other Du Pont plants in New Jersey and elsewhere in the U.S. It is located within the boundaries of Carneys Point Works and consists of three, five-acre cells (Areas I, II, and III), which were constructed above grade. Area I, which was filled and closed by 1978, has a single liner of 30-mil Hypalon and is equipped with a leachate



REF. : U.S.G.S. 7.5 Minute Quadrangle for Wilmington (South)
U.S.G.S. 7.5 Minute Quadrangle for Penns Grove

SCALE IN MILES

0 1/2

EXHIBIT 1-1

LOCATION MAP, DU PONT CHAMBERS WORKS, DEEPWATER, NEW JERSEY.

collection and pumping system. Areas II and III are of similar design; however, they were constructed with two 30-mil Hypalon liners. Du Pont has added a fourth cell to the landfill, increasing its capacity to 1.2 million cubic yards (MM CY).[3]

- The 40 million gallon per day (mgd) powdered activated carbon treatment (PACT) wastewater treatment plant is authorized to receive hazardous waste from both on-site and off-site sources, including other Du Pont plants and commercial generators. Currently on-site wastes flow through a combination of pipes and open, unlined ditches; however, projects are underway and the unlined ditches will be replaced with an above-ground sewer line by 1991.[4] Wastes from off-site generators are brought in by tank trucks and discharged to the headworks of the treatment plant; however, railcars and river barges have also been used to transport wastes to the plant. Treated effluent is discharged to the Delaware River through a permitted outfall, and dewatered sludge is disposed of in the "C" landfill.

- Three unlined surface impoundments are associated with the wastewater treatment plant: "A" Basin (17 acres), located just ahead of the plant, is used to store excess flow; "C" Basin (3 acres) is used to "pretreat" wastewater from the tetraethyl lead production area; and "B" Basin (15 acres) functions as a polishing and retention basin for treated effluent and non-contact cooling water prior to discharge into the Delaware River.

- The ethyl chloride incinerator (non-commercial) treats a continuous stream from the ethyl chloride manufacturing area. This waste stream contains hydrogen chloride, aluminum chloride, carbon dioxide and miscellaneous "high boilers" (long-chain polymers), and vent gas streams from chemical reactors. Furnace effluent gas flows to a common treatment system, which consists of a packed tower scrubber, followed by a flooded fibrous bed scrubber. All waste scrubber liquid is piped to the Chambers Works wastewater treatment plant. The ethyl chloride incinerator has no storage facilities and operates only when ethyl chloride is being processed at the plant.

- The multi-purpose incinerator (non-commercial) treats chemical wastes from Chambers Works and other Du Pont manufacturing plants. Typical waste streams contain amines, anilines, mixed solvents, and hot still tars. Furnace gases flow through a packed tower scrubber, followed by a wet-wall electrostatic precipitator, and the liquid from both units is treated in the Chambers Works wastewater treatment plant. Ash which settles out of the scrubber effluent stream is collected in a batch process and disposed of in the chemical waste landfill.

Storage facilities include a concrete pad for drum storage, storage tanks for segregation and blending of wastes, tanker unloading stations, and an unloading station for the hot tars.

- The thermal treatment unit is a large, furnace-type structure used for decontaminating Du Pont-owned property such as tanks, piping, reactor vessels, containers, rail tankcars, and truck tanks containing tetraethyl lead residues. Materials to be decontaminated are placed on a flatbed railcar, which is then moved into the furnace. Residual baghouse dust (<100 lbs/week) is manifested as hazardous waste and shipped off-site to several metal reclaimers.

- Other existing hazardous waste management units include the chemical waste tank storage area, an oil/water separator, and the Telomer "A" treatment area. Three existing units have been closed in recent years. They are the Telomer "A" storage area (1986), the nitrocellulose waste pile (1986), and the Freon spent catalyst container storage area (1985).

1.2 PROPOSED EXPANSION

In accordance with its corporate Waste Internalization Program, Du Pont proposes to expand the hazardous waste management capabilities of the Chambers Works plant by adding a 140 million BTU/hr rotary kiln incinerator and a 27-acre, approximately 1.8 million cubic yard secure landfill to the facility (see Exhibit 1-1 for site locations). The proposed rotary kiln is designed to process approximately 35,000 tons of hazardous wastes annually, with the afterburner potentially providing an additional 27,000 TPY of capacity for liquids only. It will be used to treat wastes generated at Chambers Works and other Du Pont plants, as well as hazardous wastes from other commercial generators. The afterburner will be fueled using Du Pont liquid hazardous wastes, however, fuel oil will be used if sufficient high heating value (BTU) hazardous liquid wastes are not available. Also, the afterburner may receive liquids which would normally go elsewhere (e.g., the wastewater treatment plant). The tank farm will ultimately provide about 220,000 gallons of waste storage capacity plus 10,000 gallons for waste holding/blending. The container storage area will have the capacity to store approximately 257,400 gallons of waste (approximately 4680 55-gallon drums). The secure landfill will be used to dispose of ash from the incinerator and to increase the capacity of the "C" landfill for disposal of sludge from the wastewater treatment plant and bulk hazardous wastes, such as chemically contaminated rubble from Chambers Works and other Du Pont plants. The proposed additions would increase the capacity of the facility by more than 50 percent.[5]

1.3 REGULATORY FRAMEWORK

Operation of the Du Pont Chambers Works hazardous waste management facility is regulated by a number of Federal and State environmental laws. The following paragraphs describe hazardous waste management under the Resource Conservation and Recovery Act (RCRA) and the Hazardous and Solid Waste Amendments (HSWA) (42 USC 6901 et seq.), as well as associated State laws, such as the New Jersey Hazardous Waste Facilities Siting Act (NJSA 13:1E-49 to 13:1E-173) and the New Jersey Solid and Hazardous Waste Management Regulations (NJAC 7:26-1.1 to &:26-12.14). Information relating to the impacts of other environmental laws on the proposed Chambers Works expansion is presented in the applicable paragraphs of Sections 2 through 4.

1.3.1 Resource Conservation and Recovery Act

In enacting the Resource Conservation and Recovery Act of 1976 (RCRA) and the Hazardous and Solid Waste Amendments of 1984 (HSWA) (42 USC 6901 et seq.), Congress provided a basic regulatory framework for the management of solid wastes in general, and hazardous wastes in particular, by granting the U.S. Environmental Protection Agency (USEPA) broad authority to develop a comprehensive hazardous waste management program. The RCRA program, which is codified in Title 40 of the Code of Federal Regulations (40 CFR 262-272), specifies criteria for identifying hazardous waste and provides a detailed list of wastes that are considered to be hazardous. In addition, any firms that produce or generate hazardous waste are subject to rules for handling, containing, and tracking the movement of the waste through ultimate disposal; transporters of hazardous waste must comply with regulations that address record keeping, labeling, and the delivery of hazardous waste to authorized treatment, storage, or disposal (TSD) facilities; and owners and operators of TSD facilities are required to apply to USEPA for permits, which are issued based on standards that include record keeping, reporting, monitoring, inspection, maintenance, and waste tracking requirements, as well as location, design, construction, and operating standards that minimize risks to public health and the environment.

When the RCRA program was first instituted, existing TSD facilities were conferred "interim status," allowing owners and operators to continue operations until decisions could be made on their permit applications. In addition, individual states were invited to establish their own RCRA programs, in place of USEPA's program, provided their regulations were at least as stringent and consistent with the Federal regulations, and adequately enforced.

The 1984 amendments to RCRA considerably expanded its scope and added a number of detailed requirements. In particular, the amendments increased the responsibilities of owners and operators of TSD facilities, requiring them to retrofit some existing waste management units, establish ground-water monitoring programs, and clean up all releases of hazardous wastes, regardless of when those wastes were placed in the facility. In addition, the scope of interim status provisions was expanded, requiring owners and operators to provide information on all potential pathways of human exposure from all releases of hazardous waste.

Du Pont operates the Chambers Works hazardous waste management facility under RCRA interim status. Existing units were the subject of previous RCRA permit applications; the Part A permit application was originally filed in 1980 and the Part B in 1983. Since that time, the application has been revised a number of times to include hazardous waste management units that have been added to the facility. In the State of New Jersey, the Department of Environmental Protection (NJDEP) manages the RCRA program pursuant to the New Jersey Solid and Hazardous Waste Management Regulations (NJAC 7:26-1.1 to 7:26-12.14) and issues RCRA permits that address all pre-HSWA requirements. Region II of the USEPA is responsible for ensuring that all post-HSWA requirements are met and issues HSWA permits. NJDEP and USEPA have finalized portions of the RCRA and HSWA permits for the Chambers Works facility that deal with the existing "C" landfill. Portions of the permits dealing with the other existing units had not been finalized when this Environmental and Health Impact Statement (EHIS) was being prepared.

1.3.2 New Jersey Hazardous Waste Facilities Siting Act

The New Jersey Hazardous Waste Facilities Siting Act of 1981 (NJSA 13:1E-49 to 13:1E-91) was enacted to provide a mechanism for the planning, siting, licensing, and regulation of major commercial hazardous waste management facilities in the State. The Act established a governing body, known as the Hazardous Waste Facilities Siting Commission, to review both the siting criteria in the Act and regulatory criteria and to prepare a Major Hazardous Waste Facilities Plan which would analyze New Jersey's hazardous waste management practices and define the State's need for additional commercial TSD facilities.[6] According to the Plan, two types of facilities are required to meet the current needs: one or more rotary kiln incinerators to satisfy a capacity shortfall of 50,000-75,000 tons per year, and an 80-acre land emplacement facility.[7] The proposed Chambers Works incinerator (with the secure landfill to dispose of the resulting ash/slag) would help to meet this need by increasing the State's capacity to treat and dispose of its own hazardous wastes. The Commission is also mandated to oversee the siting of new hazardous waste facilities and the expansion of existing hazardous waste facilities. Siting criteria are discussed in Section 4.8.

1.3.3 New Jersey Toxic Catastrophe Prevention Act

The New Jersey Toxic Catastrophe Prevention Act of 1986 (NJSA 13:1-K-19 et. seq.) was enacted to prevent accidental releases of Extraordinarily Hazardous Substances (EHSs) in New Jersey. An EHS is any substance that if released in sufficient quantities into the environment, would likely produce acute health effects resulting in death or permanent injury to persons exposed. The original Act identified eleven specific substances as EHSs and defined reportable quantities for each. The regulations (NJAC 7:31 et seq.) that were adopted pursuant to the Act in June 20, 1988 identified an additional 93 EHSs. Any facility which at any time generates, stores, or handles any of the EHSs in quantities equal to or greater than the reportable quantity has to comply with the requirements of the Act. Such a facility is required to develop for approval by NJDEP a risk management plan (RMP) for the purpose of minimizing extraordinarily hazardous substance accident risks. An RMP is composed of eight specific elements: safety review of the design of new and existing equipment, standard operating procedures, preventive maintenance procedures, operator training, accident investigation procedures, risk assessment of equipment and operating alternatives, and audit procedures to ensure programs are being executed as planned. These elements address both the engineering, and management controls that are required to develop an effective release prevention plan. The regulations define the minimum requirements for an acceptable risk management program. In addition, a facility may be required to conduct an extraordinarily hazardous substance accident risk assessment (EHSARA) if deemed necessary by NJDEP.

1.3.4 Permits and Approvals

The Chambers Works expansion must be approved by various divisions within NJDEP which will issue the appropriate permits when Du Pont demonstrates that the proposed project will meet the required levels of environmental protection. Exhibit 1-2 presents a list of necessary permits and approvals. During preparation of this EHIS, Du Pont was preparing a modification to the Chambers Works RCRA permit application to include the proposed incinerator, waste storage area, and landfill. A modification to the NJ Pollutant Discharge Elimination System (NJPDES) permit is not required since the discharge from the wastewater treatment plant will not change. A Freshwater Wetlands permit is also not required because wetlands will not be affected. However, Du Pont will have to obtain a transition area waiver for the proposed landfill site (see Section 3.4.1.2). Du Pont has submitted Wetland Delineation Reports for the proposed landfill and incinerator to the NJDEP showing that wetlands will not be affected.

1.4 ISSUES OF CONCERN

1.4.1 Existing Facility

Operation of the existing Chambers Works waste management facility has not been without problems. Following inspections by NJDEP in 1985 and USEPA in 1986, Du Pont was assessed civil penalties and placed under an administrative order to correct a number of violations of the State's hazardous waste management and water pollution control regulations.[8] Inspectors discovered containers without clear markings, inadequate aisle space in container storage areas, and unlined collection ditches that discharged pollutants to the environment. In addition, inspectors determined that Du Pont failed to meet the waste analysis requirements for hazardous waste incinerators, and that the Chambers Works ground-water sampling and analysis plan failed to monitor adequately ground water migrating under the facility. As a result, Du Pont was assessed more than $41,000 in penalties and ordered to correct all violations.

Du Pont has, however, challenged several of these findings detailed during the NJDEP inspection (detailed in Administrative Order/Notice of Administrative Penalty Assessment (HS010-87)).[9] At the time of the inspection and fine, Du Pont was negotiating with the State for an engineering solution to the unlined

EXHIBIT 1-2

PERMITS AND APPROVALS REQUIRED FOR
THE DU PONT CHAMBERS WORKS EXPANSION

PERMIT	AGENCY	STATUS
Hazardous Waste Facility Permit (RCRA Permit)	NJDEP	Du Pont Preparing Application
Prevention of Significant Deterioration (PSD) Permit	NJDEP	Under Review by Agency
Waterfront Development (Coastal Area Facility Review Act (CAFRA)) Permit	NJDEP	Under Review by Agency
Wetland Delineation Reports	NJDEP	Under Review by Agency
Stream Encroachment Permit	NJDEP	Under Review by Agency
Risk Management Program	NJDEP	Existing Facility Risk Management Program to be Modified/Updated
Soil Erosion and Sediment Control Plan	Salem County, Soil Conservation Commission	Under Review by Agency

ditch problem, and had maintained on-going contact regarding the adequacy and completeness of both the written waste analysis plan and facility closure plan.[10]

A subsequent investigation by the EPA National Enforcement Investigations Center (NEIC) in September and October of 1987 also indicated problems with compliance with several RCRA and HSWA regulations.[11] For example, NEIC found in a spotcheck of many manifests that Chambers Works had some waste descriptions on the manifests not matching the wastes being received and treated, and some restricted wastes being received from off-site generators without the required notification information and discharged to unlined surface impoundments ("A" and "C"). Also, sludges from the wastewater treatment plant were not being analyzed before disposal in the "C" landfill, and the waste analysis plan was found to be inadequate. Du Pont is currently working to correct all violations and bring the facility into compliance with statutory and regulatory requirements.[12]

1.4.2 Proposed Expansion

In addition to issues associated with Du Pont's existing facilities, there have been a number of concerns raised with regard to the proposed incinerator and landfill. These concerns focus on the process for siting such facilities as well as the potential environmental issues associated with their operation. In terms of the siting process, reservations have been voiced over the New Jersey Hazardous Waste Facilities Siting Commission's designation for Du Pont's proposed action. The proposed action has been designated a facility expansion rather than a new construction project. The Siting Act distinguishes between new facilities, expansions of existing facilities, and commercial versus non-commercial facilities.

The site designation requirements contained in the Act apply explicitly only to "new major hazardous waste facilities." A "new major hazardous waste facility" is defined in the Act as being "any major hazardous waste facility (i.e., capacity to treat, store, or dispose of more than 250,000 gallons of hazardous waste) other than an existing major hazardous waste facility." An "existing major hazardous waste facility" is defined as any major hazardous waste facility legally in operation or under construction prior to the effective date of the Act (September 10, 1981). The term "commercial hazardous facility" is defined as a facility that accepts hazardous waste from more than one generator for storage, treatment, or disposal at a site other than where the waste was generated. Thus, to be an existing major hazardous waste facility and exempt from the provisions of the Act, a facility must meet three tests: 1) it was legally in operation or under construction as of September 10, 1981; 2) it has accepted hazardous waste from more than one generator for storage, treatment or disposal at a site other than the site where the hazardous waste was generated; and 3) it has had the total capacity to treat, store, or dispose of more than 250,000 gallons of hazardous waste continuously since that date.[13] Du Pont meets these criteria.

Further, the fact that a new technology (i.e., incineration) is being added to an existing facility does not alter the site designation, because the Act does not differentiate between kinds of waste disposal technologies in regard to new or existing facilities. The DEP's hazardous waste regulations for obtaining a license to operate do require an EHIS be submitted by the Siting Commission (at the expense of the applicant) for a proposed hazardous waste incinerator at an existing site, even if considered an expansion.

Thus, although it has been suggested the proposed action is not subject to the rigorous site screening by the Commission that would otherwise be required if it were a new major commercial project, the required EHIS includes discussion and environmental impact analysis of many factors, such as socio-economics, health and safety, emergency response capabilities, air quality, water quality, etc.

Other issues raised by concerned citizens include:

- Safety of transporting hazardous wastes to Chambers Works;
- Types of hazardous wastes that will be incinerated;
- Air quality because of the incinerator and cumulative impacts of all area emissions sources;
- Impacts on wetlands;
- On-site and off-site ground-water contamination;
- Importing toxic waste from other Du Pont facilities and other companies throughout New Jersey.

These and other issues of concern will be addressed in this EHIS.

1.5 INTENT AND SCOPE OF THE EHIS

NJDEP and the Hazardous Waste Facility Siting Commission consider Chambers Works to be an existing, major, commercial, hazardous waste facility for the purposes of the Hazardous Waste Facilities Siting Act (NJSA 13:1E-51.1) and the Solid and Hazardous Waste Management Regulations (NJAC 7:26:-1.4). As such, it must comply with NJAC 7:26-12.2(i), which requires the submittal of an EHIS if owners and operators wish to modify a RCRA permit and if the modifications would increase the capacity of the facility by 50% or more. The EHIS is submitted by the Siting Commission.

The purpose of the EHIS is to provide decision-makers with detailed descriptions of the proposed modifications and to present key information on existing environmental conditions; to identify all environmental and public health impacts that are likely to result from the construction and operation of a proposed project; and to present measures that would minimize adverse impacts during construction and operation of the project. The following sections of this document provide the required information to assess impacts of the proposed expansion of the Chambers Works hazardous waste management facility:

- Section 2, Description of Proposed Hazardous Waste Units, presents all the pertinent technical information about the design, construction, and operation of the proposed incinerator and landfill;

- Section 3, Environmental Setting, describes the physical, chemical, ecological, socioeconomic, and aesthetic characteristics of the Chambers Works plant and surrounding areas;

- Section 4, Environmental and Health Impact Analysis, presents a thorough analysis of all possible impacts associated with the construction and operation of the proposed incinerator and landfill; and

- Section 5, Unavoidable Adverse Impacts and Mitigative Measures, describes impacts under normal and abnormal circumstances, including impacts under a maximum credible accident scenario. Section 5 concludes the EHIS with a discussion of how to mitigate unavoidable impacts through improvements in proposed engineered and administrative controls.

NOTES

1. RCRA Part B Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

2. USEPA, Draft Hazardous and Solid Waste Amendments of 1984 Permit for the Operation of Hazardous Waste Land Disposal Units at Du Pont Chambers Works, Deepwater, NJ, April 1988, p. II-2.

3. National Enforcement Investigations Center (NEIC), "Compliance Investigation, Land Disposal Restrictions, E.I. Du Pont de Nemours & Company, Chambers Works, Deepwater, New Jersey," EPA-330/2-88-007, December 1987.

4. Ibid.

5. Letter from Frank Coolich, Assistant Director Hazardous Waste Regulation Element Division of Hazardous Waste Management, New Jersey Department of Environmental Protection to Richard J. Gimello, Executive Director Hazardous Waste Siting Commission concerning the proposed expansion of the Du Pont Chambers Works hazardous waste management facility, August 11, 1987.

6. New Jersey Hazardous Waste Facilities Siting Commission, "New Jersey Hazardous Waste Facilities Plan," March 1985, ES-2 to ES-3.

7. Ibid, p. ES-13.

8. New Jersey Department of Environmental Protection (NJDEP), Division of Hazardous Waste Management, Administrative Order/Notice of Civil Administrative Penalty Assessment, issued to E.I. Du Pont de Nemours & Company, April 29, 1987.

9. Letter from Alfred H. Pagano, Consulting Manager Environmental Affairs, Du Pont Chambers Works, to Ronald T. Corcory, Assistant Director, Division of Hazardous Waste Management, NJ DEP, June 29, 1987.

10. Ibid.

11. National Enforcement Investigations Center (NEIC), "Compliance Investigation Land Disposal Restrictions, E.I. Du Pont de Nemours & Company, Chambers Works, Deepwater New Jersey," EPA-330/2-88-07, December 1987.

12. New Jersey Department of Environmental Protection (NJDEP), Division of Hazardous Waste Management, Administrative Order/Notice of Civil Administrative Penalty Assessment issued to E.I. Du Pont de Nemours & Company, April 29, 1987.

13. Letter from W. Carey Edwards, Attorney General of New Jersey, to Frank J. Dodd, Chairman, Hazardous Waste Facilities Siting Commission, regarding the Applicability of Major Hazardous Waste Facilities Siting Act to Proposal of New Technology On Site of Existing Major Hazardous Waste Facility, April 6, 1987.

Section 2

SECTION 2

DESCRIPTION OF PROPOSED HAZARDOUS WASTE UNITS

2.1 INCINERATOR AND WASTE STORAGE

The proposed incinerator site was previously used as a disposal area for nitrocellulose waste, which was generated at the nitrocellulose plant. The decommissioned manufacturing plant site is the proposed location for the landfill extension (see Section 2.2). Wastes were taken to the disposal site and destroyed by ignition. Use of the disposal area was stopped in the late 1970s after the nitrocellulose plant was closed. The soils, contaminated by nitrocellulose, were classified as hazardous by virtue of their ignitability, and the site had to be closed pursuant to an NJDEP-approved closure plan. The closure which involved excavating and decontaminating nitrocellulose-laden soil and returning the decontaminated soil to the excavation, commenced in the Spring of 1983 and was completed in February 1987. An on-site, portable thermal processing system was used to dry the contaminated soils and ignite the nitrocellulose. Only decontaminated soils free of ignitable amounts of nitrocellulose were returned to the excavation, spread out, machine compacted and rough graded. Imported fill soils were then applied.

The incinerator will be operated 24 hours per day, 7 days per week; however, it will be occasionally shut down for maintenance and repairs. The operation will require approximately 50 production and maintenance personnel to cover the three shifts of operation. The following subsections describe the wastes that will be accepted for destruction in the proposed incinerator, associated waste storage and handling systems, the incinerator components, design and safety systems, and the overall systems operations. Information on the proposed incinerator was derived principally from Du Pont's Draft RCRA Part B Permit Application dated 1988.

2.1.1 Wastes Accepted

The Chambers Works plant, in addition to accepting wastes generated on-site, accepts wastes from other Du Pont facilities and commercial generators. The proposed incinerator is designed to accept solid, liquid and slurried wastes including pumpable sludges. The quantity of hazardous waste to be treated in the proposed rotary kiln is approximately 35,000 tons per year, depending on the heating value of the waste. The afterburner, which can be fired with liquid hazardous wastes or fuel oil, has an additional capacity of approximately 27,000 tons of liquid hazardous waste per year.[1] Approximately 25% of the capacity is expected to be used for Chambers Works waste, 25% for other Du Pont operations wastes, and 50% for commercial wastes.[2]

An estimated 880 hazardous waste codes could be managed at the incinerator.[3] A list of possible wastes and maximum annual volumes of each was estimated based on Du Pont's knowledge of wastes generated at the Chambers Works, other Du Pont facilities, and other New Jersey commercial generator data. The largest of these projected waste codes and the annual maximum volume estimates include chemical process liquids and solids, NOS (50,100 TPY), spent halogenated solvents, NOS (7,000 TPY), ignitable wastes, NOS (6,300 TPY), phenylenediamine (4,400 TPY), nitrobody waste (2,000 TPY), chloroaniline (1,200 TPY), waste paint (968 TPY), corrosives, NOS (739 TPY), and waste oil (from Du Pont only, 600 TPY).[4] For those waste codes (approximately 830) where data were not available, the volumes of each are estimated to be 5 TPY.[5] These values represent the maximum annual volumes potentially available for disposal by incineration at Chambers Works; however, these numbers only provide the bounding value in a year for any of the waste codes and do not add up to the actual annual waste volume throughput projected for the incinerator (i.e., 35,000 tons/year).

Wastes which will *not* be accepted include polychlorinated biphenyls (40 CFR 761), polychlorinated dioxins and furans (EPA hazardous waste codes F021, F022, F023, F026, F027, and F028), radioactive wastes (40 CFR 173 subpart I), explosives (49 CFR 173 subpart c), etiologic agents (49 CFR 173.386 and infectious waste), asbestos-containing wastes, infectious wastes, or ignitable compressed gases (R 299.6212 (1)(c), 40 CFR 261.21 (a)(3) or 49 CFR 173.300 (b).[6,7,8]

2.1.2 Waste Storage and Handling System

The waste storage and handling system includes liquids receiving areas for both rail car and tank truck unloading and sampling, tank farm areas for bulk storage of liquid and other pumpable hazardous wastes, and container storage areas for fiber drums, steel drums, and other containerized hazardous wastes. Exhibit 2-1 depicts a general overview of the proposed incinerator site.

2.1.2.1 Liquids and Bulk Sludges Receiving Areas. The liquids and bulk sludges receiving areas are for unloading and sampling tank truck loads at the incinerator facility. The rail car unloading area at a remote location (i.e., approximately 500 ft outside the battery limits) consists of two bays equipped with unloading and sampling stations. The bay areas have fixed platforms at a height to allow access to the tanks and they are covered to prevent run-on of precipitation and provide protection for workers against the weather. Fuel oil for use as an auxiliary fuel for the incinerator arrives in tank trucks at the receiving area. Caustic soda used in the scrubber and neutralization systems arrives in tank cars.

Once a tank truck of fuel oil has been received, samples are taken to verify and the shipment is then unloaded into a 24,000 gallon carbon steel storage tank. There is a duplex filter between the unloading pump and the storage tank to remove any impurities from the oil. The fuel storage tank has level indicators and a high level pump shut-off valve to prevent releases. Caustic soda is handled in a similar manner, with the addition of a steam heat source and tank insulation to prevent freezing.

The tank truck unloading/sampling area has five bays, two for direct burning, two for unloading to the tank farm, and one for fluoride-waste unloading (near the afterburner). After the trucks are weighed at the plant scale site,

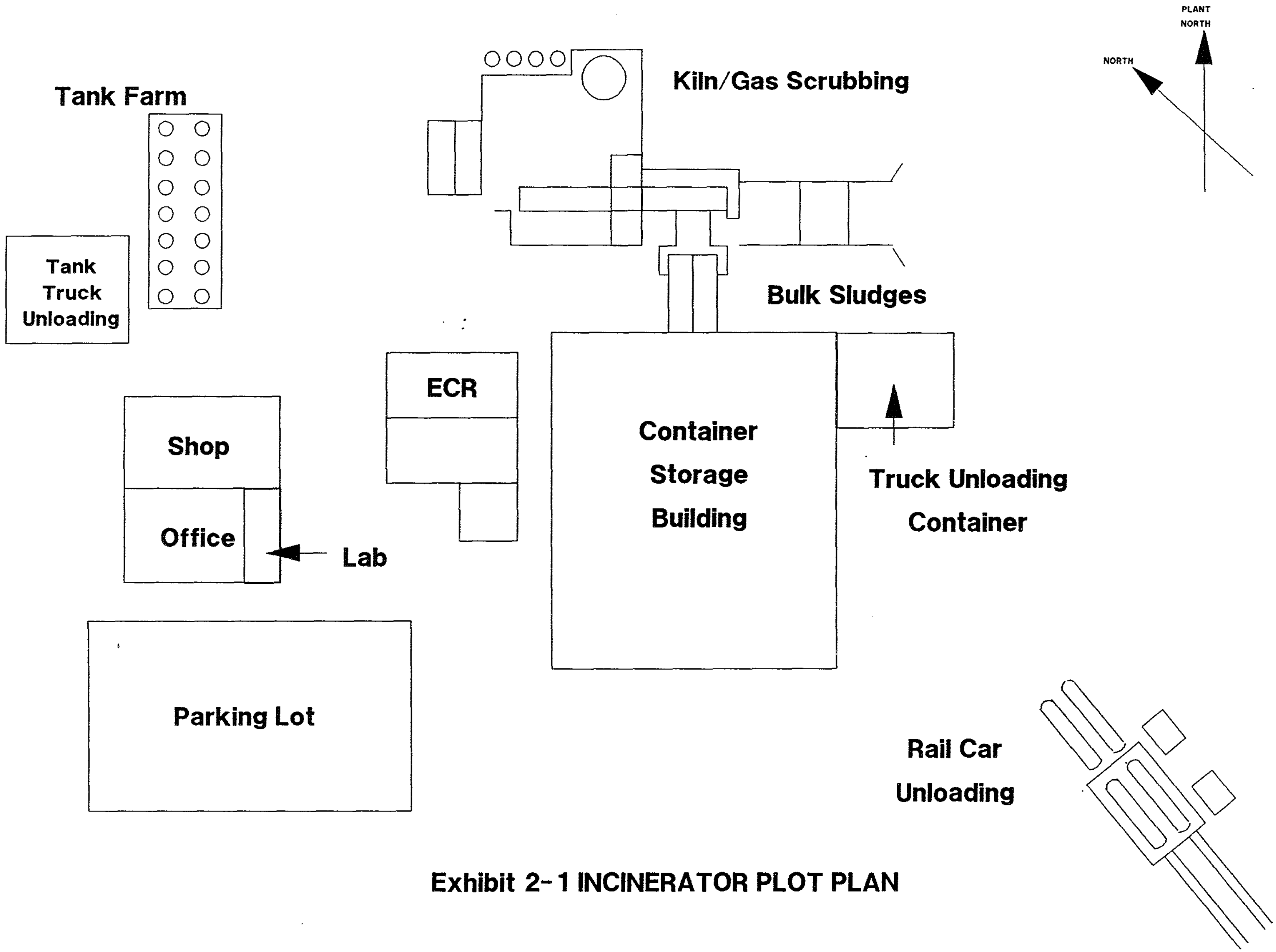


Exhibit 2-1 INCINERATOR PLOT PLAN

samples are taken. Based on the lab results and the shipping manifest, the operator will direct the shipment either to tank storage or to the direct burn area if the material is incompatible with the storage tank.

Four pumps serve the two tank farm unloading bays: one to handle all low freezing point organic liquid wastes; one for high freezing point organic liquid wastes; another for liquid wastes; and one for transferring pumpable sludge wastes. Grinders are placed in-line upstream of all the pumps to maintain the consistency of flow in the piping to the storage tanks.

The four stations have vents connected to a single header which are pulled by a vent fan and sent to be burned in the kiln (when operational), otherwise the emissions are directed to carbon adsorbers. When these are spent the carbon will also be incinerated in the kiln.

Spill and runoff containment at the truck unloading area consists of sloped floors, trenches, and sumps. Each of the four bays has a sloped floor that slopes in two directions from a high point in the center of the bay. The sloped floor (1/4 inch per 12 inch length) drains to two 18-inch wide trenches (on either side of the truck). Each trench (four total serving the area) drains to a 6700-gallon sump attached to a 20 sq ft overflow sump. The 6700-gallon sump is capable of containing 100% of the largest volume shipment that will be unloaded at the truck unloading area. Should a sump overflow due to runoff from fire suppression water, the overflow sump collects the overflow and routes it to the WWTP through a dedicated line. For further spill/runoff containment protection, the entire area is surrounded by a 6-inch high concrete curb.[9]

In addition to the truck unloading area, lesser volumes of hazardous wastes will also be unloaded at two other facilities. One of these facilities will be used solely for the purpose of unloading a high content fluoride waste while the other will be used for unloading heavy sludge wastes. In both cases the wastes will be directed from the truck immediately into the kiln for incineration. The fluoride unloading area will receive a high boiler fluorocarbon liquid with a high fluorine content (approximately 75%). The Heavy Sludge Area is expected to receive heavy sludge wastes (solid or very viscous materials) with low organic content and having low vapor pressures.[10]

2.1.2.2 Tank Farm. A tank farm will be located adjacent to the incinerator for bulk storage of organic, aqueous, and pumpable liquid wastes, pumpable sludge wastes, and decanted wastes. Two rows of tanks with eight separate containment areas are designed to prevent mixing of incompatible wastes in the event of a leak or spill from a tank. The eight containment areas are: acidic #1, acidic #2, alkaline #1, alkaline #2, liquid #1, liquid #2, liquid #3, and decanter. These containment areas will provide storage for four compatibility groups in each of two construction stages. The first stage will supply 140,000 gallons of storage capacity in 8 tanks; the second stage will supply an additional 80,000 gallons of storage in 6 tanks within 5 years of permit approval. The facility includes five bays for tank truck unloading at the tank farm as mentioned in the previous section.

Tanks for acidic storage will be constructed of 904L stainless steel. Tanks for storage in the alkaline compatibility group will be constructed of carbon steel with a one-quarter inch corrosion allowance. All tanks will be designed to ANSI, ASME, ASTM, and Du Pont standards and specifications and in compliance with RCRA requirements. All tanks will be electrically heated (except the fuel oil, low freezing, organic liquid, glycol, and one drummed liquid holding tank) to prevent wastes from freezing and to maintain them in pumpable form. The caustic solution tank will be steam heated and all other tanks except for the fuel oil tank and one drummed liquid tank will be insulated. All tanks will be equipped with level indicators and high level shut-off switches to shut off unloading pumps and the inlet block valve when the tanks are full. Tanks will also be equipped with agitators to keep the wastes mixed. Exhibit 2-2 lists the capacity, tank number, expected contents, and other data for the tanks in the tank farm and surrounding areas.

Aqueous liquid wastes from the liquid waste unloading pump or the waste decanter tank are stored in a 20,000 gallon tank. This tank is then pumped to the liquid waste nozzles in the kiln and afterburner chamber. Another 20,000 gallon tank is used for non-aqueous liquid wastes which have a freezing point less than 40 °F. These wastes are also pumped to the spray nozzle in the kiln and afterburner chamber. The waste decanter tank with 10,000 gallon capacity receives liquid wastes which contain both aqueous and non-aqueous phases. The waste is allowed to settle into phases and the decanter transfer pump withdraws the aqueous portion to be sent to the aqueous waste storage tanks (or directly to the wastewater treatment stream if it has no hazardous components). The organic phase is then pumped to an appropriate storage tank depending upon its properties.

There are two 10,000 gallon capacity tanks for the storage of low freezing organic liquids, which feed the liquid waste spray nozzles in the kiln and afterburner chamber.

Pumpable sludges from unloading or the waste decanter tank are stored in three 10,000 gallon tanks from which sludge is pumped to the kiln front wall and recirculated to keep the velocity in the lines high and prevent settling out of waste and clogging of the lines. There are six 20,000 gallon pumpable liquid organic waste tanks; four to hold low freezing organic liquid wastes and the remaining two for high freezing liquid organic wastes. These tanks are further equally divided into acidic and alkaline storage tanks. The contents of these tanks are fed to the kiln front wall and the afterburner chamber by a network of dedicated feed pumps.

Procedures will be implemented to ensure that incompatible wastes are not mixed in the tanks. All tanks will be blanketed with an atmosphere of nitrogen and each will have a conservation vent valve set at 10 psig, which will open only during the fill cycle and not because of normal daily temperature changes. Any emissions from the tank farm will normally be vented directly to the incinerator. Carbon adsorbers will be used to control emissions when the incinerator is not operating. Spill prevention procedures and instrumentation and spill containment will be provided to prevent environmental contamination from releases. To prevent spillage into the environment, automatic closing valves are placed in

EXHIBIT 2-2

TANK SPECIFICATIONS

Tank No.	Service	Capacity (gal)	Diameter x Height (ft)	Type*	Thickness (inches) Shell	Thickness (inches) Head	Insulated	Heated	Construction Phase
4512-2201-01	Low Freezer	20,000	12 X 24	S	0.500	0.625	X		1
4512-2203-01	Low Freezer	20,000	12 X 24	C	0.625	0.750	X		1
4512-2205-01	Low Freezer	20,000	12 X 24	S	0.500	0.625	X		2
4512-2207-01	Low Freezer	20,000	12 X 24	C	0.625	0.750	X		2
4512-2209-01	High Freezer	20,000	12 X 24	S	0.500	0.625	X	X	1
4512-2211-01	High Freezer	20,000	12 X 24	C	0.625	0.750	X	X	1
4512-2212-01	Low Freezer	10,000	9.5 X 19	C	0.625	0.438	X		2
4512-2301-01	Aqueous	20,000	12 X 24	S	0.500	0.625	X	X	1
4512-2303-01	Low Freezer	20,000	12 X 24	C	0.625	0.750	X	X	1
4512-2401-01	Pumpable Sludge	10,000	9.5 X 19	C	0.625	0.438	X	X	1
4512-2403-01	Pumpable Sludge	10,000	9.5 X 19	S	0.500	0.500	X	X	2
4512-2405-01	Pumpable Sludge	10,000	9.5 X 19	C	0.625	0.438	X	X	2
4512-2501-01	Waste Decanter	10,000	9.5 X 19	S	0.500	0.500	X	X	1
4512-2503-01	Low Freezer	10,000	9.5 X 19	C	0.625	0.438	X		2
4522-3701-01	Drummed Liquid	5,000	11 x 7.25	S	0.500	0.500			1
4522-3703-01	Drummed Liquid	5,000	11 X 7.25	C	0.500	0.625	X	X	1

*Material of construction: S = 904L Stainless Steel, C = SA 516 Grade 70 Carbon Steel

Source: RCRA Part B Permit Application, Vol. 4.

the feed lines which respond to the high level switches in each storage tank. Secondary containment adequate to contain a 25-year storm (6 inches of water), the entire contents of the largest tank in the containment area plus 6 inches of freeboard, is provided around the tanks. All pumps associated with the tank farm will also be contained in a secondary containment area. Secondary containment for piping systems will not be required since all lines will have welded connections and flanges.[11]

The tank farm will have a network of containment berms, sloped floors, trenches, sumps, and overflow sumps. The 14 tanks will be situated within eight separate yet adjacent containment areas (i.e., four of the areas will contain more than one tank, but no single area will contain greater than three). Each containment area will be surrounded by a concrete wall of sufficient height to contain 100% of the volume of the largest tank within the berm. Each area will have a sloped floor that will drain to a 64 cubic foot (cu ft) sump (approximately 480 gallons) that includes an in-place pump for subsequent off-loading. Should a berm overflow due to runoff from fire suppression water, for example, the overflow will collect in an attached overflow sump and be routed to the Wastewater Treatment Plant (WWTP) by means of a dedicated line.[12]

As mentioned above, the area where the kiln feed pumps will be located (i.e., "Pump Alley") will also be equipped with spill containment structures. Pump Alley, which is actually two separate containment areas, is surrounded by a concrete berm. Sloped surfaces (1/4 inch per 12 inch length) will drain to an 18-inch wide trench connected to a sump. Each sump will include an in-place pump for subsequent off-loading. Each containment area will also have an overflow sump that will collect runoff and route it to the WWTP through a dedicated line.[13]

Wastes to be handled in the tank systems consist of organic wastes, non-organic wastes, aqueous wastes, and 2-phase (aqueous and organic) wastes. The physical form of these wastes include pumpable sludge, low freezing liquids (<40 °F), and high freezing liquids (up to 300 °F).

The new Chambers Works incinerator will also employ six above-ground tanks treating hazardous waste generated on-site. These six tanks will accumulate wastes for less than 90 days. These six tanks will be used to neutralize scrubber and condenser water in the incinerator air pollution control train. The effluent from these tanks will be discharged to the Chambers Works wastewater treatment plant. These tanks will have all necessary air permits.

2.1.2.3 <u>Container Storage and Feed Areas</u>. The container storage and feed areas will be housed in a fully enclosed, heated 46,000 sq ft building adjacent to the incinerator. Storage capacity will be provided for about 257,400 gallons of waste contained in 30-, 35-, 50-, 55- and 85-gallon fiber, steel and plastic drums and containers. Approximately 4680 drums can be safely handled in the storage and processing areas, based on an average 55-gallon drum. If containers are sent to storage, they will be segregated into the appropriate storage area according to contents. Containers will not be stacked over two high and will be spaced to facilitate routine inspections for leaks and so that labels will be clearly visible. Container handling procedures will provide adequate aisle space for fire protection and spill control and to allow for safe and efficient transportation of the containers.

Facilities for managing and feeding containers will include conveyors, a liquid removal station and two 5000 gallon holding tanks, a thaw box to heat drummed material requiring it, a drum lift, a drum deheader/re-sealer system, sample area, and repackaging area for containers that do not meet specifications for direct feed to the kiln, and related systems needed to handle containerized wastes properly. All containers will be closed at all times except during sampling, repackaging or other required handling operations. Emissions from open drums and other sources will be vented to the incinerator or to portable carbon adsorption units. The holding tanks are equipped with level indicators, high level shut-offs, agitators, and are nitrogen blanketed similar to the tanks in the tank farm.

Shipments will be received in a central location and screened for the criteria outlined in the waste analysis plan. When the waste manifest has been verified, the trucks will be directed to the unloading area for the designated waste type. The new Chambers Works incinerator container storage building may store both hazardous and nonhazardous wastes. Incompatible wastes will be stored in separate containment areas according to the following: acidic aqueous, alkaline aqueous, acidic organic, and alkaline organic. If wastes cannot be stored at the tank or container storage areas, they will be fed directly to the incinerator. Wastes comprised generally of non-combustible solids, including metals, will be fed to the incinerator with wastes of high heat content to help maintain the necessary operating temperature in the incinerator. Other wastes that pose process hazards or jeopardize compliance with air quality standards may warrant special handling, such as mixing or direct feed, or rejection of the waste shipment. All wastes will be accepted for incineration only after a detailed evaluation of chemical and physical properties is conducted as part of the pre-acceptance process.

All containerized wastes will be received and handled in Department of Transportation (DOT) approved shipping containers compatible with the classified waste such that no significant release will occur during normal storage or handling. These containers may range widely in size and type, however, 30-and 55-gallon fiber, plastic, and steel drums are expected to be the most prevalent container types handled.

Once a waste shipment arrives, it is compared with the accompanying shipping manifest and visually inspected. Any discrepancies will be noted and reported to the generator. Next the waste is sampled and the sample analyzed for key parameters. Once the analytical results are evaluated, the shipment of waste is either accepted, rejected or the generator is contacted to recharacterize his waste. If any containers are leaking or visibly damaged they will be placed in new overpack containers and any releases cleaned up. Paperwork will be updated as needed.

Wastes will be fed to the new Chambers Works incinerator as containerized solids, lab packs, or bulk liquids or pumpable sludges from storage tanks or directly from trucks. Drummed liquid waste will be blended in one of the two tanks in the container storage area. Wastes in the tank storage area are blended as necessary to optimize burn conditions. Bulk sludge will unloaded in a hopper and pumped to the kiln.

The container storage and handling areas will have a network of containment structures including sloped floors, trenches, sumps, overflow sumps, and curbing. The storage area will be divided into four distinct areas based upon chemical compatibility (i.e., alkaline organic, acidic organic, alkaline aqueous, and acidic aqueous). Each area will feature sloped floors (1/4 inch per 12 inch length) that drain to trenches serving the east and west sides of the area. Each trench will empty into a sump; sumps in the two organic waste areas will have 2500-gallon capacities while those in the two smaller aqueous waste areas will have 400-gallon capacities. Each sump will be connected to an overflow sump in case fire suppression water, for example, causes the other sump to overflow. The overflow sump will collect runoff and route it to the WWTP through a dedicated line.[14]

The sampling area and container handling area will have containment structures similar to the aqueous storage areas except that the trenches will channel liquids to sumps located only on the west side of the building. The northwest corner of the container storage and handling area will contain two 5000-gallon liquid holding tanks. Each tank will be surrounded by a 6 inch concrete curb that will form separate containment areas. Each area will have a sloped floor that drains to a 5000-gallon sump, and each sump will be attached to an overflow sump. The latter can collect runoff from fire suppression operations and route it to the WWTP through a dedicated line.[15]

2.1.2.4 Fluoride Unloading Area. The fluoride unloading area will be used for unloading a specific high boiling fluorocarbon liquid that has a high fluorine content (approximately 75%). The liquid waste will be pumped from the delivery truck directly into the kiln to a dedicated fluoride burner.[16] The fluoride unloading area consists of a ramp leading to a covered bay. The area will have a containment system consisting of a 12-inch high concrete berm, sloped floor (1/4 inch per 12-inch length, minimum), trench, sump, and overflow sump. The sump will have a 1000-gallon capacity and will be equipped with an in-place pump for subsequent off-loading of runoff. Should this sump overflow, the overflow will collect within the overflow sump and be routed to the WWTP via a dedicated line.[17]

2.1.2.5 Heavy Sludge Area. The heavy sludge area will be used for unloading heavy sludge wastes and feeding them directly to the kiln; these wastes will not be stored. Du Pont expects to receive heavy sludge wastes with low organic content and with low vapor pressures. The sludges may be solid or very viscous materials. The area will feature a 10 cubic yard (cu yd) tilting hopper that will receive heavy sludge wastes and funnel them to a positive displacement pump. Excessively dry sludges may be slurried with water to facilitate pumping to the kiln for incineration.[18]

The heavy sludge area will have a containment system consisting of a 12-inch high concrete berm, sloped floor, sump, and overflow sump. The 200 cu ft sump (approximately 1500 gallons) will collect runoff and will be backed up by a 64 cu ft overflow sump located outside the berm. The latter will route runoff to the WWTP through a dedicated line.[19]

2.1.3 Incinerator System

Information in this subsection is taken from the Chambers Works Incinerator Process Description[20] and the Facility Description and Air Permit Application included in the RCRA Part B Application for the proposed facility.[21,22]

2.1.3.1 Waste Delivery System. The proposed Chambers Works hazardous waste incinerator is designed to accept a wide variety of wastes generated by Chambers Works and other Du Pont plants, and will also be capable of accepting most wastes designated as hazardous by NJDEP. The incinerator system consists of a rotary kiln and afterburner chamber, air pollution control system (APCS), and associated incinerator waste handling equipment. Exhibit 2-3 is a general flow schematic of the incinerator system.

Wastes are fed to the rotary kiln or afterburner chamber in one of several ways, depending on the characteristics of the waste stream (e.g., physical state, viscosity, BTU value). The rotary kiln and afterburner chamber are equipped with several waste and fuel burners and waste injection nozzles, for the introduction of liquid and sludge wastes into the incinerator. Waste and fuel burners in the rotary kiln and afterburner chamber are designed to mix combustion air with the waste or fuel, and support a flame. The burners are ignited using natural gas and fuel oil. Waste injection nozzles atomize the liquid or sludge wastes using compressed air or steam and inject the atomized waste into the kiln or afterburner chamber.

The following wastes can be fed directly to the burners and nozzles:

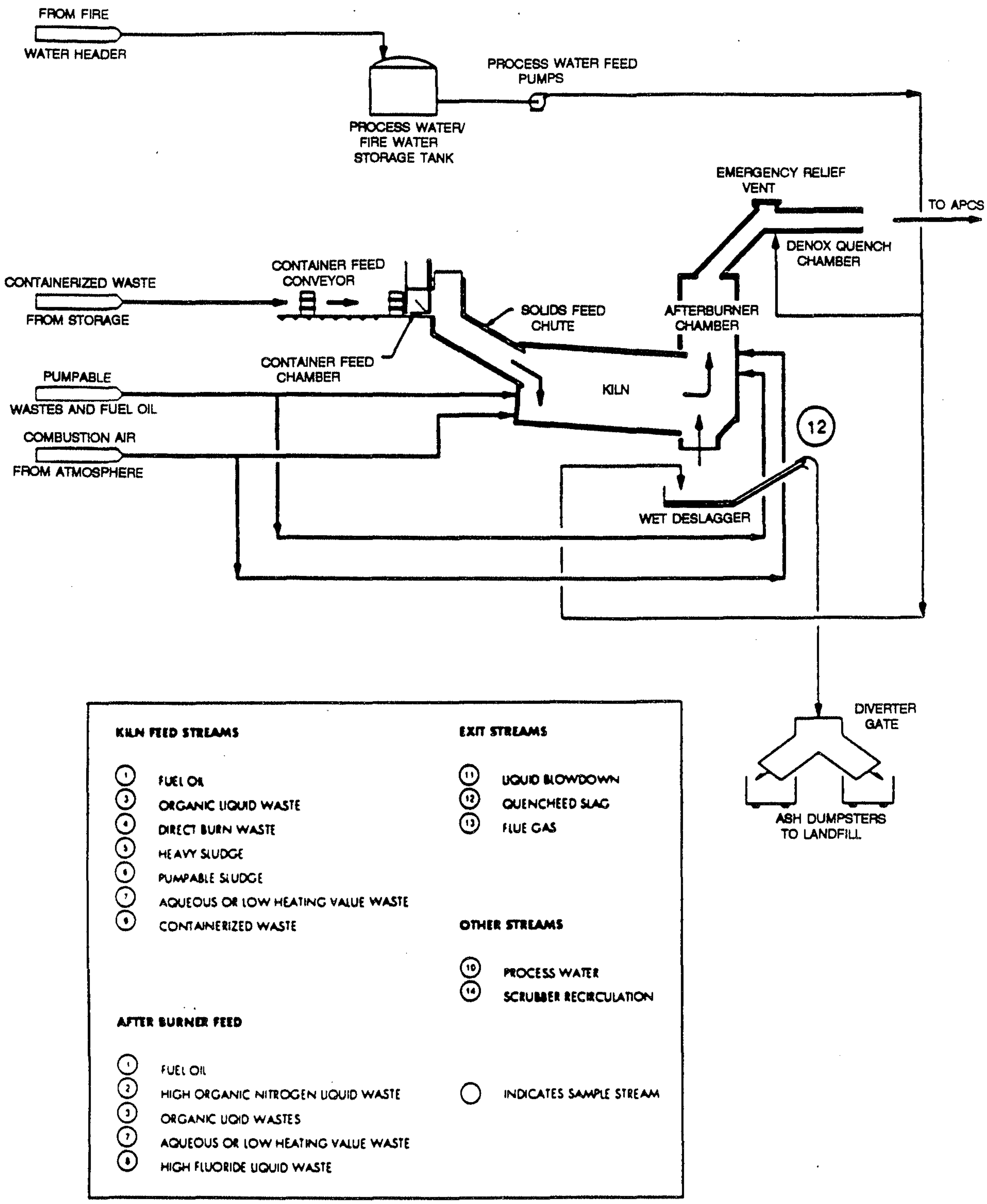
- Direct-burn liquid waste (e.g., non-chlorinated organic liquids)
- Atomizable liquid waste (e.g., chlorinated organic, aqueous liquids)
- Bulk heavy sludge wastes (e.g., high solids-content treatment sludges)
- Pumpable sludge wastes (e.g., petroleum still bottoms)
- Auxiliary liquid fuel (fuel oil and waste fuel)

A discussion of wastes accepted is provided in Section 2.1.1.

Liquid wastes from containers will be pumped to one of two 5000 gallon drummed-liquid holding tanks and then to a liquid waste burner or to the tank farm for further blending. The liquid waste burner is designed for 30 MMBTU/hr heat input. Liquid wastes from tank trucks may be pumped directly into the rotary kiln through a liquid waste burner or the waste storage tanks (in the tank farm). Liquid wastes from tank storage may be pumped to a waste burner or spray

EXHIBIT 2-3

INCINERATOR SYSTEM



nozzle. Waste storage tanks and associated equipment are discussed in Section 2.1.2.

Sludge wastes are fed to the kiln through one of two sludge nozzles, depending on the viscosity of the waste. Fuel oil, when required for auxiliary fuel or for start-up of the incinerator, is fed to the kiln through a 50 MMBTU/hr burner. Containerized wastes are fed directly to the kiln through the container feed chamber and container feed conveyor and feed chute. The container feed chute and kiln front wall are cooled by a water/glycol cooling system.

Each kiln feed stream is equipped with a control valve, flow transmitter, and emergency shut-off system. An interlock system will close all waste feed block valves when conditions prohibiting the burning of waste are detected by the incinerator instrumentation system. Incinerator emergency shutdown systems are discussed in Section 2.1.3.4.

Wastes are fed to the incinerator afterburner chamber through two identical sets of fuel oil burners and liquid waste spray nozzles mounted on two opposing walls of the chamber. The burners and nozzles are each rated at 30 MM BTU/hr. The two waste spray nozzles are used for wastes similar to those fed into the rotary kiln. Two "low-NO_x" burners, which mix the waste and combustion air such that lower amounts of nitrogen oxides are generated than from standard burners, are used to feed high organic nitrogen wastes into the afterburner chamber. The nozzles are designed to burn high-nitrogen low-freezing liquid organic wastes and direct burn liquid wastes. Two additional liquid injection nozzles in the afterburner chamber are used for injection of low-nitrogen low-freezing organic wastes and fluoride-containing liquid wastes. The high-fluoride waste burner is rated at 5 MMBTU/hr and designed to burn a 7:3 mixture of high-fluoride waste and fuel oil. The waste/fuel mixture has a design heating value of 7500 BTU/lb.

The fuel burners and waste spray nozzles in the afterburner chamber are equipped with flow monitoring, control, and interlock systems similar to those for the rotary kiln nozzles and burners. Incinerator emergency shutdown systems are discussed Section 2.1.3.4.

2.1.3.2 <u>Rotary Kiln and Afterburner</u>. The proposed rotary kiln and afterburner incineration system is designed by the European firm Deutsche Babcock Anlagen, and will fire 35,000 TPY of wastes in the kiln at an hourly design feed rate of 17,500 pounds for approximately 7000 hours per year. The afterburner has an additional liquid waste capacity of 26,250 TPY. Actual feed rates during incinerator operation will depend on the BTU value and other characteristics of the wastes accepted. The design heat rate of the rotary kiln during continuous operation is 80 MM BTU/hr and that for the afterburner chamber is 60 MM BTU/hr. An average waste feed heating value of 8000 BTU/lb was used to calculate the nominal continuous feed rate of 17,500 pounds per hour.

As previously discussed, the incinerator feeds consist of containerized wastes, aqueous and organic pumpable liquids, pumpable and heavy sludges, fuel oil and waste fuel, and air required for combustion and atomization. The average design feed rate to the kiln is 10,000 pounds per hour, and a minimum of 20 percent of the heat load to the kiln is supplied by high BTU-value organic liquids or auxiliary fuel. This requirement provides stability to kiln operation.

The rotary kiln is an inclined, refractory-lined cylindrical vessel with an internal diameter of 12.4 feet and a length of 39.2 feet. The rate of rotation of the kiln is designed to be variable depending on the waste feed characteristics and feed rate. The kiln drive system is self-regulating and self-lubricating, and is equipped with a kiln brake to prevent the kiln from rotating backwards during upsets or power outages, which may result in release of waste from the kiln.

The rotary kiln operates at temperatures between 1650 and 2400 °F. Ash and slag from the kiln fall into a wet deslagger at the discharge end of the kiln. A fume hood and vent fan exhaust hot gases from the ash handling system to the afterburner. Treatment and disposal of ash and other wastes generated by the incinerator are discussed in Section 2.3.2.2.

Exhaust gases from the kiln flow into the afterburner chamber, which is a vertical, refractory-lined vessel with inside dimensions of 17.7 feet by 20.5 feet and a height of 30 feet from the lowest burner. The combustion temperature in the afterburner chamber ranges between 2000 and 2400 °F. Auxiliary fuel is used as needed to maintain the desired temperature in the afterburner chamber. The design gas residence time in the afterburner chamber is a minimum of 2.5 seconds, which is expected to be exceeded under normal incinerator operating conditions. The exhaust gases from the afterburner chamber flow through the afterburner discharge duct to the air pollution control system (APCS).

A number of waste storage and handling equipment exhaust vents and pressure relief valves are ducted to the rotary kiln and afterburner chamber. Organic vapors from the this equipment will be combusted in the incinerator when it is operating. Types of vapor emissions from waste storage and handling areas are discussed in Section 2.3.2.1.

The kiln and afterburner chamber (ABC) will have a network of containment structures including concrete berms, sloped floors, trenches, sumps, and overflow sumps. The kiln and ABC will have the following separate containment areas:

- Front wall of the kiln area
- Kiln area
- Afterburner area
- Wet deslagger area

Each of these areas features concrete berms ranging from 6 inches to 12 inches in height, sloped floors that drain to 18-inch wide trenches, and 64 cu ft sumps that serve to collect runoff from the trenches. Some of the sumps are equipped with in-place pumps to facilitate subsequent off-loading. Each containment area also has an overflow sump located outside the berm to collect fire suppression water. The overflow sump is connected to the WWTP by a dedicated line.[23]

2.1.3.3 Air Pollution Control System. The exhaust gases from the afterburner chamber flow through the discharge duct to the incinerator air pollution control system (APCS). Exhibit 2-4 provides a general overview of the APCS. The APCS is designed to remove gaseous and particulate air pollutants from the exhaust gas stream before discharge of the exhaust gas to the atmosphere. The APCS consists of the following components:

- $DeNO_x$ Quench Chamber
- $DeNO_x$ Reactor Vessel
- Flue Gas Saturator
- Packed Tower Condensers (two)
- Calvert Collision (Venturi) Scrubber
- Mist Eliminator
- Induced Draft (I.D. (two)) Fans
- Stack

The $DeNO_x$ quench chamber is a vessel in which water is sprayed into the hot exhaust gas. The temperature of the quench chamber exhaust is automatically controlled to 1750 °F, which is the temperature required for optimum efficiency of the $DeNO_x$ reaction. In the $DeNO_x$ process, vaporized ammonia (NH_3) is injected with steam into the $DeNO_x$ reaction vessel through atomization nozzles. The NH_3 reacts with nitrogen oxides (NO_x) in the exhaust gas to form molecular nitrogen (N_2) and water. The NH_3 injection rate is automatically controlled based on the concentration of NO_x in the exhaust gas. The $DeNO_x$ reaction, in conjunction with the low-NO_x burners in the afterburner chamber that reduce NO_x formation, control the emissions of NO_x from the incinerator.

The exhaust gas from the $DeNO_x$ reactor enters a flue gas saturator where the gas stream is further cooled to its saturation temperature by injection of high pressure water. Some of the water-soluble acid gases from the exhaust gas stream (hydrochloric acid (HCl) and hydrofluoric acid (HF)) are absorbed into the water in the saturator.

The saturated exhaust gas enters one of two counter-current flow packed tower condensers, in which the upward-flowing exhaust gas contacts the downward-flowing condensation water. The two condensers remove approximately 92 percent of the water condensing from the exhaust gas, along with acid gases (primarily HCl and HF and some sulfur dioxide (SO_2)) absorbed in the condensate. The condenser also promotes the growth of particles and acid aerosols (primarily phosphorus pentoxide (P_2O_5)), which increases the removal efficiency of these materials in the downstream scrubber.

The water from the saturator and condensers drains into a neutralization system. Treatment and disposal of wastewater from the APCS and other wastes generated by the incinerator are discussed in Section 2.3.2.3.

The exhaust gas from the condensers enters a high-energy Venturi scrubber of proprietary design. The gas entering the scrubber is accelerated through two Venturi nozzles to a high velocity and is contacted with a high pressure water stream. The particulate removal efficiency of the scrubber is a function of the

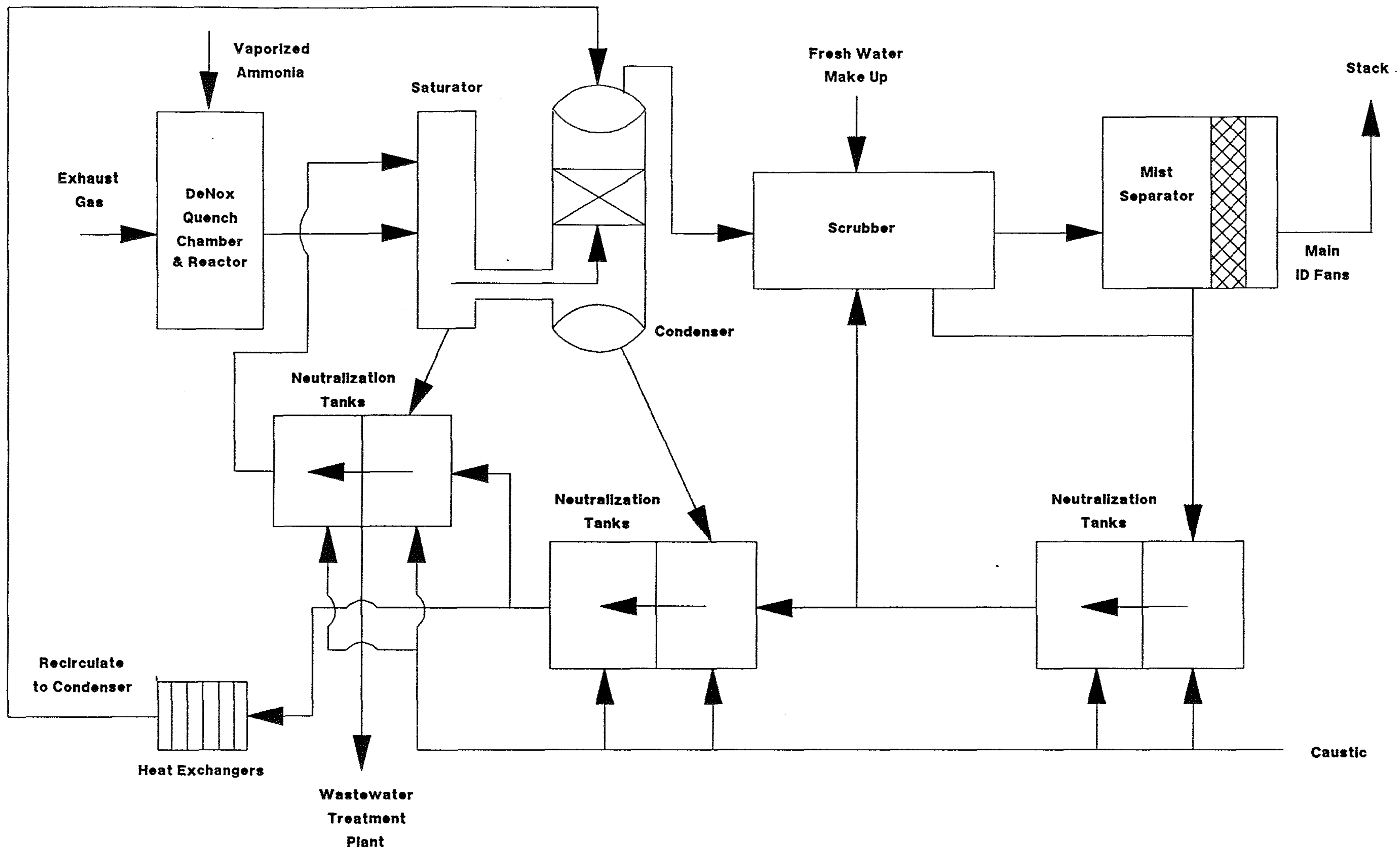


Exhibit 2-4 AIR POLLUTION CONTROL SYSTEM

pressure drop of the gas stream across the scrubber. The pressure drop is maintained above 70 inches of water. The pH of the scrubber water is controlled by addition of caustic.

The Venturi scrubber exhausts to a mist eliminator that removes entrained water droplets from the gas stream. The gas then exhausts through two I.D. fans (in series) to a 213 foot stack. A portion of the exhaust gas from the fan can be recycled and combined with the exhaust gas from the condensers to control the kiln draft and scrubber pressure drop. The recycle damper is normally closed.

The water from the Venturi scrubber and mist eliminator drains into a wastewater neutralization system. Treatment and disposal of wastewater purge from the APCS and other wastes generated by the incinerator are discussed in Section 2.3.2.3.

The incinerator APCS controls the emissions of acid gases and particulate matter from the incinerator. Emissions of organic vapors are controlled in the afterburner chamber. Stack emissions from the incinerator are discussed in Section 2.3.2.1.

The gas scrubbing area described above will have containment structures including concrete berms, sloped floors, trenches, sumps, and a overflow sump. The area will be subdivided into two separate areas: gas cleaning area (GCA) #1 and gas cleaning area #2. Each is surrounded by a 12-inch high concrete area without a berm in between the two areas. Each containment area has sloped floors that drain to an 18-inch wide trench and a 64 cu ft sump that collects runoff from the trench. Each sump has an in-place pump to facilitate subsequent off-loading. The two areas will be served by a single overflow sump located to the south of gas cleaning area #2. Should runoff fill the containment system in GCA #1 and rise above the top of the sloped floors, the runoff would flow into the containment system in GCA #2 and eventually collect in the overflow sump. The runoff would then be routed via a dedicated line to the WWTP. Excessive runoff in GCA #2 could flow to the same overflow sump without affecting GCA #1.[24]

2.1.3.4 Emergency and Safety Systems. The incinerator emergency vent and automatic waste feed interlocks are discussed in this subsection. Other emergency systems such as fire protection systems and emergency response equipment and procedures are discussed in Section 2.5.3, Emergency Prevention, Preparedness, and Response Measures.

Emergency Vent System

The rotary kiln and afterburner are equipped with an emergency pressure relief vent located at the highest point of the afterburner discharge duct. The vent is designed to open only in the event of overpressurization of the rotary kiln or afterburner chamber, to protect the incinerator system from possible explosions. The vent will open automatically if the pressure in the kiln or afterburner chamber exceeds a high set point. Upon activation of the emergency vent, all waste feeds to the incinerator will be cut off by the automatic control valves that are part of the interlock system. Emissions of air pollutants from the emergency vent will therefore occur only for a short period. Air pollutant emissions from the operation of the emergency vent are discussed in Section 4.2.

Waste Feed Interlock System

The incinerator system is equipped with process instrumentation that will interrupt waste and auxiliary fuel feeds to the incinerator in the event that incinerator or APCS operating parameters fall below or increase above the specified values required for waste destruction and control of emissions. Instrumentation on the kiln and afterburner includes temperature transmitters at the kiln and afterburner discharge ducts, flow transmitters on all waste and fuel feed streams, and pressure transmitters in the afterburner chamber. The oxygen content of the afterburner exhaust gas and the flow rate of secondary combustion air are also monitored. Waste feeds are interlocked to stop if the temperature in the kiln or afterburner chamber decreases below a low setpoint, when the pressure in the afterburner exceeds a high set point, or when the burner flame or air flow are lost. If the afterburner chamber temperature begins to decrease, auxiliary fuel will be added to increase the temperature in the chamber. If the temperature continues to decrease, the waste feed will automatically cut off.

Instrumentation on the APCS includes temperature and pressure transmitters in the exhaust gas streams. The pH and flow rates of the saturator, condenser, and scrubber water discharges are monitored and controlled, as is the flow rate of caustic to the neutralization systems. The gas stream pressure drop across the venturi scrubber and scrubber water flow rate are also controlled and monitored. If any of these monitored parameters fall below low set points, all waste feeds to the incinerator will be interrupted. In addition, if the flow of water to the saturator decreases below the low set point, auxiliary fuel flow is also cut off and an emergency saturator water system is activated to protect downstream equipment from high temperature conditions.

2.1.4 Systems Operations

The selected rotary kiln incinerator is the Deutsche Babcock Anlagen design which will provide a destruction efficiency of more than 99.99% for all organic constituents in the feed streams. The incinerator has a rotary kiln combustion unit and an afterburner chamber and is designed to accept solid, liquid and slurried wastes including pumpable sludges. These wastes are charged to the kiln to provide effective combustion and destruction. Only liquid waste is charged directly to the afterburner chamber. Supplemental fuel may be needed to maintain the temperature necessary to achieve the required destruction efficiency of the hazardous organic constituents in the waste feed. The burn is controlled to produce inert gases, solids for landfilling and scrubber effluent to be pumped to a RCRA-approved wastewater treatment facility. The flue gases from the kiln and the afterburner will pass through a series of air pollution control devices to provide best available control technology (BACT) before discharge through a 213-foot high stack. Two induced draft fans will draw the combustion flue gas through the incinerator and the gas scrubbing train to the stack.

2.1.4.1 Waste Acceptance and Analysis Plan. The information in this subsection is summarized from the Waste Acceptance and Analysis Plan of the Part B permit[25]; refer to the permit for more detailed information.

Pre-acceptance Procedures

Before Chambers Works agrees to accept waste for incineration, the waste must be evaluated and analyzed. The pre-acceptance process begins with a preliminary assessment of the waste to determine the general feasibility of incineration. This evaluation will be carried out by the Chambers Works research and development group, in conjunction with the new Chambers Works incinerator technical consultant. If it is determined that the waste can be incinerated, the generator will complete a waste characterization form and submit a sample for thorough characterization. The analytical parameters to be analyzed in the waste characterization process are discussed in detail in the Part B permit.

Wastes generated on-site will be recharacterized every two years. However, if the waste-generating process has not changed significantly, the recharacterization requirement may be waived. Waste streams from non-Chambers Works generators will be handled in the same manner with the exception of the recharacterization waiver. All analytical results are recorded on a waste approval sheet and filed in the incinerator computer system.

Verification and Acceptance Procedures

All shipments, upon arrival, will be inspected for compliance with record keeping and transportation requirements, and then directed to the incinerator for waste verification analyses. Before any wastes are unloaded, the content of the shipment will be visually or analytically confirmed to be the same as the sample analyzed and approved during pre-acceptance. For some wastes such as lab packs, contaminated clothing, soil, empty drums, etc., visual inspection and comparison of the wastes against the manifest and packing lists will be sufficient to accept wastes. Wastes can be accepted or rejected as described below.

- If the waste analytical results do not match the composition specified in the waste characterization form, the truck will remain in the unloading or holding area while the generator is informed of the discrepancy.

- If there is a minor discrepancy (i.e., the waste has a different concentration of hazardous constituents than manifested or a physical property does not match the manifest) and the waste can still be accepted for disposal, the waste will be accepted after the generator is notified of the discrepancy and agrees to the revised disposal contract terms.

- If there is a major discrepancy (i.e., the waste is a restricted waste) the load will be immediately rejected and returned to the generator.

- If the waste received is not that described on the manifest, but could still be incinerated, it may be accepted after the generator is notified and the contract terms modified. Acceptance will be based on the availability of compatible storage or the direct burn scheduling.

- If a waste generated at Chambers Works does not match its data on file, the generating process personnel will be contacted to recertify the waste before it can be accepted.

If the material sampled matches the analysis specified in the waste characterization form, or a load discrepancy has been resolved, the waste will be unloaded into the appropriate tank or container storage area. The waste verification and acceptance/rejection procedures rationale is summarized in Exhibit 2-5.

Waste Receipt and Disposition

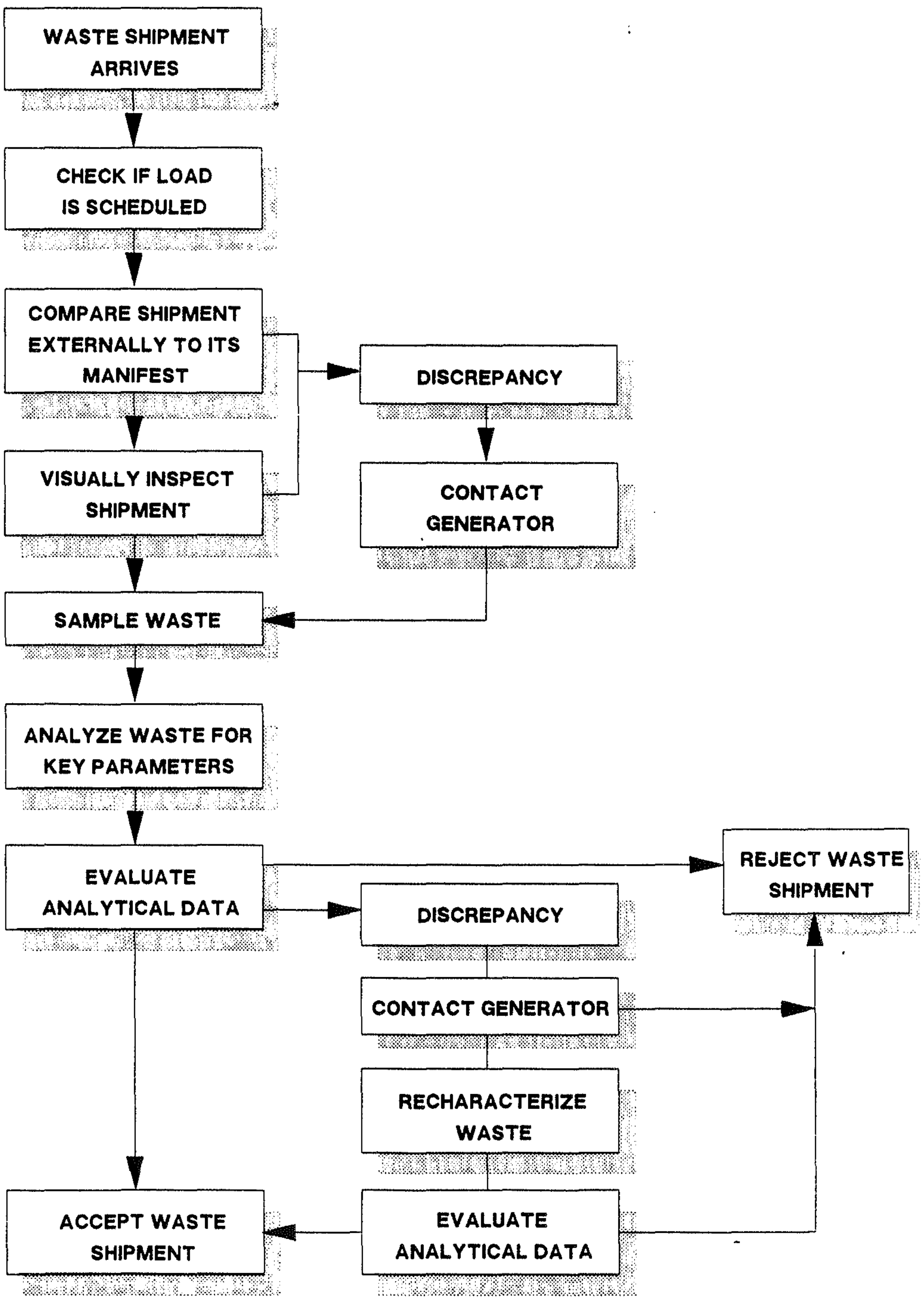
Once a waste is approved for acceptance, the waste will be transported to the appropriate storage area. Tank trucks will be directed to the unloading bays while drummed shipments will be directed to the container storage building unloading docks. The wastes can be fed to the incinerator directly from trucks or from storage tanks. Tank trucks from the unloading bays will be connected to the appropriate tanks via hoses. Drummed liquid waste will be transported by fork-lift truck to one of the two tanks in the container storage area to be de-drummed and blended. From the drummed storage tanks, waste will be fed to the incinerator or sent to the tank farm for further blending. All blended waste will be analyzed prior to incineration to monitor and ensure optimum incinerator feed composition. Containerized solids will be incinerated based on the results of acceptance procedure sampling and analysis.

Sampling Procedures and Analytical Parameters

All wastes destined for the new Chambers Works incinerator will be fully characterized prior to approval for acceptance. Wastes from off-site will be sampled and analyzed for fingerprint parameters. Wastes received from on-site generators will be analyzed as necessary since these wastes are generally well known and characterized. If wastes are to be unloaded into the blend tanks in the container storage building or the bulk storage tanks, the wastes will be analyzed for compatibility with the tank contents prior to unloading. Analytical parameters will be selected using the criteria described in the Waste Analysis Plan of the Part B permit. The rationale for selecting the analytical parameters and the analytical methods to be used in verifying the waste compositions are also presented in the Part B permit.

EXHIBIT 2-5

WASTE VERIFICATION AND ACCEPTANCE/REJECTION PROCEDURES



2.1.4.2 <u>Waste Storage and Handling</u>. Wastes that are destined for either the tank farm or the container storage area must be accepted and sampled for proper disposition to storage tanks or container storage areas, directly fed to the incinerator, or decanted or blended for burning.

The following waste streams can be fed directly to the kiln front wall burners and nozzles:

- direct burn wastes fed directly from the tank truck or drummed liquid holding tank due to compatibility problems with other wastes or waste management factors;

- liquid wastes, primarily aqueous or organic or non-organic non-aqueous wastes (e.g., alcohols, liquid organics, water-soluble solvents contaminated washdown water, water decanted from other wastestreams) from the tank farm;

- pumpable sludge wastes with a low enough viscosity to be pumpable and atomizable through the pumpable sludge nozzle;

- waste liquids, mostly organic liquids with relatively high heating values, which can be used along with auxiliary fuel to stabilize incinerator operation through the burner nozzle designed for 30 MM BTU/hr;

- fuel oil for use at start-up (50 MM BTU/hr nozzle for start-up) or when needed to maintain the desired kiln discharge temperature; and

- heavy sludge wastes which consist of organic solids and filter cakes slurried with aqueous or very viscous organic streams.

Containerized waste fed directly to the kiln must meet the following requirements:

- total weight per container less than 600 pounds

- maximum heat release per container 2.5 MM BTU

- no free-standing liquids

Wastes meeting these requirements will be moved from storage to the pallet unloading conveyor. A specific container is selected, weighed, and the label checked for a match with the burn schedule. If a match is made the container is sent to the incinerator via the feed lift conveyor; a non-match is set aside and the problem resolved. Free liquids are pumped to either of the two 5000 gallon drummed liquid holding tanks for eventual pumping into the kiln or to the tank farm. Steel drums will be de-headed and resealed prior to incineration.

Safeguards to ensure that no incompatible wastes will be mixed in pipelines or tanks include waste analysis, qualitative compatibility testing, labeling of lots, dedicated pumps for classes of liquids, and flushing of empty lines and tanks with solvent (typically fuel oil) prior to refilling. No incompatible wastes will be stored in tanks located within the same containment area.

When tank service is to be switched between incompatible materials the following cleaning procedures will be enforced:

1) empty the tank and associated piping by draining or pumping;

2) inspect the tank and remove any residual sludge;

3) flush feed lines, outlet lines, and recirculation lines with a suitable solvent totaling 10% by volume of the piping; and

4) flush the interior with a suitable solvent totalling 10% by volume of the tank capacity, sprayed through a rotating nozzle which covers the entire tank, or fill and agitate the tank.

2.1.4.3 Incinerator Operating Parameters and Procedures. A mass and heat balanced combustion is based upon average waste feed compositions. The kiln is fired at 80 MM BTU/hr and the afterburner chamber is fired at 60 MM BTU/hr for a total heat release of 140 million BTU/hr. An average waste feed heating value of 8000 BTU/lb was assumed to calculate the hourly design feed rate of 17,500 lb/hr. The kiln waste feeds on an average annual basis total 10,000 lb/hr. A minimum of 20% of the heat load to the kiln will be supplied by a high-BTU atomizable liquid waste or an auxiliary fuel. This fuel provides a base-load for the incinerator and will help equalize fluctuations in operating conditions created by batch feeds, etc. The afterburner chamber waste feeds are atomizable aqueous and organic wastes and on an average annual basis will equal 7500 lb/hr.

The wastes are combusted in the kiln and the afterburner chamber at gas temperatures ranging from 1650 °F to 2400 °F. The ash and slag fall into a wet deslagger at the discharge end of the kiln where they are quenched and dewatered prior to disposal to a secure landfill at the Chambers Works facility.

All blended waste will be analyzed prior to incineration to monitor and ensure optimum incinerator feed composition. Verification samples will be collected from the blend and bulk storage tanks prior to incineration. These verification analyses will be used to control the incinerator feed stream and operating parameters as well as to ensure compliance with permitted emission levels. The key analytical parameters include:

- BTU Content
- Ash Content
- Total Halogen Content (principally fluorine and chlorine)
- Compatibility
- Percent Solids or Water
- Lead, Mercury, Sulfur, and Nitrogen Concentrations

Exhibit 2-6 presents a summary of a material and mass balanced operating condition for the rotary kiln and the afterburner combustion chamber. This is only an example, the incinerator can treat wastes with a variety of feed compositions at differing levels of excess air and operating temperatures.

Feed streams to the incinerator are waste and air and auxiliary fuel, if necessary. The waste feed shown in the Exhibit consists of a mix of containers, liquids, direct burn wastes and sludges with an overall composition with heating value 8000 BTU/lb. At a feedrate of 10,000 lb/hr, the heat input rate is 80 million BTU/hr (the thermal capacity of the kiln). The waste contains 30% ash and 19.5% chlorine. Excess air is assumed to be 150% for containers and sludges and 30% for direct burn and liquids. (In the example, the excess air is 114%.) Assuming the air is at 60 °F and saturated with water, 115,150 lb/hr of air is required for the 10,000 lb/hr of waste.

Streams leaving the kiln are combustion gases and slag. Approximately 60% of the ash that enters the kiln leaves as ash to the wet ash deslagger, the remainder leaves with the combustion gases. Combustion gases leave the kiln at a flow rate of 123,500 lb/hr and a temperature of 2077 °F. The temperature is based on a heat balance around the kiln that includes heat losses through the walls.

The feed streams to the afterburner chamber are kiln exit gas, waste, combustion air, air in leakage and water vapor evaporated from the deslagger. For the example in the Exhibit, the waste feed is 7500 lb/hr of liquid, aqueous and direct burn wastes with the overall composition shown in the Exhibit. The waste contains 0.27% ash and 12.1% chlorine and has a heating value of 8000 BTU/lb. Air input to the afterburner chamber is equivalent to 30% excess air for the burners and 1555 cu ft/min air in leakage. Approximately 1 pound of water is evaporated from the ash deslagger for each pound of ash quenched. The calculated operating temperature of the afterburner is 2208 °F based on estimated wall losses of 2.58 million BTU/hr.

The overall material balance for the kiln and afterburner shows three input streams: 17,500 lb/hr of waste, 177,098 lb/hr of air, and 1756 lb/hr of water vapor; and two output streams: 1799 lb/hr of ash and 194,544 lb/hr of combustion gases.

EXHIBIT 2-6

MATERIAL BALANCE FOR THE KILN AND AFTERBURNER COMBUSTION CHAMBER, lb/hr

	Rotary kiln				Afterburner combustion chamber				
	Input streams		Output streams		Input streams				Output
Compounds	Waste to Kiln	Air to Kiln	Kiln exit gas	Ash to deslagger	Waste to ABC	Air to ABC	Kiln exit gas	Deslagger water	ABC exit gas
C12	NA	0	19	0	NA	0	19	0	38
Ash	2,999	0	1,200	1,799	20	0	1,200	0	1,220
02	NA	26,637	14,130	0	NA	14,276	14,130	0	18,681
N2	NA	87,350	87,395	0	NA	46,992	87,395	0	134,697
CO2	NA	0	12,346	0	NA	0	12,346	0	22,346
SO2	NA	0	160	0	NA	0	160	0	380
NO2	NA	0	28	0	NA	0	23	0	98
HC1	NA	0	1,985	0	NA	0	1,985	0	2,908
HF	NA	0	32	0	NA	0	32	0	276
H20	848	1,263	5,942	0	2,440	680	5,942	1,756	18,766
P205	NA	0	113	0	NA	0	133	0	197
NH3	NA	0	0	0	NA	0	0	0	0
Other	6,152	0	0	0	5,041	0	0	0	0
Total	10,000	115,150	123,350	1,799	7,500	61,948	123,350	1,756	194,554
Temperature, F	70	70	2,077		70	70	2,077	180	2,208
Pressure, psia	NA	14.68	14.68		NA	14.68	14.68	14.87	14.66
Flow acfm	NA	25,816	130,831		NA	29,888	130,831	760	235,600
Elemental analysis									
Chlorine	1,950	0	1,950	0	905	0	1,950	0	2,854
Ash	2,999	0	1,200	1,799	20	0	1,200	0	1,220
Oxygen	894	27,659	28,547	0	2,505	14,880	28,547	1,560	47,487
Nitrogen	53	87,350	87,404	0	332	46,992	87,404	0	134,727
Hydrogen	577	141	721	0	633	76	721	196	1,630
Carbon	3,367	0	3,369	0	2,727	0	3,369	0	6,098
Sulfur	80	0	80	0	110	0	80	0	190
Fluorine	31	0	30	0	232	0	30	0	262
Phosphorus	49	0	49	0	37	0	49	0	86
Total	10,000	115,150	123,350	1,799	7,500	61,948	123,350	1,756	193,554

Source: RCRA Part B Permit Application, Vol 5.

2.1.5 Compliance with Applicable Regulations

Plans for the construction and operation of the proposed incinerator and waste storage and handling areas are in compliance with the Federal Clean Air Act, Resource Conservation and Recovery Act (RCRA), New Jersey Air Pollution Control Rules, and the New Jersey Hazardous Waste Management Rules, and Regulations on Toxic Substances specifically sections 7:26 - 9.4, 9.6, 10.4, 10.6, and 10.7 and 7:27 - 17. In addition, the facility will modify and update its existing Risk Management Program (RMP) to comply with the Toxic Catastrophe Prevention Act Program regulations, 7:31 et seq. The modified and updated RMP will include all the operations and equipment resulting from the construction and operation of the proposed incinerator and related material handling areas. The Air Permit Application and the RCRA Part B Permit Application indicate that the proposed incinerator and associated waste storage and handling areas contain the various system components and administrative controls that are required including the following:

Air Pollutant Emission Regulations

- Best Available Control Technology for criteria and hazardous air pollutants;
- Meeting emission limitations for the releases of hazardous (NESHAP) air pollutants (i.e., arsenic, beryllium, mercury, and benzene);
- Identifying and treating Principle Organic Hazardous Constituents (POHCs) in the waste feed to a minimum of 99.99 percent destruction and removal efficiency (DRE);
- Limiting Hydrogen Chloride (HCl) emissions from the incinerator to less than 4 lb/hr, or controlling it at greater than 99 percent efficiency;
- Registering equipment and operations emissioning toxic volatile organic compounds with the NJDEP;
- Particulate emissions less than 0.1 grain/scf corrected to 12% CO2 in the exhaust gas, and less than 0.03 grain/scf corrected to 7% O2 in the exhaust gas; and
- Emissions of Hydrogen Halides (HCl, HF, HBr) not greater than 50 ppm by volume corrected to 7% O2 in the exhaust gas.

Storage and Handling Regulations

- Sloped containment system for the waste storage area with a volume to contain 10% of the volume of all the containers in the area plus volume for precipitation;

- Storage tanks with sufficient shell strength, pressure controls, and controls to avoid overfilling;

- Procedures to ensure incompatible wastes are not mixed and wastes incompatible with the tank material are not placed in these tanks;

- Inspections of tank monitoring and overfill control equipment;

- Berms or walls separating non-compatible waste storage tanks; and

- Ample aisle space for emergency response equipment.

Incinerator Waste Handling Regulations

- Disposing and treating waste generated by the incinerator (e.g., ash) as hazardous waste; and

- Following the NJPDES permit limitations of the Chambers Works wastewater treatment plant in discharging.

EPA has developed draft standards for emissions of certain acutely toxic and carcinogenic metals and for emissions of products of incomplete combustion (PICs). Under the draft regulations, incinerators will be required to limit emissions of carbon monoxide to 100 ppm or less and limit the concentrations of metals in air to less than metal-specific risk-based values. Section 4.3 discusses the modeling of these constituents. None of the modeled metal concentration exceeded the draft standards.

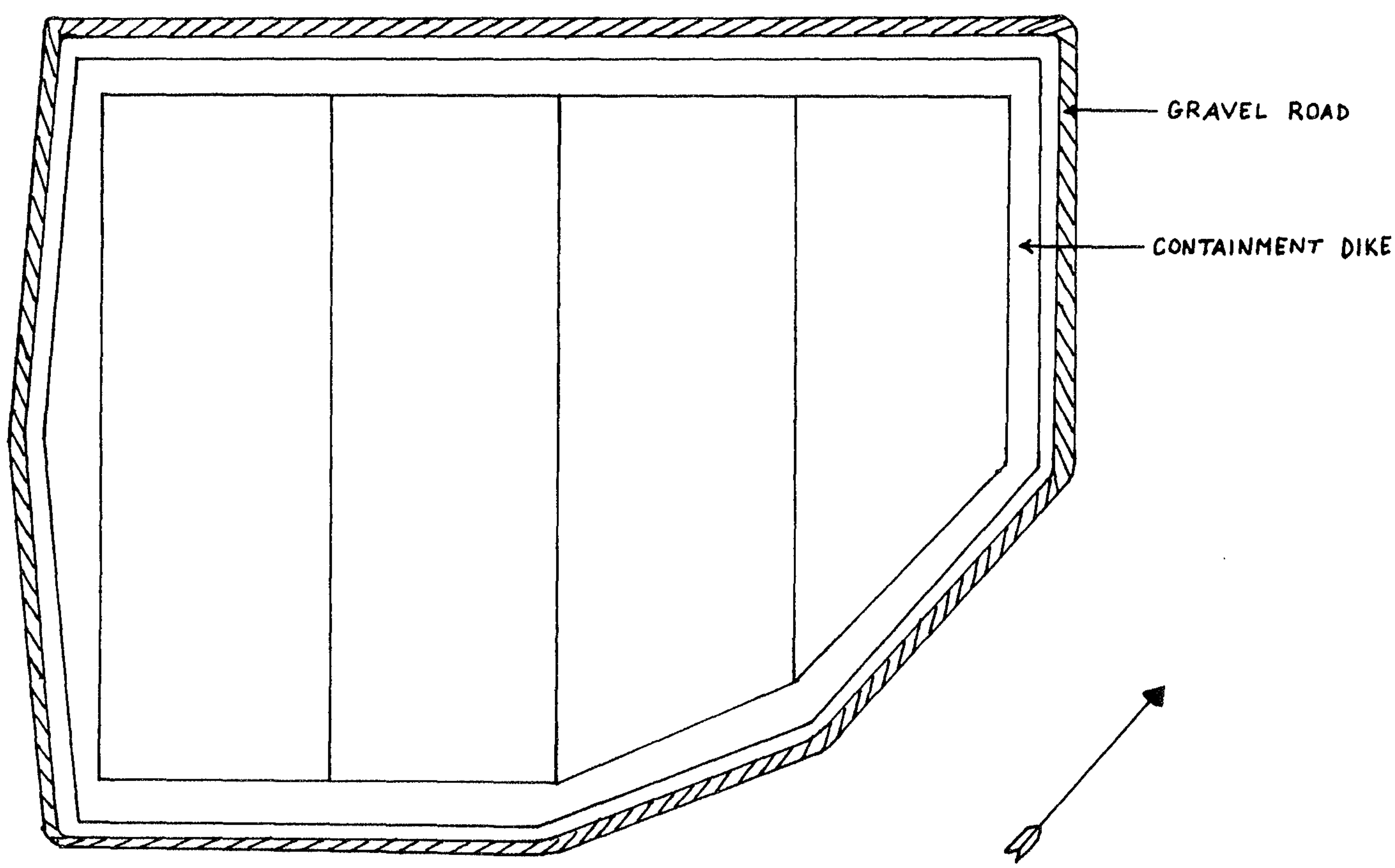
Regulations concerning Ambient Air Quality Standards and prevention of significant deterioration are discussed in Section 4.2.1. Compliance of the proposed facility with the New Jersey Hazardous Waste Facility Siting Act is discussed in Section 1.3.2.

2.2 LANDFILL EXPANSION

The landfill expansion consists of constructing a new secure landfill adjacent to the Delaware River on Carneys Point (i.e., 250 feet east of the river). Exhibit 2-7 shows a general overview of the proposed landfill site. This proposed landfill will be used to dispose of bulk solid wastes generated at Chambers Works and other Du Pont plants. Neither commercial nor containerized wastes will be accepted. The landfill will have a six-sided polygon configuration and will occupy approximately 27 acres. Thirteen additional acres will be required for roads, the truck wash station, construction areas, etc. All wastes will be contained above grade in an earthen vault-like structure, the top of which will be 100 feet high. It will consist of four cells, and each will possess double lining, a leachate collection system, and a leak detection system. In addition, the landfill will possess a ground-water monitoring system and a ground-water pumping system to collect

EXHIBIT 2-7

GENERAL OVERVIEW OF THE PROPOSED LANDFILL SITE



Source: Chambers Works Pollution Abatement Facilities Sludge Landfill Site Plan Civil, Drawing No. W1031083.

contaminated ground water. The four cells will be filled concurrently and then capped as a single unit. Wastes will be hauled and dumped 24 hours per day, 7 days per week, and wastes will be spread/compacted during daylight hours 7 days per week. The proposed landfill will not require additional personnel. Employees working on the existing landfill operation will work at the new landfill once it is put into service.

Construction of the first cell is scheduled to begin in the second quarter of 1991 and to be completed in the second quarter of 1992. This cell initially will be used primarily to dispose of ash from the proposed incinerator, which is expected to begin operation in 1992. All cells at the new landfill are expected to be constructed by the second quarter of 1996. The landfill is expected to be in service for 30 years (i.e., through 2022). Details on wastes to be accepted, landfill design, and operating procedures are presented below. Much of the information was taken from the RCRA Part B Permit Application, Volumes II, III, VI, and VII, "Chambers Works Rotary Kiln Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

The proposed landfill site was previously the site of a nitrocellulose manufacturing plant, which was in operation from the late 1800s until the mid-1970s. Nitrocellulose was produced from fibrous material (i.e., chemical cellulose, wood pulp, or cotton waste), sulfuric acid, nitric acid, and water. It was sold as gun cotton and as an intermediate for various products. The area also had administrative offices, material storage buildings, process facilities, various shops, laboratories, and shipping facilities. All structures have been removed, leaving the concrete foundations. Site soils and ground water may have been contaminated to some extent during operations. Nitrocellulose was shredded and flaked before it was packaged and shipped, and therefore, nitrocellulose particles could have been dispersed on the plant site. Soils and ground water could possess elevated levels of nitrates and nitrites from nitrocellulose contamination and decomposition. The plant also possessed underground process sewers and maybe underground storage tanks that could have leaked. In addition, residuals from alcohol and solvent spills could be present. Du Pont staff believe that wastes were never buried at the plant site. According to Du Pont staff, no site hazards associated with environmental contamination were detected when soils were sampled for analysis of engineering properties and ground-water monitoring wells were installed.

2.2.1 Wastes Accepted

The new secure landfill has a design capacity of approximately 1.8 million cubic yards and is expected to have a 30-year life. It will accept five general waste streams:

- Sludge from the existing Chambers Works wastewater treatment plant (WWTP),

- Incinerator ash from the proposed rotary kiln incinerator, existing incinerators at Chambers Works, and other Du Pont plants,

- Bulky hazardous wastes comprised of contaminated rubble and equipment, spill cleanup residues, and contaminated soils and gravel,

- Bulky non-hazardous waste comprised of rubble and equipment, and

- Asbestos contaminated with hazardous chemicals from leaks and spills.

Bulky hazardous and non-hazardous wastes and contaminated asbestos may originate at Chambers Works and other Du Pont plants. Asbestos will be disposed of in double plastic bags, and all other wastes will be disposed of in bulk form. Approximately 165 cubic yards will be disposed of daily. Anticipated annual waste loads are presented in Exhibit 2-8. Wastes that will not be accepted are listed in Exhibit 2-9. In addition, no containerized wastes will be accepted.

The WWTP sludge is comprised of three materials:

- Settled solids from the contaminated ditch wastestream which have been pressure filtered,

- Sand and grit produced from the slaking residue from the WWTP lime slaking system, and

- Spent activated carbon.

These are generated as both primary and secondary sludges, and consist mainly of unreacted lime (e.g., magnesium oxide, calcium hydroxide, silicon dioxide), activated carbon, sand and grit, and oil and grease.

The sludge also contains small amounts of organic compounds and heavy metals. The sludge is generally 45% solids and tends to be alkaline. It is not corrosive, ignitable, reactive, or toxic by RCRA hazardous waste definitions. However, it is a RCRA hazardous waste because the wastewater from which it is derived is hazardous and the WWTP is a hazardous waste management unit. Characteristics of the primary sludge are shown in Exhibit 2-10.

The ash will come primarily from the proposed incinerator and will consist of slag, ash, and salt. It will be made up of approximately 70% solids, and its composition will vary with the wastestream incinerated. The general composition of the ash from the proposed incinerator has been estimated by Du Pont based on ash composition from other Du Pont incinerators and anticipated wastestreams to be incinerated at the proposed incinerator. This composition is shown in Exhibit 2-11.

EXHIBIT 2-8

ANTICIPATED WASTE LOADS

WASTE	DRY TONS/YEAR	CUBIC YARDS/YEAR
WWTP Sludge	24,000	35,000
Incinerator Ash	15,000	15,000
Bulky Hazardous Waste	8,000	8,000
Bulky Non-hazardous Waste	2,000	2,000
Contaminated Asbestos	400	400
	49,400	60,400

Source: RCRA Part B Permit Application, Volume VI, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989, p. VI-1-3.

EXHIBIT 2-9

WASTES WHICH WILL NOT BE ACCEPTED AT THE NEW SECURE LANDFILL

Wastes Not Accepted

- Exhibits the characteristic of ignitability (D001 waste) as defined under N.J.A.C. 7:26-9.9;
- Is a listed "P" code (acute hazardous) waste under N.J.A.C. 7:26-8.15(e);
- Is a listed "U" code (toxic or as otherwise specified) waste under N.J.A.C. 7:26-8.15(f);
- Is prohibited from land disposal under N.J.A.C. 7:26-1 et seq. or 40 CFR Part 268;
- Contains a free liquid as determined by the paint Filter Tests, Method 9095, "Test Methods for Evaluating Solid Wastes, Liquids Physical/Chemical Methods (EPA Publication No. SW-846);
- Contains polychlorinated biphenyls (PCB's) at a concentration greater than 50 ppm or greater than any future concentration limit set by the United States Environmental Protection Agency or the NJDEP;
- Is radioactive as defined by 10 CFR Sections 20.105 and 20.306; or
- Is not generated by a research, development, or manufacturing facility owned and operated by E. I. Du Pont de Nemours and Co., Inc.

Source: RCRA Part B Permit Application, Section II.

"Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989, p. II-1-57.

EXHIBIT 2-10

WASTE CHARACTERIZATION PRIMARY SLUDGE FILTERCAKE FROM WWTP

I. Location: Chambers Works

II. EPA Code: F002, F005, F006

III. Composition:

MAJOR COMPONENTS	TYPICAL ANALYSIS %	TRACE COMPONENTS	AVG COMPOSITIONAL ANALYSIS (ppm)
Water	50-65	Ag	2.5
Calcium, Magnesium Hydroxides & Carbonates	15-20	As	1.0
Silicates	12-17	Ba	5.0
Oil and Grease	5-8	Cd	0.4
Trace Metals (primarily Aluminum)	3-5	Hg	0.003
		Ni	190.
		Pb	1.0
		Se	0.5
		Zn	1020
		Sulfides	trace
		Phenolics	trace

IV. Physical State @ 25°C:

- Solid, passes paint filter test for solids (35-50% solids)
- Minimal free-flowing liquid layer
- Specific gravity - 78 lb/ft^3

V. Shipping Containers: Never Shipped
Containers would require special manufacture

VI. Properties:

Btu/lb	<3000	Pyrophoric	No
Color	Brown to Black	Radioactive	No
pH	10-12	Shock Sensitive	No
Reactive	No	Explosive	No
Toxic	No	Other	Possibly dusty when dry

VII. Shipping Name: Hazardous Waste - Solid, NOS DOT Hazard Classification: ORM-E

VIII. Volume: Annual: 73,000 wet tons (19.5 million gals).

Source: RCRA Part B Permit Application, Volume II.

"Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989, p. II-1-56.

EXHIBIT 2-11

NEW CHAMBERS WORKS INCINERATOR PREDICTED ASH ANALYSIS

COMPONENT	AMOUNT
Al*	20-40 wt %
Si*	20-40 wt %
Ca*	5-20 wt %
Fe*	1-20 wt %
C	1-3 wt %
P	< 500 wt ppm
K	<1000 wt ppm
Na	<1000 wt ppm
V	< 500 wt ppm
Cr	5000 wt ppm
Ni	5000 wt ppm
Mn	<1000 wt ppm
Ti	<5000 wt ppm
Cd	< 500 wt ppm
Pb	< 500 wt ppm
Cu	<5000 wt ppm
pH	8-12
Density (dry)	70-105 lbs/ft^3

*as oxides

Source: RCRA Part B Permit Application, Volume II.

"Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

2.2.2 Landfill Design

The proposed secure landfill has been designed to contain wastes and to prevent release of contaminants (i.e., hazardous waste constituents) into the environment. Features that have been included in the landfill design to meet these two objectives include a perimeter containment dike, a double liner system, a leak collection system, a leak detection system, a ground-water monitoring system, a ground-water interceptor well system, and a truck-wash station. The dike will contain the waste material and prevent storm water and surface water run-on. The liner system will contain storm water runoff and leachate within the landfill cells, thereby preventing area ground-water contamination. The leak collection system will divert runoff and leachate from within the cells to the Chambers Works WWTP. The leak detection and ground-water monitoring systems will be used to monitor the structural integrity of the liner system and to indicate the need for corrective action. The ground-water interceptor well system, which has not yet been designed, will be used to pump out contaminated ground water, which will then be pumped to the WWTP for treatment. The truck-wash station will be used to decontaminate trucks, thereby preventing contamination. Wash water will be decanted and pumped to the WWTP for processing. As the cells are filled, the containment dike will be raised, and after they are filled, the landfill will be covered by an impervious cap which will minimize leachate generation. The landfill access road will be sloped up to the disposal area and will also circle the area below the containment dike providing appropriate run-on and runoff control features.

The proposed landfill will not include gas monitoring and venting systems, because Du Pont has determined, based on wastes to be landfilled and the operating experience with the C Area Landfill, that such systems will not be necessary. Landfilling the WWTP sludge will not result in significant gas formation. Landfilled incinerator ash should result in even less gas formation, since this ash will contain very little organic material that can be biologically degraded and form landfill gas.

Engineered design elements that will provide containment and run-on and runoff control are described in the following subsections. Operating procedures designed to prevent contaminant releases are discussed in Section 2.2.3. Details on how the landfill will be closed and on post-closure monitoring are presented in Section 2.7.2.

2.2.2.1 Containment Dike and Side Slope Cover. The containment dike will have a minimum top elevation at 17 feet (Chambers Works datum (CWD)), and its width from the toe of the outer slope to the edge of the waste area will be no less than 50 feet. The river-side (west side) of the dike will possess rip-rap on the outside slope up to 14.5 ft CWD. The 100-year flood event elevation for the Delaware River at Chambers Works at mean tide is 12.3 ft CWD (9.00 ft USC&GS datum), and the 100-year wave is 13.3 ft CWD. The maximum outer slope will be 2:1, which was designed based on various slope stability analyses using data on waste material, soils, and depths. Data on waste material (i.e., strength data) were obtained from historical sludge strength test data. The dike will be constructed of soils tested to meet required specification and compacted to 95%

or more of maximum dry density to obtain a completed permeability of 1×10^{-5} cm/s or less.

As the landfill is filled with wastes, the dike elevation will be raised by application of the side slope cover. This raising will be performed in three stages. The final landfill elevation with cover will be at 100 ft CWD. The side slope cover will consist of the following elements:

- Three-foot thick layer of clay to provide a barrier to infiltration and act as a buffer between the reinforced synthetic rubber liner (i.e., Hypalon geomembrane) and the landfilled materials,
- A 30-mil (minimum) supported Hypalon geomembrane to provide the major barrier against infiltration,
- A drainage grid to channel infiltration along the top of the geomembrane; the geogrid will be covered with a geotextile to provide a separating medium to preclude clogging of the drain grid,
- Six inches of general fill,
- A reinforcing geogrid to mitigate the possibility of slippage by the cover materials along the geomembrane,
- Twelve inches of general fill to inhibit deep root vegetation and discourage rodent penetration to the underlying liner materials, and
- Six inches of topsoil vegetated with a hardy, shallow-root low-maintenance cover (i.e., grass).

The final top cover system is described in Section 2.7.2.

2.2.2.2 <u>Liner System</u>. The liner system will cover all structures that will be in contact with waste or leachate (i.e., the interior of the containment dike and the three interior dikes that divide the area into four cells). It will consist of various materials which will be laid down after the area has been cleared and excavated for the required grades and underdrains. Underdrains are designed to collect ground water at elevation 5.0 ft (CWD). The lower liner foundation will consist of compacted soil and clay. A layer of native soil material will first be deposited in the landfill bottom area and compacted. Then a 3-foot layer of clay meeting required specifications will be installed in all areas to be lined. The clay will be compacted to achieve at least 95% of maximum dry density. The lower liner (i.e., 45-mil Hypalon geomembrane) will be placed over the clay. The minimum elevation of this liner will be at 10 ft CWD. The lower liner will be covered with a sheet of Typar geotextile (a material designed to prevent clogging), 6 inches of gravel, another sheet of Typar, 6 inches of sand, and then the upper liner (i.e., 45-mil Hypalon geomembrane). The upper liner will be overlain with Typar, a 24-inch layer of gravel, and then a final layer of Typar. This upper drainage layer is designed to prevent equipment from coming in direct contact with the upper liner. A schematic of the liner system is shown in Exhibit 2-12.

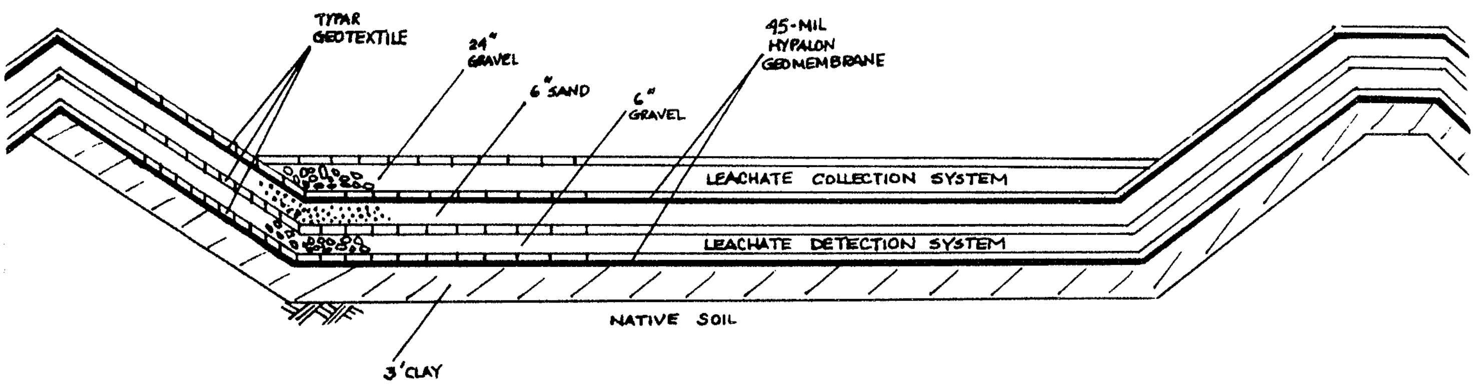
Various engineering analyses have been conducted to ensure that the performance of the liners will not be jeopardized. Results of subsurface investigations (test borings) and computer modeling indicate that post construction settling will be relatively minor. Total settlement calculated for the base of the landfill ranges from 16 inches maximum at the center to 1.5 inches minimum at the perimeter. Maximum differential settlement would occur across the east-west section at a rate of 0.17 feet per 260 feet. Also, the bearing capacity of the underlying soil is greater than the load associated with materials to be landfilled and vehicular and compacting equipment. No stability problems are expected. In addition, because the landfill will be constructed entirely above grade and the ground-water table is below the existing grade, there is no immediate potential for bottom heave of the structure. These findings indicate that the Hypalon liners will not be moved or stretched enough to cause performance problems (i.e., reduce hydraulic effectiveness). Elongation of the base is expected to be minimal and far below the limit of 20% for a Hypalon liner. Furthermore, wastes to be landfilled will not affect the liners' integrity. The Hypalon lining material has been tested and found to be compatible with the wastes. Also, the same lining material has been successfully used for previous landfilling at Area 1 of the Area C Landfill since 1975.

2.2.2.3 Leachate Collection System. Each landfill cell liner will be sloped 2% from a central north-south ridge down to leachate drains at the east and west ends. Each end will be sloped to two collection areas consisting of a single liner polypropylene penetration pipe branching to two 75-foot screened PVC pipes in a "Y" arrangement. The collectors will be installed in the gravel overlaying the liner, and each length will be surrounded by a 1-foot high, 5-foot wide layer of gravel overlain with Typar geotextile to prevent clogging. Each penetration pipe will convey leachate by gravity flow to a collector main. The collector mains on the east and west sides of the landfill will convey leachate by gravity flow to 10-foot deep by 6-foot diameter concrete collection sumps.

Leachate will be pumped from the collection sumps to the WWTP. Each sump will be equipped with two parallel pumps and secondary containment. The two pumps in a sump will be operated alternately, triggered on and off by float switches. In the event that one pump fails or has low flow, a conductivity probe will activate the other pump. LCS pumps have been sized to remove non-leachate inflow while maintaining sufficient capacity to remove one inch of rainfall from the landfill surface in 24 hours or less. The one inch figure was chosen as the most likely normal rainfall that would occur. In the event of a 25-year, 24-hour storm, the rain water will remain pooled for a longer period of time; but due to the low sludge permeability ($\sim 10^{-6}$ cm/s), it will not have an appreciable effect on the head above the liner. A system designed to remove the 25-year storm rainfall in 24 hours would result in a vastly oversized system which would be prone to pluggage.

EXHIBIT 2-12

LANDFILL LINER SYSTEM



2.2.2.4 Leak Detection System. At the east and west end of each landfill cell, each of the two leachate collection system basin areas will be underlain by a single screened PVC leak detection system collector pipe (5.5 ft). Each collector pipe will be connected to a 4-inch ductile iron pipe which will penetrate the liner and be sloped down to a collection sump. The collector pipe will be installed between the two synthetic liners in a 1-foot high, 5-foot wide layer of gravel overlain with Typar to prevent clogging. The leak detection system consists of a counter device connected to the automatic pumps serving the collection sump. The counter displays gallonage pumped and will be checked daily by an inspector.[26] Forty gpm sump pumps will activate automatically at a level of about 12 gallons, pumping the leachate through 2-inch galvanized steel force mains to the leachate collection pump sumps, from which it is pumped to the WWTP.

2.2.2.5 Ground-Water Monitoring Program. The ground-water monitoring system for the proposed landfill consists of 11 wells surrounding the site. Details on these wells are presented in Exhibit 2-13. The wells that will be routinely sampled to determine compliance with RCRA (i.e., no release of contaminants) are T28-M01B, S27-M02B, and P29-M01B, and the well to define background water quality is 532-M01B.

Du Pont will sample these wells on a quarterly basis and analyze the collected ground water for the following parameters:

- Hardness
- Chloride
- Total Phenolics
- Iron
- Total Organic Carbon (TOC)
- Total Dissolved Solids (TDS)
- Total Organic Halogens (TOX)
- pH
- Specific Conductance

Ground-water samples also will be analyzed annually for parameters listed in Exhibit 2-14. Also, on an annual basis, four replicate measurements of the parameters listed above will be performed on samples collected. Sampling procedures have been developed based on USEPA and NJDEP guidance documents. Analyses will be conducted by the Chambers Works Laboratory and by the Environmental Testing Corporation in Edison, New Jersey, both of which are certified by NJDEP to perform ground-water analyses. Analytical procedures will be consistent with USEPA certified or equivalent methods.

Analytical results will be submitted to both NJDEP and USEPA. Quarterly reports will discuss trends over time and significance based on appropriate statistical tests. Annual data will be assessed as a three phase program: 1) upgradient consistency; 2) comparison of downgradient replicate analyses with the background data for the upgradient monitoring wells; and 3) comparison of the remaining parameters and compounds with applicable standards and background data. Du Pont will also maintain files on all analytical results and reports.

EXHIBIT 2-13

GROUND WATER MONITORING WELLS

WELL NO.	PLANT COORDINATES NORTH	PLANT COORDINATES EAST	DEPTH (FT)	ELEVATION[a] GROUND (FT)	ELEVATION[a] RISER PIPE (FT)	SCREENED INTERVAL (FT)
P29-M01B[b]	11,211	6,846	34.0	12.0	13.74	28-33
Q30-M01B	11,704	7,099	31.0	10.8	12.49	25-30
R26-M01B	10,180	7,675	34.1	8.3	10.33	29-34
R28-M02B	10,831	7,418	41.0	10.6	11.03	36-41
R31-M01B	12,176	7,350	33.0	9.3	11.57	27-32
S27-M02B[b]	10,552	7,828	31.0	7.2	9.11	25-30
S32-M02B	12,425	8,021	39.3	9.5	10.95	34-39
S32-M01B[c]	12,500	7,768	30.0	8.6	9.53	24-29
T28-M01B[b]	11,151	8,208	19.5	4.7	7.89	14-19
T29-M01B	11,595	8,281	38.0	6.3	7.91	31-36
T31-M01B	12,116	8,254	35.0	5.7	7.97	29-34

[a] Referenced to Du Pont Chambers Works Datum.

[b] Points of compliance.

[c] Background well.

EXHIBIT 2-14

PARAMETERS FOR ANNUAL GROUND-WATER ANALYSIS[a]

USEPA Priority Pollutant List Volatile Organics by GC/MS plus 15[b]

USEPA Priority Pollutant List Base/Neutral Extractable Organics by GC/MS plus 15[b]

Calcium	Total Cyanide
Magnesium	Gross Alpha
Manganese	Gross Beta
Sodium	Aluminum

Source: RCRA Part B Permit Application, Volume III.

"Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989, Part 2, Table 7-2.

[a] This list is in addition to the normal quarterly analysis.

[b] Plus 15, 15 refers to tentative identification of unknowns by Methods 624/625 GC/MS to "identify" substances with peak areas greater than 10% of the nearest internal standard being searched based on a 50 ppb internal standard concentration.

2.2.2.6 Other Run-On and Runoff Controls. Other run-on and runoff controls include site grading, waste grading, drainage systems, and curbing. In addition to the containment dike, run-on into the landfill will be prevented by site grading (i.e., sloping away from the landfill). Run-on control for the landfill access ramp will be provided by 8-inch high concrete curbs on each side of the road and by adjacent grades that will slope away from the curb. The area around the truck-wash station will also be graded to divert run-on away from the structure.

Interior runoff control for the landfill will be initially provided by the liner and leachate collection system, which will be used to remove runoff in any part of the landfill base that is not covered with compacted wastes (i.e., in an empty or newly opened cell). As wastes are deposited in the landfill, runoff control will be provided by grading the wastes so as to collect the runoff. Initially wastes will be graded to promote runoff to the centers of the east and west halves of each cell. As adjacent cells become operational and the waste elevation rises above the level of the interior containment dikes, wastes will be graded to promote runoff to central ponds on the east and west halves of the landfill. The size and number of these ponds will be adjusted according to the active area of the landfill.

Runoff accumulated in the landfill will be pumped to the WWTP for processing into a non-hazardous liquid effluent and a hazardous sludge to be disposed at the landfill. Runoff will be removed using a portable diesel pump, with a spare available, pumping to one of the leachate collection system main collection sumps.

The access ramp leading to the landfill will be made of concrete and will employ 8-inch high curbs on each side and in the center to contain runoff. The center curb will divide the 24-foot wide ramp into two 12-foot sections to incoming and outgoing traffic. This ramp will be constructed of high density concrete having a maximum coefficient of permeability of 1×10^{-7} cm/s. The 10-inch thick slabs will be keyed and dowelled to prevent differential settlement, and equipped with chemically resistant water stops. The slabs will be constructed on a 12-inch drainage layer of sand equipped with leachate collection pipes. The drainage layer will be installed on a liner system consisting of a 3-foot thick layer of compacted clay covered by a 45-mil Hypalon geomembrane. The ramp will be extended above the containment dike as waste filling warrants, using the side slope cover system topped with an asphalt surface. The final length of the ramp at completion of the landfill will be approximately 750 feet. An interceptor drain across the lower part of the ramp will convey runoff to a two-stage sump at the truck-wash station. This sump consists of two tanks, each of which will have a capacity of 2115 gallons. Runoff collected in these tanks will be pumped directly to the WWTP through a connection in the main return line from the leachate system. The sump pump capacity will be 60 gpm.

The station itself will be covered and enclosed such that there will be no runoff from the station. The concrete floor of the station has the same containment design as the access ramp in terms of concrete construction, leachate collection, and liner system. The station sump will collect washwater from the truck waste operation, as well as leachate from the drainage layers under the station and access ramp.

Exterior runoff from the top of the landfill, after the landfill has been filled to capacity and closed, will be controlled by a drainage system consisting of a channel collector (36-inch-diameter corrugated metal pipe half-round) that will circumscribe the landfill top and 15-inch corrugated metal pipes that will conduct the collected water down the side slopes. The 15-inch pipes will discharge into a grasslined channel that will surround the landfill area. Storm water from the side slopes will move as sheet flow into the channel.

2.2.3 System Operations

The landfill operations will include waste acceptance, waste disposal, and site inspection. Solid wastes destined for the landfill will first be reviewed for acceptability by the generator and either the chemical waste technical chemist or chemical waste area manager. Generators will be required to prepare waste characterization forms, which will involve presenting analytical data and health and safety information required to handle the wastes appropriately. Required data will include:

- Certification of components;
- Percent moisture;
- pH;
- Results of paint filter test for free liquids; and
- Certification of the absence of land disposal restricted waste.

Standard EPA-approved protocols will be followed for the sampling and analytical methods. Disposal will be authorized by the research and development office, the site environmental group, the chemical waste area technical person, and the chemical waste management area manager. The waste characterization and approval package, as well as MSDS information on the waste or its components, will be kept on file. Appropriate certifications and/or notifications of compliance with treatment standards or best practical alternative provisions will be included with the waste characterization information in the approval package. Detailed generator waste codes and identifying sources will also be assigned to all landfill wastes.

Chambers Works and other Du Pont wastes, other than incinerator ash and WWTP sludge, will be received at the chemical waste management area. Upon arrival, the approval package will be checked for authorizing signatures and generator waste codes. Drummed or other packaged wastes will be transferred to bulk solids containers. Empty drums and packaging will be transported to the incinerator. When all wastes are in bulk form, either in a dump truck, dumpster, or dumpster dinosaur container, the chemical waste operator will visually inspect the load for free water and adherence to the waste characterization form, then sign and date the waste transportation form. If necessary, the operator will fingerprint the wastes before they are sent to the landfill to ensure proper waste identification. If the wastes contain free water, the operator will instruct the transporter to deposit the load at the dewatering pad where free water is collected; collected water flows to the WWTP. When the bulk solids are dewatered and pass the filter test, they will be transported to the landfill. Each shipment will be logged at the landfill office, and the waste type and quantity received will be recorded. The location of each shipment will also be indicated on a map of the landfill using the shipment log number.

Operators of the landfill, the proposed incinerator, and the WWTP will coordinate directly for removal of ash and sludge. Ash and sludge will be hauled to the landfill in dedicated dinosaur containers when the containers are full. Operators at the generating facilities will be required to ensure that the solids meet the "no free liquids" criteria and other land disposal restrictions before sending waste to the landfill. Composite samples of ash and sludge will be collected and tested for free liquids and percent solids monthly. On a quarterly basis, the composite sample for one week will be collected from the ash and sludge for analysis for compliance with the land disposal restrictions.

Recertification of all active waste streams will be performed annually. The process will include complete recharacterization by the generator and evaluation by the Environmental Affairs Group for compliance with current regulations. If waste streams change as a result of process modifications or EPA promulgates additional land disposal restriction treatment standards, the wastes will be recharacterized as soon as representative samples are available.

Transportation of solids to the landfill and operation of the landfill will be performed by contractor under Du Pont supervision. Containers will be dumped in the active portion of the landfill, and wastes will be spread and compacted by bulldozer and roller/aerator in 6- to 12-inch lifts. Wastes will be hauled and dumped 24 hours per day, 7 days per week, and wastes will be spread/compacted during daylight hours 7 days per week. The emptied trucks will be washed by contractor personnel at the drive-through truck wash station at the landfill entrance to control contamination of the area. Washings will be collected and pumped through the force main to the WWTP.

Du Pont will perform routine inspections of the landfill throughout its active life. These inspections will be to detect malfunctions, deterioration, operating errors, or discharge early enough to repair or remediate the problem before it threatens human health or the environment. The proposed inspection schedule is presented in Exhibit 2-15.

Du Pont personnel will also be required to make several readings at the landfill as follows:

- Record flow from area sumps — Weekly
- Record flow from leak detector wells — Daily
- Sample leachate — Monthly

EXHIBIT 2-15

INSPECTION SCHEDULE FOR PROPOSED LANDFILL

EQUIPMENT INSPECTED	EXAMPLES OF POTENTIAL PROBLEMS	FREQUENCY
Telephone	Not Working	Daily
Fire Extinguisher	Not Full	Monthly
Fire Alarm Box	Blocked	Daily (Visual)
	Not Operable	6 Weeks (Tests)
Leachate Pumping System	Tank Leak	Daily
	Pump Leak	Daily
	Pipe Leak	Daily
	Not Pumping	Daily
Leak Detection System	Not Pumping	Daily
	Physical Damage	Daily
Dikes and Top or Side Cover	Erosion, Collapse, Overflow	Daily
Working face	Run-off of Liquid Beyond Landfill	Daily
	Wind Dispersal of Waste Material	Daily

- Sample liquid from leak detectors — Monthly
- Record leachate level in area sumps and leak detector wells — 4th Week of Each Month
- Sample all monitoring wells — Quarterly (1/3 Each Month)

Data will be compiled and submitted to the New Jersey Division of Water Resources quarterly. An operational statement will be submitted to the New Jersey Solid Waste Administration annually. The landfill also will be inspected weekly by representatives of the NJDEP and the local health department. In addition, an outside Consulting Engineer, registered in the State of New Jersey, must certify annually the operation of the landfill in conjunction with permit regulations. This certification includes the following:

1. Measurement of the strength of the sludges and calculation of slope stability.
2. Obtaining a settlement analysis of the landfill.
3. Issuance of an annual report in conjunction with permit regulations.

2.2.4 Compliance with Applicable Regulations

Plans for the construction and operation of the proposed landfill are in compliance with the New Jersey Hazardous Waste Regulations, specifically Sections 7:26-9.4, 9.5, 9.8, 9.9, and 10.8. The RCRA Part B permit application contains the various system components and administrative controls that are required, including the following:

- A double liner system
- Run-on and runoff controls
- A leachate collection and removal system
- A leak detection and collection system
- A ground-water monitoring system and program
- A final cover system
- A waste analysis program
- A shipment inspection program
- A site inspection program
- Personnel training provisions
- Site security provisions
- Record keeping and reporting provisions
- Closure and post-closure care plans.

Details of these components and controls also adhere to the regulations. They are summarized above in Sections 2.2.2 and 2.2.3 of this EHIS, except the closure and post-closure care plans, which are described in Section 2.7.2. Compliance with Sections 9.6 and 9.7 of the regulations is addressed in Section 2.5 of this EHIS.

Du Pont will have to obtain a wetlands transition area waiver because parts of the landfill are within 25 feet of wetlands. Refer to Section 3.4.1.2.

2.3 SOLID WASTES, EMISSIONS, AND EFFLUENTS

2.3.1 Waste Storage and Delivery Systems

In the following subsections fugitive air emissions, storm water, and spill residues resulting from the waste storage and delivery systems are described.

2.3.1.1 Fugitive Air Emissions. Fugitive emissions originate from various sources in the waste storage and delivery systems due to the nature of the waste handling operations. The major sources and types of emissions are described below; this information is summarized from the Part B permit application[27].

The waste acceptance procedure requires sampling of incoming waste at the tank truck waste unloading stations; this sampling process emits volatile organic compounds (VOCs) to the atmosphere. The vapors emitted are directed to the afterburner chamber to be incinerated or to a carbon adsorber for VOC removal. VOC emissions also occur at the tank farm during unloading or tank filling cycles. The tanks are nitrogen blanketed and the displaced tank vapors will be vented either to the afterburner chamber or the carbon adsorber units.

Other sources of emissions are from the container sampling area, repackaging, de-heading and resealing area, de-drumming station, and holding tanks. Drummed or containerized liquid wastes are pumped to two liquid holding tanks and then to the kiln or the tank farm. Before unloading, the contents of the containers are sampled and analyzed to verify manifest data. Vapors emitted during the sampling process are vented by a localized portable hood and incinerated in the kiln or directed to a carbon adsorber unit for VOC removal. Following the sampling process, the waste containers are emptied into either of the two liquid holding tanks. This de-drumming process emits some VOCs as the drum bungs are removed and the transfer lines are installed. A portable localized vent is also placed near the bung opening to capture and direct the fugitive VOC emissions to the kiln to be burned. As the de-drummed liquid waste described above fills the two holding tanks, vapors are emitted through the conservation vents. These vapors are directed to the afterburner chamber for VOC destruction. Additional sources of fugitive VOC emissions include the heavy sludge hopper, thaw box, sampling, de-heading/resealing, and from components such as pipes, valves, flanges, etc.

2.3.1.2 Storm Water. The container storage area is designed to prevent potential for run-on and runoff from the area. The area is enclosed and entrances will be ramped or elevated. The tank farm and unloading areas will be graded to direct surface water runoff from the areas without secondary containment to drainage ditches that encircle the incineration facility perimeter. Both contaminated and uncontaminated storm water which falls into secondary containment areas will be treated at the wastewater treatment plant. The tank and container storage areas will be connected to the system which feeds contaminated process, sanitary, and storm water to the WWTP.

2.3.1.3 Spill Residue. If a spill occurs, the fugitive liquid will be contained in the segregated storage compatibility area, collected in a trench and sump. The spill area will first be isolated, then, if needed, a sample of the spilled material will be collected to verify waste identification. If a small spill or one limited to a small area occurs, solid absorbent material and/or chemical neutralizers will be spread to collect and contain the liquid. The spent absorbent will be collected with broom, a shovel, or similar equipment, and transferred to a drum or other secure container. Liquid spilled materials that have been determined compatible with the waste streams handled at the wastewater treatment plant and operating permits, and/or neutralized to minimize handling hazards will be pumped to the sewer lines connected to the wastewater treatment system. Spilled solids will be handled in the same manner as spent absorbent or residues from spill cleanup. The solids will be collected with spark-proof shovels or brooms and placed in a compatible container or left as bulk solids for transport either to the incinerator or the landfill depending on the concentration of hazardous substance in the spill residue.

Affected areas will be decontaminated by repeatedly washing and rinsing with solvents or water until the rinse water tests clean. The spent solvents and washwaters will also be directed to the WWTP, if applicable, or incinerated. Response to spills is covered in greater detail in Section 5.3.1, Foreseeable Occurrences and Their Impacts.

2.3.2 Incinerator Air Emissions, Solid Wastes, and Wastewater Effluents

The air, liquid and solid waste residues generated from the operation of the incinerator and all ancillary operations (e.g., air pollution control system) are described in detail in the following subsections.

2.3.2.1 Incinerator Stack and Vent Emissions. The proposed incinerator emits air pollutants from the main exhaust stack and from the emergency relief vent stack. The main exhaust stack is a continuous source of air emissions; the emergency vent is normally closed, and air contaminants are emitted only for short periods during process upset conditions when the emergency vent is activated. The rotary kiln and afterburner chamber are operated under negative pressure and, therefore, do not normally have fugitive air emissions. Fugitive air emissions from waste storage and handling systems are discussed in Section 2.3.1.

The main incinerator stack is located downstream of the exhaust gas reheat coil and induced draft fans, which are downstream of the air pollution control system (APCS). The incinerator operating parameters and air pollution control devices are designed to minimize stack emissions of criteria pollutants, including sulfur dioxide (SO_2), nitrogen oxides (NO_x), inhalable particulate (PM-10), carbon monoxide (CO), lead (Pb), and ozone precursors (volatile organic compounds). The APCS also controls stack emissions of metals and acid gases. The rotary kiln, afterburner chamber, and APCS are described in Section 2.1.3.

The high combustion efficiency of the rotary kiln and afterburner chamber will ensure greater than 99.99 percent destruction of the organic constituents of wastes charged to the incinerator, and also minimize the emissions of carbon monoxide and organic products of incomplete combustion (PICs). The incinerator afterburner chamber is also equipped with "low-NO_x" burners that minimize the generation of nitrogen oxides (NO_x) in the combustion zone. The APCS also includes devices to control NO_x emissions, and to control emissions of acid gases and aerosols, and particulates.

Emissions of air contaminants are expected from the incinerator main stack. Emissions of acid gases, including hydrogen chloride, hydrogen fluoride, and sulfur dioxide, will result from combustion of wastes containing chlorine, fluorine, and sulfur compounds. Phosphorus-containing wastes are also expected to be combusted, resulting in the generation of phosphorus pentoxide (P_2O_5), an acid aerosol. Uncombusted organic waste constituents, carbon monoxide, and PICs that are not destroyed in the afterburner chamber will pass through the APCS and exhaust through the main stack. Particulate material containing metals and other inorganic compounds that are not removed into the kiln ash handling system or by the APCS will also be emitted through the stack.

Estimates of emissions of air contaminants from the incinerator stack are discussed in Section 4.2. The impacts of the emissions are discussed in Sections 4.2 and 4.4.

Air contaminants will also be emitted through the emergency relief vent, which is located between the afterburner chamber and the APCS. The emergency vent is designed to open only as a result of severe overpressurization of the afterburner, and is required to protect the incinerator and APCS from possible explosions. Operation of the emergency vent is discussed in Section 2.1.3.4.

The characteristics of emissions from the emergency vent will be different than those from the incinerator main stack. The vent is interlocked such that waste feeds are automatically interrupted upon its operation. Air emissions will therefore persist only as long as waste remains in the rotary kiln and afterburner; the emission rate will be highest in the first few minutes after the vent is activated, and decrease rapidly over time. The emissions of acid gases, acid aerosols, and particulates will not be controlled by the APCS, as the emergency vent is designed for safety considerations to bypass the APCS. Emissions of organic materials and carbon dioxide will be partially controlled by the continued combustion of the waste remaining in the kiln, however the combustion efficiency will decrease substantially from that of normal incinerator operation. Combustion conditions may be such that emissions from the emergency vent are visible.

The exhaust gas from the emergency vent will contain acid gases and acid aerosols, including HCl, HF, SO_2, and P_2O_5, at higher concentrations than the normal exhaust from the main stack. In addition, particulates exhausted through the emergency vent will be emitted at a higher rate initially and will contain a higher concentration of organics than that from the main stack. Similarly, the exhaust gas emitted from the vent will contain a higher concentration of uncombusted waste constituents, carbon monoxide, and PICs. Impacts of the higher concentrations of air contaminants in the vent exhaust will be partially mitigated by the short duration of the emissions.

Estimates of emissions of air contaminants from the emergency vent are discussed in Section 4.2. The impacts of the emissions are discussed in Sections 4.2 and 4.4.[28]

2.3.2.2 Rotary Kiln Ash and Slag. Non-combustible waste constituents are converted to ash and slag in the rotary kiln. Hot ash and slag that are not entrained with the exhaust gas discharge from the end of the kiln into a wet ash deslagger where they are quenched in cool water. The wet ash is transported and dewatered by a drag conveyor to one of two ash dumpsters and is transported by truck to the proposed Chambers Works landfill for disposal. Water removed from the wet ash is treated on-site along with other wastewater generated at Chambers Works in the existing Chambers Works wastewater treatment plant (WWTP).

The kiln ash is primarily composed of inorganic compounds, including silica and metal oxides, and also contains some uncombusted heavy organic compounds and products of incomplete combustion. The composition and particle size of the ash discharged from the kiln is expected to differ from the ash entrained with the exhaust gas. The ash entrained in the exhaust gas is expected to contain smaller diameter particles than that of the kiln ash, and may contain higher concentrations of some metals than the kiln ash. Fugitive air emissions of kiln ash from the ash handling system and truck transport are not expected, as the ash is handled wet. Fugitive emissions of ash from the landfill are discussed in Section 4.2.

Estimates of the composition and volume of ash discharged from the rotary kiln are discussed in Section 4.2. The impacts of disposal of the ash in the proposed landfill are discussed in Sections 4.1, 4.2, and 4.3.[29]

2.3.2.3 Air Pollution Control System Wastewater Discharge. Ash entrained in the incinerator exhaust gas is removed by the APCS along with acid gases and acid aerosols. Acid gases and acid aerosols, including HCl, HF, SO_2, and P_2O_5, are removed in the condensers and wet scrubber using caustic (NaOH) solution. The wet scrubber also removes particulate material containing metals and other inorganic constituents through physical absorption in the scrubber solution. The APCS also removes some NO_x from the exhaust gas through reaction with NH_3.

The neutralization of acid gases and aerosols with caustic creates sodium salts that remain in the water discharged from the condenser and wet scrubber. Some ammonia salts will also be formed from reaction of the acids with residual

NH_3 from the NO_x removal system. Particulate material removed from the exhaust gas, that may include some of the sodium and ammonia salts formed in the scrubber, remains entrained in the scrubber water discharge. The scrubber and condenser water is treated in the Chambers Works WWTP.

2.3.3 Landfill Emissions and Effluents

Landfill operations will generate two liquid waste streams (i.e., storm water run-on/leachate and wash water from the truck wash station). Both of these waste streams will be collected and pumped to the WWTP for processing (refer to the first paragraph of Section 2.2.2 and to Section 2.2.2.6). Emissions from the operation should be minimal. Sludge and ash will be received as wetted wastes, and there should be little dispersion from exposed wastes. Significant drying of exposed wastes is not expected to occur because of the high volume and continuous nature of the landfilling operation. If the sludge and ash dry to the extent that particulate emissions are visible, water spray will be used for particulate control. A water truck will be available at the landfill for this purpose. Bulky wastes and asbestos may have varying moisture levels and potential for particulate emissions. However, asbestos will be received in double plastic bags to prevent emissions, and the relatively low quantity to be landfilled will allow careful placement and compaction to further prevent any emissions. Water spray will be used as necessary for particulate control during placement and covering of bulky wastes.

2.4 WASTE TRANSPORTATION

All wastes arrive at the proposed incinerator and landfill by tank truck, box trailers, flat beds (containing drums), dumpster hoppers, or dino containers. There is a rail car unloading facility; however, no wastes are expected to arrive by rail at the present time.[30,31] In addition, barge shipments of wastes are not expected.[32]

This section provides an overview of both on-site and off-site transportation, as the proposed incinerator accepts wastes from other Du Pont facilities as well as other commercial generators. Information presented includes routes used in the immediate vicinity of the plant and within the plant itself and the procedures for accepting waste shipments. Procedures and guidelines for responding to transportation accidents are found in the "Transportation Emergency Response Procedure (TERP)" manual. It contains information on training, spill reporting, mitigation actions, protective gear, cleanup and decontamination, and documentation. An overview of emergency preparedness, prevention, and response measures are found in Section 2.5.3 of this document. Information on both off-site and on-site transportation accidents is included.

2.4.1 Off-Site Transportation

Traffic carrying wastes generated off-site to the proposed incinerator and landfill follow the same routes used to access existing hazardous waste management units. The facility is accessed from the NJ Turnpike (I-95) and (I-295) via County Road 540 West to US Route 130, as shown in Exhibit 2-16. Access to the treatment units is through the Broadway gate located at the intersection of US Route 130 and NJ Route 140.[33] Two access roads (each approximately 1/4 mile) connect US 130 with the plant gates.[34]

2.4.2 On-Site Transportation

Approximately 250 trucks enter the plant each weekday.[35] It is estimated that half of these trucks carry hazardous waste, primarily to the Chambers Works wastewater treatment plant.[36] Traffic to the proposed incinerator is minimal in comparison, averaging eight to ten trucks per day. Although shipments are expected 24 hours per day, 75% of all shipments arrive between 8:00 a.m. and 4:00 p.m.[37,38] Of these shipments, five are expected to carry wastes from other Du Pont and non-Du Pont facilities.[39] The remaining trucks carry wastes generated within the Chambers Works. Truck traffic enters the Broadway gate during all operating hours except shift changes, when truck traffic is stopped for automobile traffic.[40] On-site traffic routes are shown in Exhibit 2-17. Trucks are routed to the incinerator via Ponsol, Plant No. 1, and Patrol Roads.[41]

Signal lights, officer signals, and traffic signs control all traffic flow on Chambers Works roads. Route 130 traffic is controlled by a signal light at Broadway. Railroad crossings are protected by a flagman.[42] Most Chambers Works roads are two lanes wide and allow for two-way traffic; however, some routes, including those to the Scale House and around the warehouses, are one way. Speed limits are posted at 20 mph or lower in congested areas and are monitored by radar. Parking is not allowed on the roads, vehicles must park in the designated parking areas.[43]

2.4.2.1 Wastes Destined for the Landfill. Wastes transported to the landfill include the following:

- Sludge from the waste water treatment unit;
- Ash from the incinerator;
- Construction rubble; and
- Contaminated asbestos.

The number of shipments per day varies as follows: 15 to 20 of sludge; 6 to 10 of ash; and 1 to 2 of rubble and asbestos.[44] Vehicles used to transport wastes to the landfill consist of dump trucks (5, 15, and 20 cubic yard capacity) and dino container trucks (15 and 30 cubic yard capacity). An occasional stake-body, flat bed, or pick-up truck is also used.[45]

EXHIBIT 2-16

TRANSPORTATION ROUTES TO THE SITE

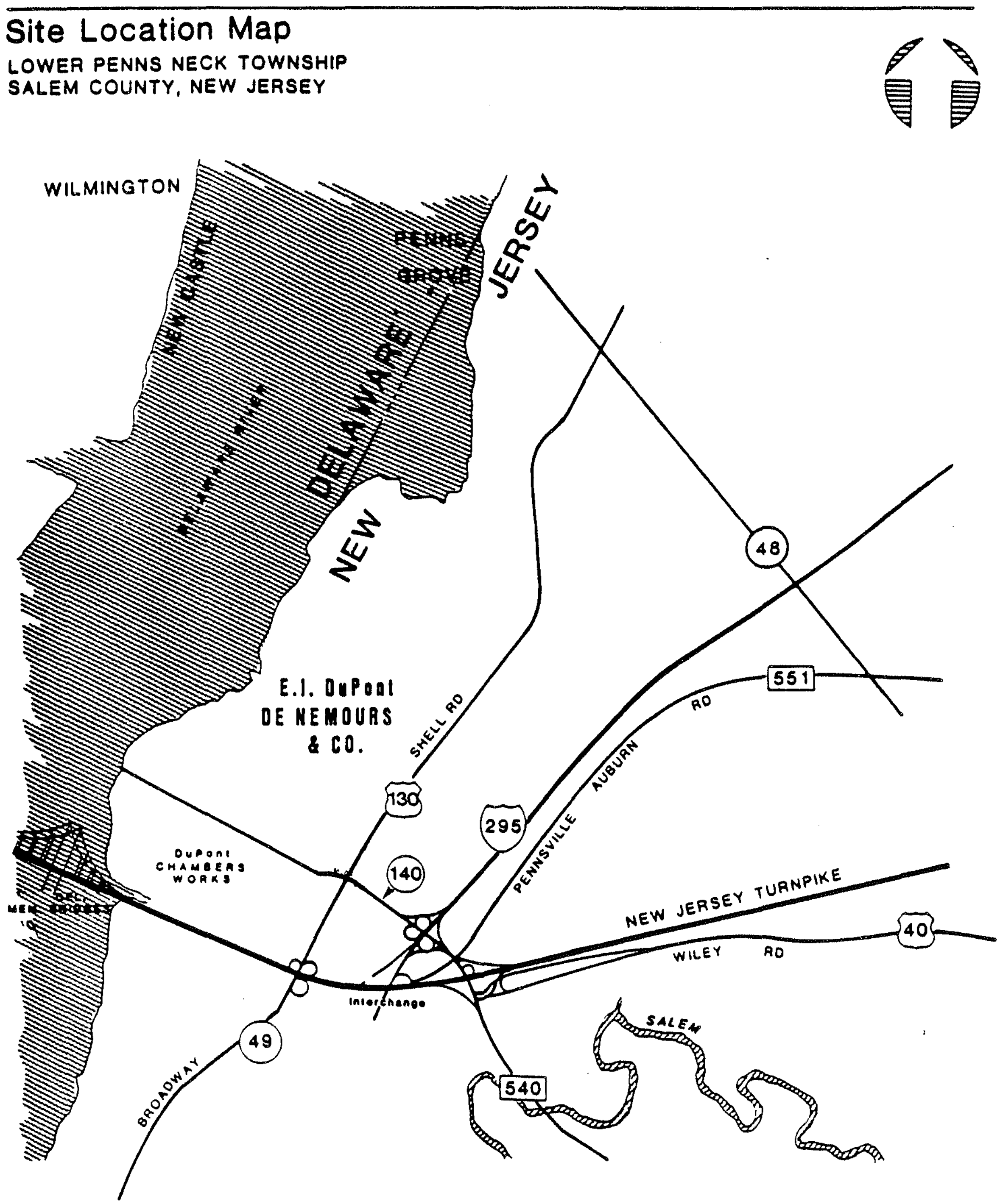
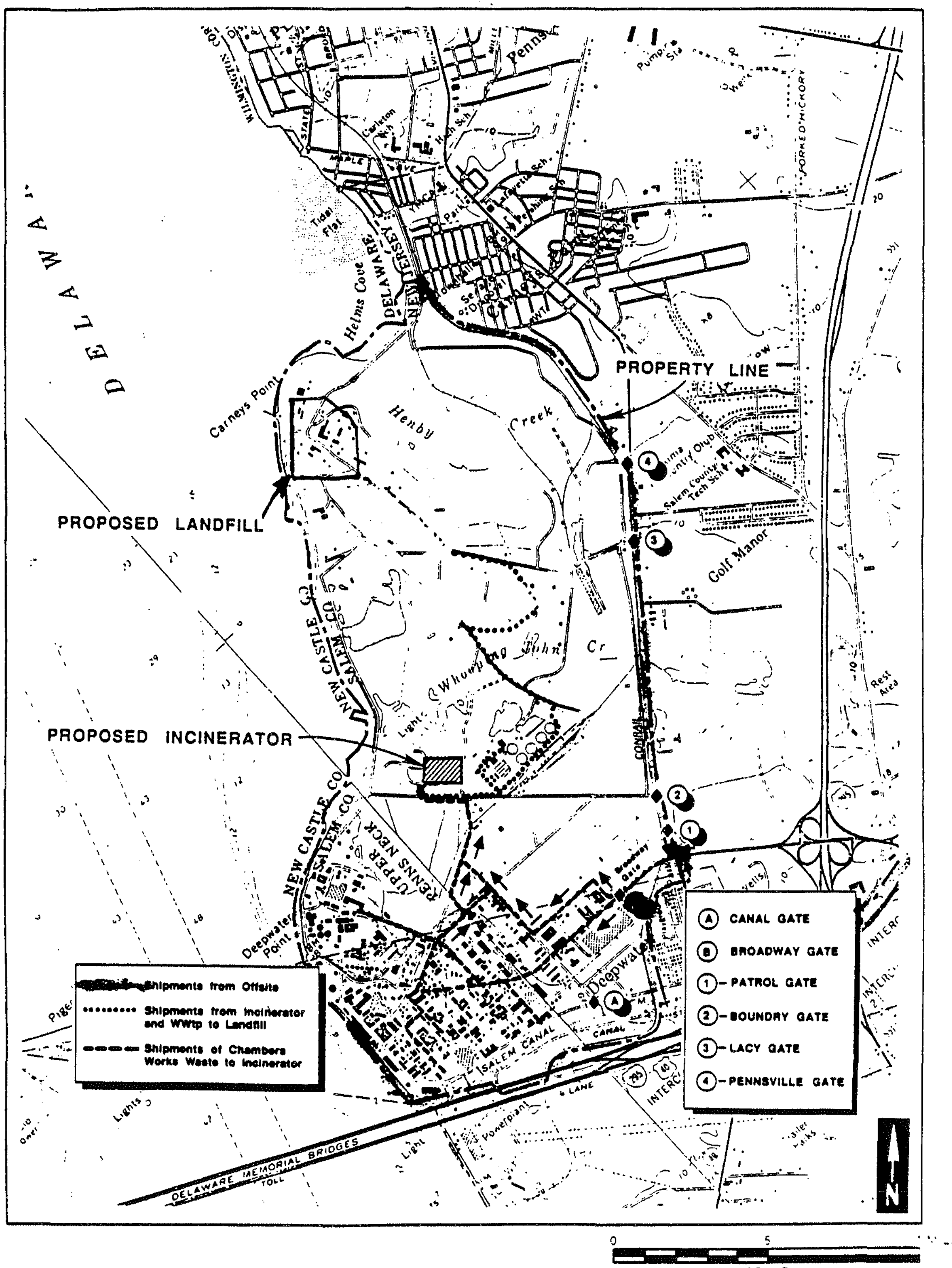


EXHIBIT 2-17

ON-SITE TRAFFIC ROUTES AND GATE LOCATIONS



The principal route from the Waste Water Treatment Plant and the Incinerator is along Boundary Road to Clarifier Road and out Plant Road to the landfill. Additional trucks carrying construction rubble or contaminated asbestos proceed from the generating area and head along either the Ponsol road or Sandblast Road to Plant No. 1, Patrol, and Clarifier Road to the landfill.[46,47]

All trucks and equipment used at the landfill area are washed in the truck wash before leaving the landfill and returning to the plant.[48] The water will be heated for freeze protection. Wastewaters generated during washing operations are recycled to the waste water treatment system via sumps.[49]

2.4.2.2 Wastes Destined for the Incinerator. Tank trucks entering the plant and destined for the proposed incinerator first check in and are weighed at the plant weigh station. The tank trucks then proceed directly to the incinerator for direct burn or unloading bays in the tank farm area, where the contents of the trucks are sampled for compatibility with the current contents of the designated receiving tank. Materials found to be incompatible are routed to the direct burn bay or temporarily stored in the Chemical Waste Area of the Chambers Works if direct burn is unavailable. If the incinerator is inoperable, the truck is sent back to the generator or to a RCRA permitted Chambers Works container storage area for temporary storage.[50] All truck shipments to the facility are managed to segregate incompatible materials as required by 49 CFR 177.848.

All the waste tanks at the tank farm and container storage areas are blanketed by nitrogen to prevent explosive mixtures in the gas phase of the tanks. All unloading to the storage tanks is done under nitrogen blanket. A pressure regulator furnishes nitrogen under a minimum of 3 inches water pressure to each tank. Any emissions during unloading are vented to the afterburner chamber or to a set of carbon adsorbers. The pressure setting of the conservation vent is set at approximately 10 psig to assure that the tank only vents during its filling cycle and not during normal daily cycles due to heating and cooling of the tank and its contents. The vacuum setting is set at one to two inches of water. Additionally, each tank is protected by a rupture disk and a relief valve.

Containerized wastes are received at the container storage building in box trailers or flatbed trucks. The containers may range from small boxes of materials to 85-gallon drums; it is anticipated that 55- and 35- gallon steel, plastic and fiberpack drums will be routinely received. Upon arrival, the containers are inspected and if approved, the shipment is sampled. Once accepted, all containers are labelled to identify its compatibility group, contents, date received, and other information from the manifest. The labeled containers are then moved by forklift either to storage or the appropriate processing station, such as the liquids removal station. Wastes that are not compatible with one of the four designated storage areas are not placed in storage, but are fed directly to the kiln. Wastes that are not compatible with the incinerator feed equipment are refused.[51]

2.5 WASTE MANAGEMENT

This section provides a brief description of the numerous administrative and operational procedures and systems that will be established at the new incinerator and landfill with regard to waste management. The topics that are discussed include security; record keeping; emergency prevention, preparedness, and response measures; notification of releases; training, and health and safety.

2.5.1 Security/Access Control[52]

Chambers Works has established several engineering and operational provisions to ensure the security of the entire plant as well as the proposed incinerator and landfill. The Chambers Works property is surrounded by an 8-foot chain link fence that is topped with barbed wire and displays "No Trespassing" signs. Access is controlled by gates that are either guarded or locked and kept under surveillance by means of closed circuit cameras, that are monitored at the Emergency Control Center (ECC). Plant access is controlled by the use of photo identification badges; visitors must register with a receptionist and receive a visitor's pass to enter the plant. The Protection Division is responsible for security and operates a 24-hour trained security force. Two-way radios link the security force to the ECC at all times. Security personnel man access gates, monitor traffic, and routinely patrol the facility. Fences, gates, and surveillance cameras are inspected regularly to ensure proper functioning.

With regard to security at the incinerator, the incinerator and tank farm will be surrounded on three sides (fourth side is the incinerator access road) by a 6-foot chain link fence topped with barbed wire. Three surveillance cameras will be positioned along the periphery as well as approximately 40 lights that will illuminate the area. Intruders can also be detected by means of approximately five process monitoring cameras located throughout the incinerator site. The Chambers Works security force will also patrol the area during their rounds.

Security at the landfill will be provided by a surveillance camera and area lighting. The Chambers Works security force will monitor the area during routine patrol, as well.

2.5.2 Record Keeping

A comprehensive record keeping system will be established for both incinerator and landfill operations. A proposed system for documenting all incinerator and landfill operations has already been established as well as a proposed system for storing the records. Records will be completed and filed for all aspects of the operation including equipment acceptance tests and inspections; hazardous waste acceptance, receipt, and disposition; analytical sampling; kiln operations; site inspections; maintenance; training; safety and health; and administrative activities.

The following list provides a representative sampling of the numerous records that will be completed and stored:

- Waste Approval Sheet
- Waste manifests
- Manifest Discrepancy Report
- Waste Transportation Order
- Notice of Out-of-Specification Waste
- Waste Characterization Form
- Waste sampling and analysis records
- Fingerprint analysis records
- Material Safety Data Sheets
- Incinerator Daily Inspection Log
- Storage Tank Daily Inspection Log Sheet
- Hazardous Waste Training Record
- Tank system proof-testing certification statements[53]

Additional information regarding record keeping for specific operations can be found in Sections 2.1.4 and 2.2.3 as well as other sections of this "Description of Proposed Hazardous Waste Units."

2.5.3 Emergency Prevention, Preparedness, and Response Measures

The description of emergency prevention, preparedness, and response measures will cover the topics of contingency plans, fire and spill prevention, detection and warning, on-site evacuation, fire protection, response equipment, and the Chambers Works response system and associated operations.

2.5.3.1 Contingency Plans and Procedures. Chambers Works will use several contingency plans and procedures for chemical releases or fires that occur at either the incinerator or landfill. The main contingency plan, used throughout the plant, is the "Discharge Prevention, Containment or Countermeasure (DPCC) Plan," which includes a separate "Discharge Clean-up and Removal (DCR) Plan." The DPCC Plan covers responsibilities of plant personnel, reporting of emergencies, engineering practices, security, monitoring, training, inspections, and maintenance. The DCR Plan addresses spill cleanup procedures, mitigation agents, the use of outside contractors, and waste disposal.[54] Another contingency plan is the "Contingency Plan for Secure Landfill" which discusses emergency coordinators, emergency equipment, emergency procedures, reporting procedures, and training.[55]

Procedures and guidelines that will also be used for chemical releases or fires include "Chambers Works Spill Control Safety Guidelines," and "Transportation Emergency Response Procedure (TERP)." The latter will be utilized for transportation accidents on and off the plant site that involve trucks or railcars carrying wastes destined for the incinerator or landfill.[56] The guidelines manual addresses the topics of training, spill reporting, mitigation actions, protective gear, cleanup and decontamination, and documentation.[57]

2.5.3.2 Risk Management Program. Chambers Works has a current risk management program (RMP) for the purpose of minimizing extraordinarily hazardous substance accident risks. This RMP is in compliance[58] with the Toxic Catastrophe Prevention Act Program regulations NJAC 7:31 et seq. The facility may need to modify and update the existing RMP as a result of the construction and operation of the proposed incinerator and related material handling and storage areas. At the outset, it is conceivable that the proposed incinerator and the related air pollution control equipment will need to be included in the existing RMP since ammonia which is on the list of Extraordinarily Hazardous Substances (EHS) will be used in the NO_x emission reduction system.

Du Pont has indicated that the existing RMP will be modified and updated to include all the operations and equipment that may be subject to the requirements of NJAC 7:31 et seq., as a result of the proposed expansion.

2.5.3.3 Fire, Spill and Leak Prevention. The incinerator and landfill will be engineered, equipped, and operated to prevent accidents and minimize potential human health and environmental hazards. Engineering systems and operational/administrative procedures for preventing accidents are discussed below.

Engineering Systems

The tank storage area is designed and will be equipped to prevent ignition and reaction of incompatible materials. Each tank will be equipped with a submerged anti-static fill line to reduce the potential for explosions. To prevent explosive mixtures in the vapor spaces, tanks will be blanketed with non-flammable nitrogen. Pressure releases from the pressure/vacuum valve will be vented to the kiln, ABC, or to carbon bed adsorbers when the kiln is not operating. In addition, all electrical components (e.g., pumps, agitators, instrumentation, controls, etc.) associated with the tanks will comply with the requirements for the National Electrical Code Class I, Division 2, Group D classification, as a minimum.[59] To prevent overfilling, all tanks, regardless of content, will be equipped with level indicators and high level shut-off switches to shut-off unloading pumps and inlet block valves when the tanks are full. All tanks will be grounded and will have lightning protection.[60]

The incinerator itself will be equipped with numerous fire, explosion and release prevention systems and devices. Kiln explosion prevention devices will include double block valves and bleed lines that prevent accidental introduction of materials into the kiln. In addition, the kiln will be operated under negative pressure to continually remove accumulations of gases and to prevent the buildup of explosive concentrations.[61] The incinerator will also be equipped with several redundancy and backup provisions as part of the safety design to prevent accidental releases and explosions. Key provisions include the following:

- Temperature measurement in the kiln and afterburner
- Level indicators
- Flow measurement
- Pressure measurement in the afterburner and scrubber
- Check valves in critical systems
- Process and emergency pumps
- Stack analyzer systems
- Emergency shut-down controls
- Carbon absorption beds
- Emergency cooling water
- Waste feed shut-off valves[62]

The latter three systems are described in Section 2.1.3. The effectiveness of the above mentioned systems will be discussed in detail in Section 5.

The truck unloading area is designed and will be equipped to prevent fires and releases. Prior to unloading, trucks wheels will be chocked and the truck will be grounded with grounding cables. In addition, tank trailers will be connected to a nitrogen system to blanket the vapor space and minimize fire hazards. As with storage tanks, pressure releases will be vented to the kiln or to a carbon bed adsorber when the kiln is not operating.[63]

Engineering controls for fire and release prevention in container storage and handling areas include vent systems, nitrogen blanket system, high level shut-offs, and carbon adsorbers. The vent systems will be present in the sampling area, repackaging area, de-heading/resealing area, and liquid removal station. They will route fugitive emissions to the kiln for incineration. If the kiln is not operating, liquid removal and drum de-heading/resealing will not occur. Sampling operations, however, can occur even when the kiln is not operating because fugitive emissions can be vented to carbon adsorbers. At the liquid removal station, nitrogen blankets are utilized to minimize fire hazards present in the waste holding tanks. Level indicators and high level shut-offs are used in the holding tanks, as well. During thaw box operations, any fugitive emissions given off from heated drums will be contained by individual carbon adsorbers placed in the drum bungs.[64]

Engineering controls for containing spills in the tank farm, container storage area, truck unloading area, and railcar unloading area are discussed in Section 2.1.2. Any spills that occur at the incinerator will be contained within diked areas or sumps. Trucks and railcars en route to the incinerator and landfill present the only real possibility of uncontained spills. Spills of this nature are covered in contingency plans and procedures.

Run-on and runoff containment systems at the landfill and truck wash station are discussed in Section 2.2.2.6.

Operational/Administrative Procedures

Operational/administrative programs and procedures that Chambers Works will employ in an effort to prevent accidents at the incinerator and landfill include:

- A comprehensive safety program
- Area-specific RCRA training programs
- Standard operating procedures for waste acceptance, handling and storage
- Inspection and maintenance program

Incinerator and landfill personnel will receive training in health and safety procedures and preventive and emergency measures, as necessary for the employee position and work area. The training will encompass the nature and characteristics of hazardous wastes, the proper use of personnel protective equipment, and operating and contingency procedures. This training is intended to ensure that all employees working with hazardous wastes are knowledgeable of the hazards and risks, thereby promoting a safe working environment and preventing accidents.[65]

The training program will outline safe operating procedures for both the incinerator and landfill. Chambers Works has standard procedures for handling hazardous wastes and for loading and unloading containerized, tank, and rail car shipments of hazardous materials and wastes. Included in the procedures is a loading/unloading checklist and requirements chart, available as a quick reference to reinforce hazardous materials handling precautions. These procedures are instructed in the training program and documented in the Safety How manual. Training is covered in greater detail in Section 2.5.5.[66]

Smoking is not permitted on the Chambers Works plant except in designated areas; "No Smoking" signs are posted at frequent intervals to remind personnel and visitors of the smoking policy. Only spark-proof equipment will be used at incinerator and landfill to prevent accidental ignition or reaction of stored or processed wastes.[67]

Waste pre-acceptance and acceptance procedures are designed to ensure proper identification, and thereby safe management of ignitable and reactive wastes. All wastes will undergo chemical and physical analyses before they are approved for incineration or landfilling. The waste identity will be verified before wastes are accepted at the facility, consistent with the procedures outlined in the Chambers Works waste acceptance and analysis plan.[68]

Inspection and maintenance are key components of the fire/spill prevention program. The incinerator site, including all tanks, vessels, piping, and containers, will be inspected once per 12-hour shift, at a minimum.[69] Unloading areas will be inspected daily or weekly, as appropriate for the level of activity and type of operation.[70] Personnel will look for deterioration, malfunction, tampering, and potential leaks. In addition, monitoring and security devices will be inspected daily,[71] and safety and emergency equipment will be inspected at least monthly.[72] The landfill will also be inspected regularly, with the leachate pumping system, leak detection system, and exposed surface of the landfill being inspected daily.[73] Inspection forms will be completed and kept on file for a minimum of three years. If problems are discovered during an inspection, a work order for repairs will be prepared and submitted to the maintenance, electrical or mechanical department, as appropriate. If there is an imminent hazard, repairs will be made immediately, whereas non-emergency maintenance will be scheduled as required.

2.5.3.4 Detection and Warning. Fires, leaks, and spills at the incinerator can be detected by in-place detection devices or by human senses. For tanks, level alarms, monitored in the Central Control Room (CCR), will be used to signal leaks or spills. Alarms, monitored in the CCR, serving each of the sumps will be activated when liquid collects within. Sumps will also be equipped with removable covers, inspection ports, and lights to facilitate manual inspection of any accumulated liquid. For fires, smoke detectors will be located in the Office Building and in the Instrument Equipment Room of the ECR Building.[74]

Detection and notification of releases to the atmosphere will be aided by portable air monitoring instruments and the Systematic Approach for Emergency Response (SAFER) computer system. The ECC operator enters the chemical name, rate and size of release, and meteorological data provided by the plant meteorological tower. SAFER then calculates the path and concentration of the vapor cloud and provides pre-planned instructions to the ECC.

When an emergency occurs, the discoverer can warn others by activating an outside evacuation/fire alarm having a 95-100 dBA sound output. Such alarms will be installed at the following incinerator locations: laboratory, container storage and handling area, tank farm, both sides of the incinerator building, and the existing truck turnaround area.[75] Each building or enclosed area will also be equipped with an internal alarm (i.e., horn, buzzer, or bells) that will be activated, if applicable.[76] The emergency will then be reported to the Emergency Control Center (ECC) by phone or transmitted by means of a fire alarm box, at least seven locations throughout the incinerator site. Emergencies at the landfill can be reported by phone in the trailer/office or transmitted by the fire alarm box next to the trailer. During evacuation, emergency messages can be announced to personnel by means of a public address system.[77]

Upon notification of an emergency, the ECC Emergency Response Technician activates a plant-wide alarm, however, if landfill personnel cannot be notified of an emergency in this manner, the ECC will notify the nearby WWTP Control Room Operator to drive to the landfill and alert personnel.[78] Area control centers throughout Chambers Works are then activated and radio communication between the centers is established. At this same time, security personnel cordon off the affected area and, if necessary, prevent traffic from entering the plant.

2.5.3.5 Evacuation. In the event of a fire or chemical release at the incinerator site, personnel will report to the primary rally point, which is the Office. This rally point will be equipped with escape masks (i.e., short duration respirators) to aid in escape from the incinerator site, if necessary. If the Office does not provide a safe haven, then announcements over the public address system will be made to inform personnel where to evacuate.[79]

If other hazardous waste management areas at the plant need to be evacuated in addition to the incinerator site, personnel will report to designated rally points within their area unless otherwise instructed.

2.5.3.6 Fire Protection. Fire protection at the incinerator consists of fire resistant construction, in-place automatic suppression systems, water supply, and equipment for manual firefighting. The landfill is not equipped with fire protection systems and equipment, except for extinguishers, due to the extreme unlikelihood of a fire ever developing due to the materials present.

From a structural standpoint, the incinerator and container storage building, as well as other enclosed hazardous waste management areas and ignitable or reactive chemical process areas, will be constructed of fire resistant walls and partitions. Fire doors will also be used.[80] In this regard, the incinerator is being designed to meet or exceed all requirements of the New Jersey Uniform Construction Code.[81]

Automatic systems at the incinerator include water sprinkler systems and halon systems. These systems, in conjunction with fire resistant structural features (e.g., firewalls), are designed to control fires and limit fire spread. Automatic sprinkler systems will protect the front wall of the kiln, container storage building, container feed building, lab, shop, and office as well as the tank truck unloading area.[82] Halon 1301 suppression systems will serve areas that cannot be protected by water due to the presence of electrical equipment. These areas include the Central Control Room in the Office Building, Instrument Equipment Room in the ECR Building, and the Analyzer Room in the Air Compressor Building.[83] All automatic fire suppression systems will be designed and installed in accordance with National Fire Protection Association Standards.[84]

The water supply for fire suppression operations consists of a six inch underground main located around the periphery of the incinerator site, from which several branch lines extent inward into key areas in the site. There are six hydrants located on the periphery main and three additional located at strategic positions within the incinerator grounds. Each hydrant will be equipped with a hose box containing 200-250 feet of 2-1/2 inch hose with a nozzle.[85] Post indicator valves, which indicate whether a valve/line is open or closed, are located along the periphery main and at key locations at the site.

The tank farm will be protected by two in-place monitor nozzles, one on each side of the tank farm. Each monitor will be capable of flowing 500 gpm, and the water streams should reach a distance of 150 feet. The streams are expected to carry over the highest tank (31 feet, 6 inches) easily, and be able to overlap by approximately 50 feet towards the center of the tank farm.[86]

Sufficient water pressure and volume are available to control fires that may occur. An incoming water treatment plant at Chambers Works has a 400,000 gallon storage capacity. Additional supply is available from a 150,000 gallon elevated tank near the Power House and a 750,000 gallon water storage tank on Ponsol Road near the Polymer Products Department.[87]

Pressure in the water mains is maintained by five pumps at the water treatment plant with a total pumping capacity of 10,100 gpm. Three auxiliary pumps, located near the 750,000 water storage tank, maintain water pressure in the event a water treatment plant pump fails or is otherwise out-of-service. Auxiliary pumps have a rated capacity of 2,500 gpm each. In the event of a fire, the pumps will feed the fire main at 125 psig.[88] In addition, the incinerator facility itself has a 500,000 gallon process/fire water storage tank, with 400,000 gallons dedicated for firefighting. Two fire pumps at the incinerator site will supply water to the fire water mains at up to 2000 gpm (each) if the pressure in the main falls below 125 psig.

Fire suppression services for the incinerator and landfill sites will be provided by the Chambers Works Fire Department, Permanent Fire Brigade, and the local fire brigade that serves Fire Brigade Zone #7 (where the incinerator and landfill are located).[89] Fire suppression services are discussed in Section 2.5.3.8.

2.5.3.7 Emergency Response Equipment. Equipment for emergency response will be available at both the incinerator and the landfill and from other locations throughout the plant. Response equipment at the incinerator will include personal protective equipment, spill cleanup equipment and materials, fire extinguishers, fire hoses, and in-place monitor nozzles. The landfill will be equipped with fire extinguishers and personal protective gear, most of which will be stored in the landfill trailer.

Other Chambers Works equipment that would be available for incidents at either the incinerator or landfill includes specialized leak and spill control equipment, air and liquid monitoring devices, protective gear, portable power and lighting equipment, and mechanical equipment (e.g., backhoes, cranes, etc.).

The Chambers Works Fire Department operates two fire suppression response units as follows:

- A 1000 gallon per minute (gpm) pumper with 750 gallon booster tank, plus equipment; and

- A 1000 gpm pumper with a 1000 gallon foam concentrate tank and proportioner for foam delivery, and also a 2000 lb supply of dry chemical with nitrogen gas bottles for distribution.[90] Foam that is carried includes National Foam Hazmat Foam #2 for acid spills and Universal Foam and high expansion foam for firefighting.

The Chambers Works Transportation Emergency Response (TERP) Team operates four response vehicles which are described below:

- CW-132 - Truck equipped with capping devices, plugs, patches, generator, Level A and B personal protective gear, and a cellular phone.

- CW-333 - Communications vehicle equipped with communication devices for use inside Level A protective gear and a cellular phone with a data link. The data link can access over 8000 Material Safety Data Sheets from Du Pont, the Computer-Aided Management of Emergency Operations (CAMEO) system, the "Hazard Line" database, and the Chemical Transportation Emergency Center (CHEMTREC).

- U-2 - Trailer equipped with capping equipment, transfer pumps, and an air cascade system for breathing apparatus.

- U-1 - Special compressor with appropriate piping for off-loading bulk chlorine containers.[91]

The Chambers Works Medical Department operates an ambulance service consisting of two ambulances (one serves as backup). The ambulances are staffed by registered nurses and first aid-trained drivers.[92]

Chambers Works also has a mobile control center that can be used in the event of a major incident. The unit is operated by the Protection Division (i.e., security) and can be positioned at the scene of an incident.[93]

2.5.3.8 Response System and Operations. Chambers Works maintains fire, spill, and emergency medical response teams that are available on a 24-hour basis. The Fire Department, or Emergency Response Force, is composed of four full-time staff (a Chief and three officers) per shift. The Fire Department is assisted by the Permanent Fire Brigade which is composed of five or more fire suppression-trained Chambers Works employees (per shift) who can be called upon as needed. The Fire Department is also assisted by a network of seven local fire brigades located throughout the plant.[94] The overall fire suppression force (i.e., all shifts combined) includes 18 full-time and 32 part-time fire department personnel and 150 local/area fire brigade members.[95] A fire or chemical release at the incinerator or landfill would likely involve the response of the Fire Department, Permanent Fire Brigade, and the fire brigade from Fire Brigade Zone #7.

If the emergency involved a container, the Chambers Works Transportation Emergency Response (TERP) Team would also respond. The TERP Team is comprised of nine specially trained Chambers Works employees, three of whom are assigned full-time to hazardous materials response and training activities. The team assists in the containment, confinement, and transfer of chemicals leaking or spilling from containers, with the exception of radioactive, explosive, and PCB-containing materials (which will not be accepted at the incinerator or landfill). The TERP Team will respond not only to plant emergencies but also to off-plant transportation emergencies within 300 miles of Chambers Works.[96] When Du Pont vehicle are involved in off-plant accidents, the TERP Team from the closest Du Pont facility responds and is then supplemented by the better equipped Chambers Works TERP Team.[97]

When injuries occur, the Chambers Works Medical Department can provide on-scene emergency medical care, and, if necessary, can transport injured persons to the Chambers Works Industrial Medical Clinic or off-site hospital for treatment. In addition, Chambers Works can call upon emergency response resources (i.e., fire, emergency medical, and law enforcement) from the surrounding townships, when necessary, under mutual aid agreements.[98]

In the event of a fire or chemical release at the incinerator, trained personnel, under the direction of the area Emergency Coordinator, will initiate response actions in accordance with contingency plans, "Chambers Works Spill Control Safety Guidelines," and operational procedures in the Safety How manual. If the fire or release cannot be handled by incinerator personnel, the Emergency Control Center is contacted to request additional assistance. Depending on the type and magnitude of the problem, the ECC will dispatch one or more of the following Chambers Works response teams, as appropriate: Fire Department, Permanent Fire Brigade, Fire Brigade #7, TERP Team, and/or Medical Department (i.e., Industrial Medical Clinic). At an incident, the Fire Chief directs the actions of all emergency responders.[99] If the emergency is beyond the capabilities of Chambers Works response teams, emergency resources from nearby townships will be called upon to assist.

2.5.4 Community Notification of Releases

Chambers Works already has procedures and systems in-place for notifying nearby communities and the State of chemical releases. Whenever off-site human health or the environment are endangered, the Chambers Works Environmental Consulting Manager, or his designee, contacts both the New Jersey Department of Environmental Protection (NJDEP) and Salem County Office of Emergency Management (OEM). The Chambers Works Emergency Control Center has direct phone lines to each. Upon notification, Salem County OEM is responsible for coordinating response measures (i.e., evacuation, in-place sheltering, traffic control, etc.) in the local communities. Salem County OEM has direct radio and telephone links with local police and State Police, the NJ Office of Emergency Management, and the New Castle County, Delaware OEM.[100]

When releases are expected to impact the State of Delaware, Chambers Works will notify the Delaware River Bridge Authority and either New Castle County or the State Department of Public Safety, Division of Emergency Planning and Operations (whichever is contacted notifies the other).[101]

The Townships of Carneys Point and Pennsville in coordination with the Salem County OEM and the Du Pont Chambers Works, have established a warning system for the one-mile area surrounding the Deepwater Village area. This system, known as the "Community Alert System," is located just outside the Chambers Works facility and consists of a single siren device that produces a 125 dBC sound level output at 100 feet.[102] Upon verified notification of a hazardous material/waste incident that may pose a threat to the surrounding residents (because of an incident at the Chambers Works or on one of the major highways in the immediate vicinity), the dispatchers at the Salem County Communications Center will activate the siren. The sounding of the siren simply informs the residents in the area to seek shelter indoors and tune to an Emergency Broadcast Station for further information.[103]

In the event of a chemical release, the Chambers Works Emergency Control Center can utilize their SAFER computer system (refer to Section 2.5.3.3) to calculate the path and concentration of the vapor cloud. This information can then be forwarded to the Salem County OEM to assist them in making public protection decisions and planning contingency actions.

2.5.5 Training Program[104]

The personnel training program for the proposed new Chambers Works incinerator and landfill will be similar to the hazardous waste training program currently used for personnel handling hazardous wastes throughout the plant. All hazardous waste management personnel successfully complete a training program within 6 months of beginning, or assignment to, a hazardous materials handling job. The program is based on Du Pont and Chambers Works standards and guidelines that comply with 40 CFR 264.16(a)(1).

The training program is tailored to employees' positions and work areas. To provide the appropriate level of training, training requirements are determined by the area environmental coordinator, with guidance from the Environmental and Health Section of the Safety, Health, Environmental and Protection Division.

The incinerator training program, like the existing and future landfill programs, will consist of written components and classroom and field training. The incinerator field training will be incorporated in the equipment tests and trial burns, prior to start-up. Employee training progress will be audited via observation and/or documentation.

Training materials for the incinerator and landfill will encompass all areas of training, such as: operating instructions and procedures, safety and emergency equipment, accident prevention, equipment inspections and maintenance, regulations, Material Safety Data Sheets, and contingency measures. Safety and personal protective equipment, such as respirators, may be used in training as well as emergency equipment, such as fire extinguishers.

Employees will also be required to participate in annual refresher training to review initial training program components and to receive updates regarding new or revised procedures and equipment. Incidents during the previous year that required emergency action or implementation of contingency plans will be reviewed, as well, and methods of preventing similar occurrences will be discussed.

At the conclusion of each initial and annual refresher training session, the instructor will certify that the employee completed the required training.

Separate documentation will contain information regarding the type and date of training. All training records will be kept on file.

2.5.6 Health and Safety Program

To protect the safety and health of employees and visitors, the Chambers Works Safety, Health, Environmental and Protection Division has established a facility-wide health and safety program. This general program, in addition to programs that will be specific to the incinerator and landfill, will be implemented to protect personnel at both the incinerator and landfill sites.

All Chambers Works operating areas use a Du Pont program to promote the safe handling and distribution of hazardous materials/wastes. The program is called "RHYTHM" - Remember How You Treat Hazardous Materials. Employees go through initial RHYTHM training and attend refresher sessions annually. A part of the RHYTHM program is called "TERP," Transportation Emergency Reporting Procedure. This is a program for handling transportation emergencies involving hazardous materials. It provides information on procedures and equipment for assisting in the mitigation and clean-up of leaks and spills both on and off the Chambers Works facility.[105]

Chambers Works also uses a Du Pont safety and health manual, entitled Safety How, to provide instructions and procedures regarding daily operations as well as emergencies. Included in this manual are safety procedures that are applicable to operations that will take place at the incinerator and landfill. The following list provides a representative sampling of the numerous topics covered in Safety How:

- Fire prevention and protection
- Safety equipment (e.g., safety showers)
- Personal protective clothing
- Respiratory protection
- Safety signs and warning systems
- Handling injuries and illnesses
- Medical evaluation
- General health methods
- Safety and health rules
- Unloading/loading of tank trucks, tractor trailers and rail tank cars
- Chemical transfer
- Use of tools and handtrucks
- Handling drummed materials
- Incident investigation[106]

Safety and communications meetings are held regularly with all personnel to discuss current conditions, problems, unusual incidents or other items with regard to handling hazardous substances.[107]

In addition to the "Chambers Works General Safety Rules" and "Facilities Department Safety Rules," specific safety and health rules have been tentatively established for both the incinerator and landfill. These specific rules address topics regarding hazards, protective clothing and respirators, operations, hygiene, limited access areas, emergency procedures, and visitors.[108]

Another component of the health and safety program is the Chambers Works Medical Department that operates the Chambers Works Industrial Medical Clinic and ambulance service. The clinic is operated on a 24-hour basis and provides full service emergency medical treatment for Chambers Works employees. The clinic is staffed by physicians, nurses and technicians during the day and by nurses and technicians during off hours, with physicians on-call. The ambulance service is staffed by nurses and security officers trained in first aid procedures. Although the Chambers Works Medical Department has the capabilities to handle several patients with a variety of injuries, local emergency medical services and hospitals will be used when necessary (e.g., patient requiring special treatment at a burn center, mass casualty incident, etc.).[109]

2.6 PROJECT CONSTRUCTION

Project costs, schedule, work force, and equipment associated with the incinerator and landfill are described in this subsection. In addition, the number of workers expected to be hired from the local area is discussed.

2.6.1 Construction Activities and Equipment

Projects proposed for the Du Pont Chambers Works Plant include a rotary kiln incinerator and a hazardous waste landfill. Constructing these two projects is expected to cost approximately $100 million. The projects will require an increase in the size of the work force at the site, an increase in the number of construction vehicles, increased water demand (less than 500 GPM) and increased electric demand (10,000 KVA) during operations. The proposed landfill will consist of an approximate total of 27 acres of land while the incinerator and associated facilities and roads will require approximately 15 acres of land.

The following is a list of equipment needed for the incinerator and landfill during construction and operations. Equipment estimates are peak numbers and will vary according to the phase of construction.

Construction Equipment-Incinerator

- 240 personal vehicles
- 100 trucks/day hauling fill
- 10 trucks- miscellaneous activity
- 10 cranes
- 10 manlifts
- 4 fork trucks
- 4 payloaders

- 3 bulldozers
- 3 scrappers

Construction Equipment-Landfill

- 150 trucks/day hauling fill
- 10 trucks-miscellaneous activity
- 2 bulldozers
- 3 scrappers

Operations Equipment-Incinerator

- 25 personal vehicles
- 8 trucks/day delivering waste
- 5 trucks-miscellaneous operations and maintenance activity
- 10 trucks per day delivering ash to landfill

Operations Equipment-Landfill

- 20 trucks/day from waste water treatment plant*
- 10 trucks/day from incinerator
- 2 trucks/day miscellaneous*
- 1 loader*

Operations Equipment- Landfill

- 1 D-5 dozer*
- 1 D5H dozer*
- 1 compactor*
- 1 backhoe*

* same as existing landfill

2.6.2 Construction Schedule and Work Force

Construction on the incinerator is expected to last approximately 30 months. The incinerator will require approximately 275 workers during the peak construction period. Construction personnel will be hired by contractors (selected through competitive bid) for both jobs. The number of workers hired from the local area will depend largely on the contractor selected. The peak will last 9 to 12 months out of the 30 month construction phase of the project. During the non-peak months of the construction phase, approximately 150 to 175 workers will be employed. Most of these workers will not be on-site throughout the 30-month duration. The mix of jobs during construction requires many different types of skills and the average duration for construction employment is expected to be about six months. Thus, like most construction projects, the work force will be largely a temporary one. Approximately 50 production and maintenance personnel will remain on-site.

Construction on the first cell for the proposed landfill is expected to begin in 1991. A new cell will be added each year or as necessary to construct four cells by the second quarter of 1996. The proposed landfill will begin operating in the second quarter of 1992 when construction of the first cell is completed. Landfill construction and operations will be intermittent. Construction occurs 6 to 9 months each year for approximately five years. Operations occur throughout the five year period and continue beyond year five. Employment during landfill construction is expected to be minimal, requiring about 25 workers. Landfill operations will require no increase in work force over current levels.

The maximum number of additional workers to be employed at one time (for both proposed projects) during construction is 300 workers. Typically workers for projects at the Chambers Works plant have been drawn from the surrounding area including New Jersey, Pennsylvania, Delaware and Maryland. Operations and maintenance personnel are expected to come from the local area.

2.7 CLOSURE AND POST-CLOSURE CARE

In this subsection the closure and post-closure care plans for the incinerator and associated waste storage areas as well as for the landfill are discussed.

2.7.1 Incinerator and Waste Storage Areas

This section summarizes the closure and post-closure care plans for the proposed incinerator and waste storage areas.[110] It provides technical details of closure and post-closure care and procedures for decontamination of the incinerator and waste storage areas. The plans are designed to allow separate closure of the incinerator, tank storage, container storage, and other areas of the Chamber Works plant. However, it is expected that the waste handling units will be closed concurrently.

2.7.1.1 Closure Plan. Du Pont will conduct a clean closure of the incinerator and waste storage units. All equipment and buildings will be cleaned and decontaminated to the level required for their final disposal method (e.g. scrap, clean fill, etc.).

Background soil samples will be collected and analyzed. Samples adjacent to the unit's location will be taken at the time of closure; if there is no statistical variation from the background samples, then Du Pont will consider no cleanup necessary, otherwise Du Pont will conduct a health-based risk assessment to ascertain whether the contaminant levels present a significantly different health risk than do the background levels.

Disposal of Wastes

At the time of closure, hazardous wastes still in the facility will be incinerated in the proposed incinerator, disposed in the proposed landfill, and/or treated at the WWTP. These units will be operated using normal acceptance and operating procedures. If these units are unavailable, other approved RCRA facilities will be used.

Waste feeds will be burned in the incinerator using normal procedures until all the waste in the waste storage units has been incinerated. Wastes generated in the decontamination procedures for the waste storage units and waste feed systems will also be incinerated. After the incinerator shutdown, the solid contents of the wet deslagger will be disposed at the proposed landfill following normal procedures. The ash dumpsters will be used for this process. The liquid from the wet deslagger and the air pollution control train will be treated at the WWTP.

Decontamination

Storage tanks and associated equipment will be decontaminated using a four-step process: 1) removal of residual sludge from the tank or part; 2) rinse with solvent; 3)purge with gas; and 4) rinse with detergent. Sludge will first be pumped out of the tanks and equipment. Any non-pumpable sludge will be vacuumed out. After an inspection ensuring complete sludge removal, the feed lines to the tank will be flushed with a suitable solvent. The solvent, totalling 10% by volume of the tank and respective lines, is collected in the tank and pumped through the incinerator feed lines to the kiln for incineration. This rinse is followed by a nitrogen or steam purge. A solvent rinse using a rotating spray nozzle in the tank to ensure coverage is performed, followed again by a gas purge. Finally, the tank and process lines are flushed with water/detergent to remove any traces of the solvent.

The containment areas and the waste handling equipment in the tank and container areas will be decontaminated by removal of residue by scraping and/or vacuuming, and, if needed, followed by spraying or scrubbing the surfaces with water and detergent until visibly clean. The variations include sandblasting or steam cleaning and/or removing parts by disassembling, cutting, or breaking the equipment to achieve visible cleanliness. Surfaces and equipment that have been contaminated with water-reactive contaminants may be rinsed with appropriate solvent prior to the water/detergent step above.

Carbon adsorbers in the vent lines will be removed and the spent carbon incinerated. Adsorber containers will be manually scrubbed with water/detergent. The vent systems will be purged with steam equivalent to 10 times the system's volume. The steam will be directed to the incinerator. As stated earlier, wastes generated in the decontamination process will be incinerated in the proposed incinerator or treated in the WWTP.

After all of the decontamination wastes have been incinerated, the incinerator will be shutdown and cooled in accordance with standard procedures. Refractory and ash will be removed from the incinerator and associated equipment and ductwork and disposed in the proposed landfill. The packing from the condenser will also be removed, packaged, and disposed in the landfill. The incinerator and associated equipment and ductwork will be decontaminated using the same two step process as outlined above. The waste generated in the incinerator decontamination procedures will be directed to the WWTP.

The saturator and other air pollution control equipment will be operated with clean water and ambient air to decontaminate the system. After draining the condenser and removing its packing, the liquid sumps will be inspected for residual sludge which will be disposed in the landfill or packaged for off-site disposal.

Although the induced draft fan, stack, and ductwork from the mist separator should not be contaminated, they will be inspected for residue and decontaminated, if necessary. The wastes generated during the decontamination will be disposed at the WWTP.

Potentially contaminated tools and clothing will be packaged and disposed in the proposed landfill.

Decontaminated equipment with potential for reuse (e.g., fans, conveyors, tanks, etc.) will be sold for reuse or reused by Du Pont. Other decontaminated equipment will be sold as scrap or disposed as construction debris. All contaminated equipment will be disposed as hazardous waste in approved RCRA Subtitle C facilities.

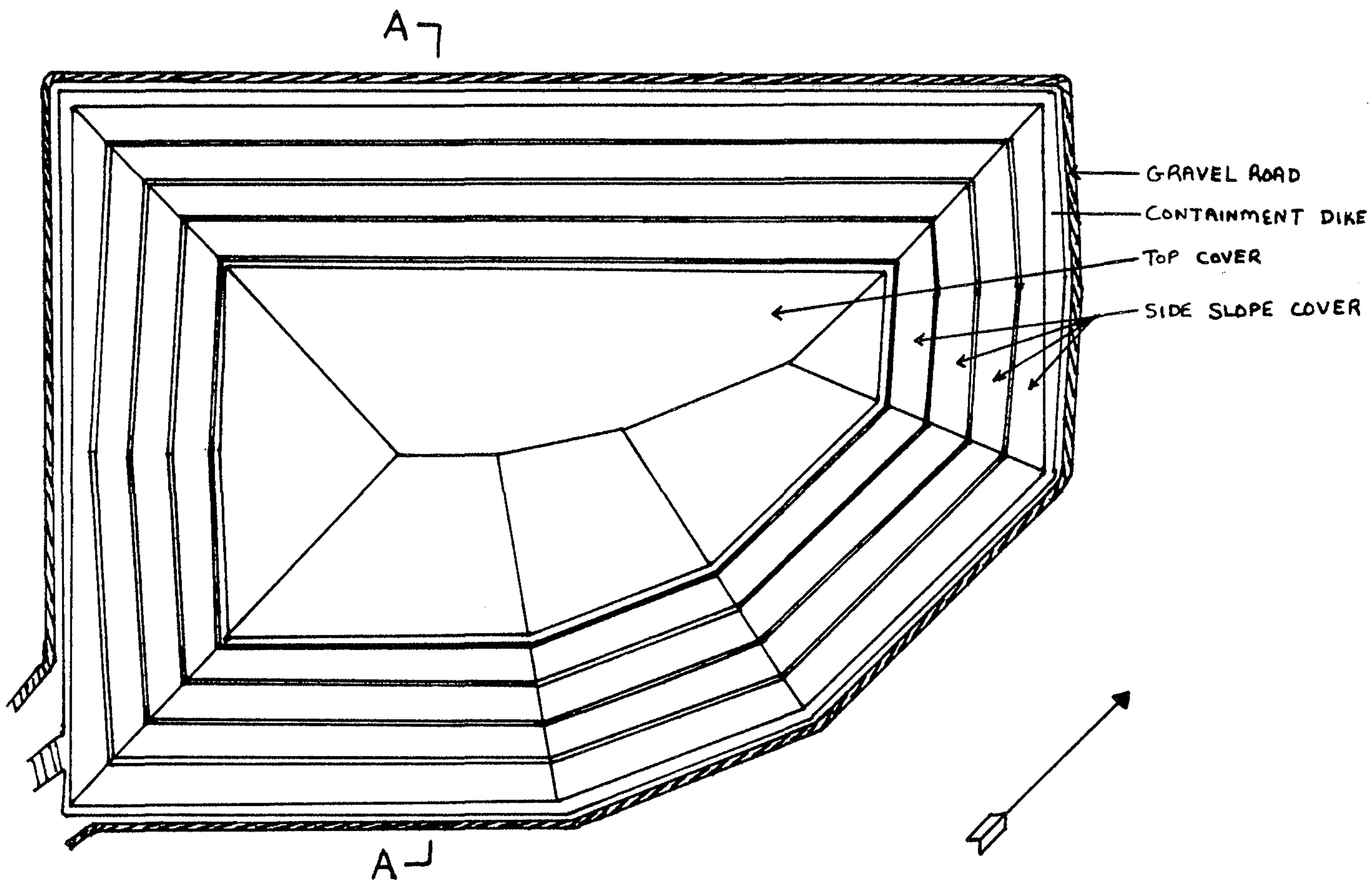
2.7.1.2 Post-Closure Care. After the incinerator and waste storage units have been closed pursuant to the closure plan, Du Pont will not need to provide post-closure care. Since all of the wastes, equipment and contaminated soil will have been removed, there will be no hazardous constituents in the area that will require containment. Therefore, there will be no containment structure that will require maintenance and inspection, and no need for monitoring for release and migration of hazardous constituents.

2.7.2 Landfill

Du Pont has developed a plan to close the landfill and to conduct post-closure activities.[111] Objectives of the plan are to isolate the landfill from the environment and to minimize leachate generation, thereby mitigating potential threats to human health and the environment. This plan has been developed in accordance with the Hazardous and Solid Waste Amendments of 1984 to the Federal Resource Conservation and Recovery Act and in compliance with NJDEP requirements. Closure is projected to start 30 years after commencement of filling operations. If operations at the proposed landfill begin when the proposed incinerator comes on-line in 1992 as planned, closure will start in 2022; the actual start date for closure will depend upon filling rates for the landfill. Closure will take 18 to 24 months, and post-closure activities will be ongoing after closure is completed. Exhibits 2-18 and 2-19 illustrate the landfill after closure.

EXHIBIT 2-18

AERIAL VIEW OF PROPOSED LANDFILL AFTER FINAL CLOSURE

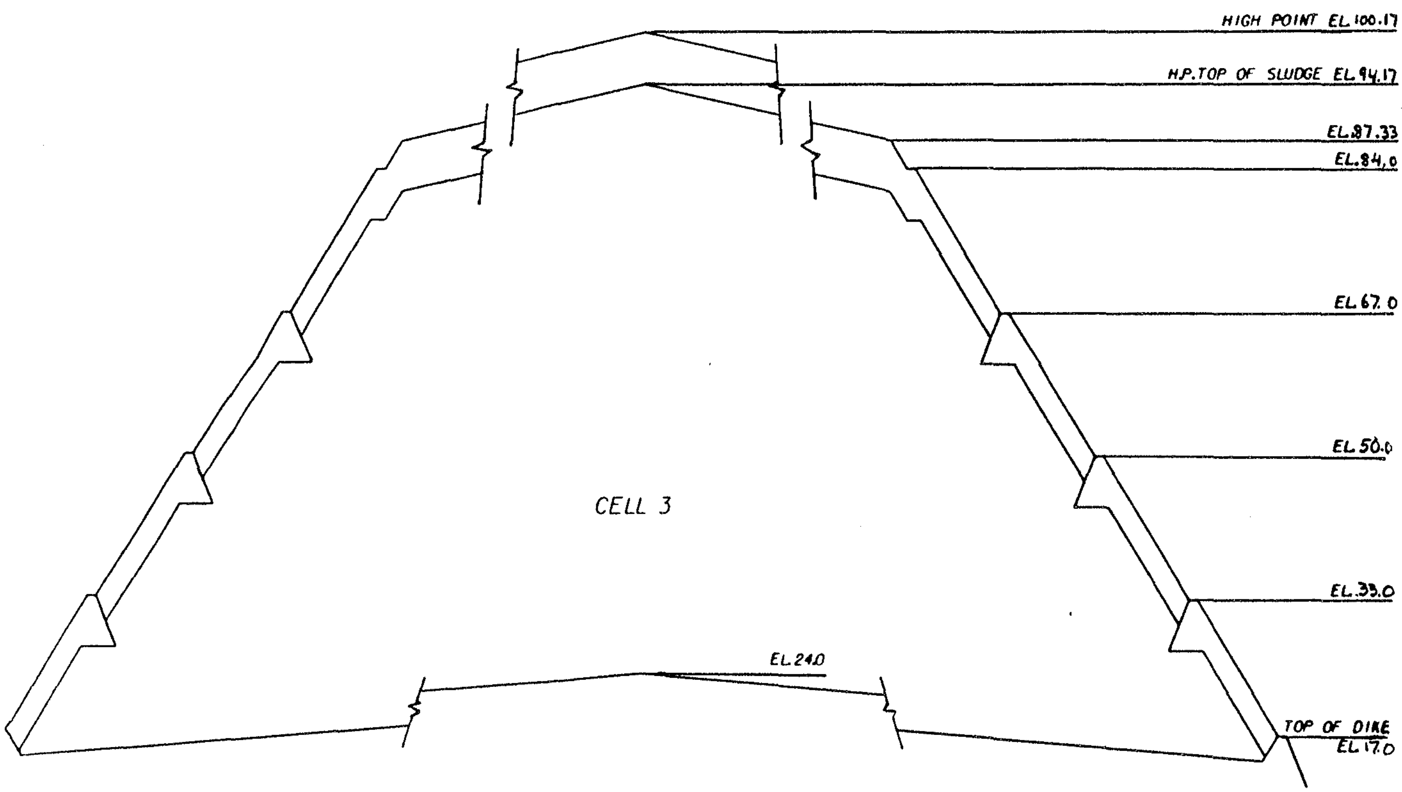


Source: Adapted from Chambers Works Pollution Abatement Facilities Sludge Landfill Ultimate Closure Plan @ Sect. Civil, Drawing No. W1041907 and Chambers Works Pollution Abatement Facilities Sludge Landfill Site Plan Civil, Drawing No. W1031083.

Note: Cross-section A-A is shown in Exhibit 2-19.

EXHIBIT 2-19

CROSS-SECTION OF PROPOSED LANDFILL CELL AFTER FINAL CLOSURE



SECTION A-A

Source: Chambers Works Pollution Abatement Facilities, Sludge Landfill Ultimate Closure Plan, Sect. Civil Drawing No. W1041907.

Note: See Exhibit 2-18 for the location of the cross-section.

2.7.2.1 Closure Plan. Closure will consist primarily of constructing the final cover system over the relatively flat cap portion of the four-cell unit. The side slope cover system is an integral part of the perimeter dike system and thus will be constructed as part of the ongoing landfill operation (refer to Section 2.2.2). The top cover will be a liner system consisting of a lower clay soil barrier and an upper geomembrane (Hypalon) liner. The cover above the geomembrane will include a storm water management system and protective cover soil capable of supporting vegetation. The final cover system is designed to perform the following functions:

- Minimize infiltration, and therefore, minimize leachate generation
- Provide slope stability
- Mitigate soil erosion
- Provide storm water management.

Specific design components include the following:

- Thirty-six inches of clay placed directly on the subgrade to provide a barrier to infiltration and act as a buffer between the geomembrane and the landfill materials

- 30-mil (minimum) Hypalon geomembrane liner to provide the major barrier against infiltration

- A geotextile layer to protect the geomembrane from coarse materials above

- Twelve inches of sand to provide drainage of any precipitation which percolates through the upper layers of the cover; also to protect the geomembrane during construction

- A geotextile layer to prevent the migration of soil fines from the soil cover into the drainage layer

- Eighteen inches of common fill material to inhibit deep root vegetation, to discourage rodent penetration to the underlying liner, and to provide a storage layer for any precipitation which percolates beneath the ground surface

- Six inches of soil vegetated with a hardy shallow-root, low maintenance cover at approximately 3.5 to 5 percent slope to provide runoff and prevent ponding.

Storm water runoff features are described in Section 2.2.2.6.

2.7.2.2 Post-Closure Care. Post-closure activities will consist of ground-water monitoring, pumping and treatment of leachate generated after closure, maintenance of the final cover system to control erosion and liner damage, and inspection of the cover system and monitoring wells. Ground water will be sampled on a quarterly basis from those wells used during active operations (refer to Section 2.2.2.5). It is anticipated that approximately 100,000 gallons of leachate will be generated annually and need treatment. The cover system will be inspected for structural deterioration (e.g., cracking and subsidence), ponding and erosion, condition of vegetation, and vandalism. Plants having a deep-root system will be removed, and small washout gullies will be backfilled. Monitoring wells will be inspected for structural deterioration, vandalism, and general condition. Site security will also be maintained. Du Pont will restrict use of the property such that the integrity and proper functioning of the ground-water monitoring wells and cover system will not be disturbed.

NOTES

1. RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Vol 1 of 2, Section 2.

2. Ibid.

3. RCRA Part B Permit Application, Volume I, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Attachment 2-A.

4. Ibid.

5. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 1.

6. RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Vol. 1 of 2, Section 2.

7. RCRA Part B Permit Application, Volume I, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 3.

8. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 1.

9. Ford, Bacon & Davis, Inc., Engineers-Contractors, Chambers Works Incinerator, Tank Farm Containment Plan Process, Drawing #W990050A, Revision E, February 24, 1989.

10. Telephone conversation with Patrick J. Costello and Frank Kinear, E.I. Du Pont de Nemours & Company, April 11, 1989, regarding the fluoride and heavy sludge unloading areas at the proposed incinerator.

11. Telephone conversation with Patrick J. Costello, Senior Consultant for Environmental Affairs, E.I. Du Pont de Nemours & Company, February 28, 1989, regarding engineering controls at the proposed incinerator.

12. Ford, Bacon & Davis, Inc., Engineers-Contractors, Chambers Works Incinerator, Tank Farm Containment Plan Process, Drawing #W990050A, Revision E, February 24, 1989.

13. Ibid.

14. Ford, Bacon & Davis, Inc., Engineers-Contractors, Chambers Works Incinerator, Container Storage Building Containment Plan Process, Drawing #W990001A, Revision G, February 24, 1989.

15. Ibid.

16. Telephone conversation with Patrick J. Costello, Senior Consultant for Environmental Affairs, E.I. Du Pont de Nemours & Company, March 13, 1989, regarding the fluoride unloading area.

17. Ford, Bacon & Davis, Inc., Engineers-Contractors, Chambers Works Incinerator, Kiln/Gas Scrubbing Area Containment Plan Process, Drawing #W990020A, Revision D, February 24, 1989.

18. Telephone conversation with Patrick J. Costello and Frank Kinnear, E.I. Du Pont de Nemours & Company, April 11, 1989, regarding the fluoride and heavy sludge unloading areas at the proposed incinerator.

19. Ford, Bacon & Davis, Inc., Engineers-Contractors, Chambers Works Incinerator, Kiln/Gas Scrubbing Area Containment Plan Process, Drawing #W990020A, Revision D, February 24, 1989.

20. Du Pont, "Detailed Process Description of the Chambers Works Incinerator - Permitting Issue," Preliminary Issue, Revision C, July 28, 1988.

21. RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

22. RCRA Part B Permit Application, Volume I - Introduction and Facility Description, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

23. Ford, Bacon & Davis, Inc., Engineers-Contractors, Chambers Works Incinerator, Kiln/Gas Scrubbing Area Containment Plan Process, Drawing #W990020A, Revision D, February 24, 1989.

24. Ibid.

25. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

26. Telephone conversation with Patrick J. Costello, Senior Consultant for Environmental Affairs, E.I. Du Pont de Nemours & Company, March 9, 1989, regarding proposed landfill engineering controls.

27. RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

28. Ibid.

29. Ibid.

30. Minutes of March 2, 1988 meeting of Radian and RGH with Du Pont, ENSR, and Ford, Bacon and Davis. Held at Du Pont Deepwater plant, Pennsville, NJ.

31. Letter from Patrick J. Costello, Sr. Consultant for Environmental Affairs, E.I. Du Pont de Nemours & Company, to Mr. Gerald Kelly, ICF Technology, dated October 11, 1988.

32. Ibid.

33. Orth, Rodgers, Thompson & Associates, Inc., "Traffic and Vehicle Classification Study For Du Pont Chambers Works in Lower Penns Neck Township, Salem County, New Jersey," April 1988.

34. Minutes of March 2, 1988 meeting of Radian and RGH with Du Pont, ERT and Ford, Bacon, and Davis, held at Du Pont Deepwater plant, Pennsville, NJ.

35. RCRA Part B Permit Application, Volume I - Introduction and Facility Description, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

36. Stephen LaRue, "Waste Disposal is Competitive Venture for Firm," Today's Sunbeam, Salem, N.J., Tuesday, May 10, 1988.

37. RCRA Part B Permit Application, Volume 1 - Introduction and Facility Description, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

38. Letter from Patrick J. Costello, Sr. Consultant for Environmental Affairs, E.I. Du Pont de Nemours & Company, to Mr. Gerald Kelly, ICF Technology, dated October 11, 1988.

39. RCRA Part B Permit Application, Volume 1 - Introduction and Facility Description, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

40. Ibid.

41. Ibid.

42. _Ibid_.

43. _Ibid_.

44. Letter from Patrick J. Costello, Sr. Consultant for Environmental Affairs, E.I. Du Pont de Nemours & Company, to Mr. Robert R. Hall, ERT, dated April 12, 1988.

45. _Ibid_.

46. _Ibid_.

47. RCRA Part B Permit Application, Volume 1 - Introduction and Facility Description, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

48. Memo from Patrick Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, to Mr. Robert R. Hall, ENSR, Concord, MA on April 12, 1988.

49. Minutes of October 29, 1988 meeting of ICF Technology with Du Pont, ENSR, and Woodward Clyde. Held at Du Pont Deepwater plant, Pennsville, NJ.

50. RCRA Part B Permit Application, Volume IV - Process Information and Engineering Reports: Containers and Tanks, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

51. _Ibid_.

52. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 2.

53. RCRA Part B Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Volume II, Sections 1, 3, and 7 and Volume IV, Section 1.

54. E.I. Du Pont de Nemours & Company, "Discharge Prevention, Containment or Countermeasure Plans," Sections I and IV.

55. Contingency Plan for Secure Landfill.

56. E.I. Du Pont de Nemours & Company, "Transportation Emergency Response Procedure Manual."

57. E.I. Du Pont de Nemours & Company, Guidelines for Process Hazards, Section III-F, "Chambers Works Spill Control Safety Guidelines."

58. Telephone conversation with Mr. Patrick Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, on July 12, 1989.

59. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 6.

60. Telephone conversation with Patrick J. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, March 9, 1989, regarding protective equipment for the tank farm.

61. Letter from Patrick J. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, to Mr. Tim McAdams, Radian Corporation, dated May 4, 1988, concerning (in part) devices and procedures to prevent kiln explosion.

62. Letter from Patrick J. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, to Mr. Tim McAdams, Radian Corporation, dated April 11, 1988 concerning (in part) equipment redundancy and back-up provisions.

63. RCRA Part B Permit Application, Volume IV, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 1.

64. RCRA Part B Permit Application, Volume IV, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 2.

65. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 6.

66. Ibid.

67. Ibid.

68. Ibid.

69. Ibid, Section 4.

70. Ibid, Section 3.

71. Ibid.

72. Ibid.

73. Ibid.

74. RCRA Part B Permit Application, Volume IV, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 1, p. 14 and Section 2, p. 12.

75. Letter from Patrick J. Costello, Sr. Consultant, Environmental Affairs, E. I. Du Pont de Nemours & Company to Mr. Tim McAdams, Radian Corporation, dated May 4, 1988, concerning (in part) the Incinerator Fire Protection Plan.

76. Telephone conversation with Patrick J. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, March 8, 1989, regarding engineering controls at the proposed incinerator.

77. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 4.

78. Ibid.

79. Ibid.

80. Ibid, Section 6.

81. Telephone conversation with Sig Podralski, Sr. Process Consultant, E.I. Du Pont de Nemours & Company, March 15, 1989, regarding code compliance.

82. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 4.

83. Ford, Bacon & Davis, Inc., Engineers-Contractors, Chambers Works Eastern Regional Incinerator Fire Protection Plan, Drawing #W982091B, Feb. 11, 1988.

84. Telephone conversation with Sig Podralski, Sr. Process Consultant, E.I. Du Pont de Nemours & Company, February 28, 1989, regarding fire protection systems at the proposed incinerator.

85. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 4.

86. Telephone conversation with Sig Podralski, Sr. Process Consultant, E.I. Du Pont de Nemours & Company, February 28, 1989, regarding fire protection systems at the proposed incinerator.

87. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 4.

88. Ibid.

89. Telephone conversation between Patrick J. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, and Scott A. Gutschick, ICF Technology, Inc., November 21, 1988, regarding fire protection services.

90. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 4.

91. Letter from Patrick J. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, to Mr. Gerald Kelly, ICF Technology, Inc., dated December 6, 1988, concerning (in part) the Chambers Works Transportation Emergency Response Team and fire protection services.

92. Telephone conversation with William Vogler, Medical Department Administrator for Du Pont/Chambers Works, December 7, 1988, regarding emergency medical services at Chambers Works.

93. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 2.

94. Ibid, Section 4.

95. Letter from Patrick J. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, to Mr. Gerald Kelly, ICF Technology, Inc., dated December 6, 1988, concerning (in part) the Chambers Works Transportation Emergency Response Team and fire protection services.

96. Letter from Patrick J. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, to Mr. Gerald Kelly, ICF Technology, Inc., dated December 6, 1988, concerning (in part) the Chambers Works Transportation Emergency Response Team and fire protection services.

97. Telephone conversation with Albert C. Stein, Area Manager, RHYTHM/TERP, Du Pont-Chambers Works, February 28, 1989, regarding the Du Pont-Chambers Works TERP Team.

98. Telephone conversation with Nicholas J. Psaltis, Sr. Environmental Consultant for Du Pont/Chambers Works, December 6, 1988, regarding agreements between Chambers Works and nearby townships for emergency services.

99. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 4.

100. Ibid.

101. Telephone conversation with Patrick J. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont de Nemours & Company, February 28, 1989, regarding emergency response procedures and systems.

102. ATI, Design A - Single Siren System Coverage (drawing/map), Du Pont/Chambers Works, Deepwater, NJ, January 1987.

103. Carneys Point, NJ Emergency Operating Plan, Annex X - Hazardous Materials, January 20, 1988, pp. X-2 and pp. 9.8 (Appendix 9, pg. 8 of Annex X).

104. RCRA Part B Permit Application, Volume II, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 7.

105. E.I. Du Pont de Nemours & Company, "Discharge Prevention, Containment or Countermeasure Plans," Section II, p. 5.

106. E.I. Du Pont de Nemours & Company, "Safety How," March 1988.

107. E.I. Du Pont de Nemours & Company, "Discharge Prevention, Containment or Countermeasure Plans," Section II, p. 4.

108. E.I. Du Pont de Nemours & Company, Proposed Area Safety and Health Rules - Regional Incinerator and Proposed Area Safety and Health Rules, for Contractor Operation of Secure Landfill.

109. Telephone conversation with William Vogler, Medical Department Administrator for Du Pont/Chambers Works, December 7, 1988, regarding emergency medical services at Chambers Works.

110. Information in this section is summarized from RCRA Part B Permit Application, Volume III - Closure and Post Closure Plans and Cost Estimates, and Financial Assurance Mechanism, "Chamber Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

111. RCRA Part B Permit Application, Volume III, Part 2 of 2, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

Section 3

SECTION 3

ENVIRONMENTAL SETTING

This section describes the physical, biological, and socioeconomic environment for the Du Pont Chambers Works site and surrounding area. The discussions in this section present regional and site-specific information necessary for an understanding of the environment in and around the Chambers Works Property. The information presented is intended to provide the foundation for the assessment of environmental impacts of the proposed hazardous waste facility expansion. This assessment is provided in Section 4.

3.1 GEOLOGY, TOPOGRAPHY, AND SOILS

The proposed landfill and incinerator units are situated within the Atlantic Coastal Plain physiographic province. The geological, topographical, and sedimentological characteristics of the local environment are thus derived from fluvial-deltaic deposition, sea level fluctuation, glacial outwash, and erosional processes. It is the characteristics of these deposits and their interrelationships that provide the dynamic hydrogeologic framework for ground-water flow in the vicinity of the Chambers Works Property. Therefore, the information available concerning the stratigraphy of these deposits and their relationship with the Chambers Works Property and surrounding environment are critical for the environmental analysis presented in this document. For example, the site stratigraphy will determine the migration characteristics (e.g., rate of movement) of contaminants that could leak through the landfill liner system. Section 3.2 presents the hydrology of the area, detailing both ground and surface water quality and uses and delineating floodplain/hazard areas.

In the Chambers Works area, as well as in other areas along the Delaware River, confined regional aquifer systems are capped by surficial deposits of glacial and post-glacial origin. Several lines of evidence, some discussed in this document, indicate that the Delaware River/Estuary is the natural recharge area for the regional aquifer system. Human influences may be enhancing this natural process through heavy pumping of the regional systems and the development of significant cones of depression along an axis including the metropolitan areas of Wilmington, Philadelphia, and Camden. Therefore, the degree of interconnection between the surficial deposits (aquifers) and regional aquifers must be understood in order that fate and transport analyses and risk assessments may be conducted for present or potential industrial contamination. The best methods for determining the degree of interconnecting of these deposits involve studies of stratigraphy and aquifer testing (pump testing).

Because of the limited regional extent of the surficial deposits, the highly variable stratigraphy they contain, and their generally flat-lying aspect, there are few exposures of the deposits and, consequently, few detailed stratigraphic studies of these deposits have been conducted in the Chambers Works area. However, the lateral and vertical variability of these deposits is critical for an understanding of both ground-water flow within the deposits and the extent of the interconnections with the confined aquifers located within the underlying Potomac Group and Raritan and Magothy Formations[1]. Because extensive hydrogeologic or stratigraphic studies have not been conducted by either the U.S. Geological Survey or the New Jersey Department of Environmental Protection Geological Survey (formerly Bureau of Geology and Topography) in the area including Chambers Works it is necessary to use data from a variety of sources to develop a conceptual model of the system at that location. The data include:

- Regional studies such as those that have been described in the previous section;

- Data from well drilling and geotechnical analyses that have been conducted at Du Pont and in the surrounding area over the past several years;

- Data that Du Pont has been developing as part of their RCRA corrective action and compliance activities at other units at the Chambers Works Facility; and

- Data that has been developed by Du Pont specifically to characterize the sites of the proposed secure landfill and hazardous waste incinerator.

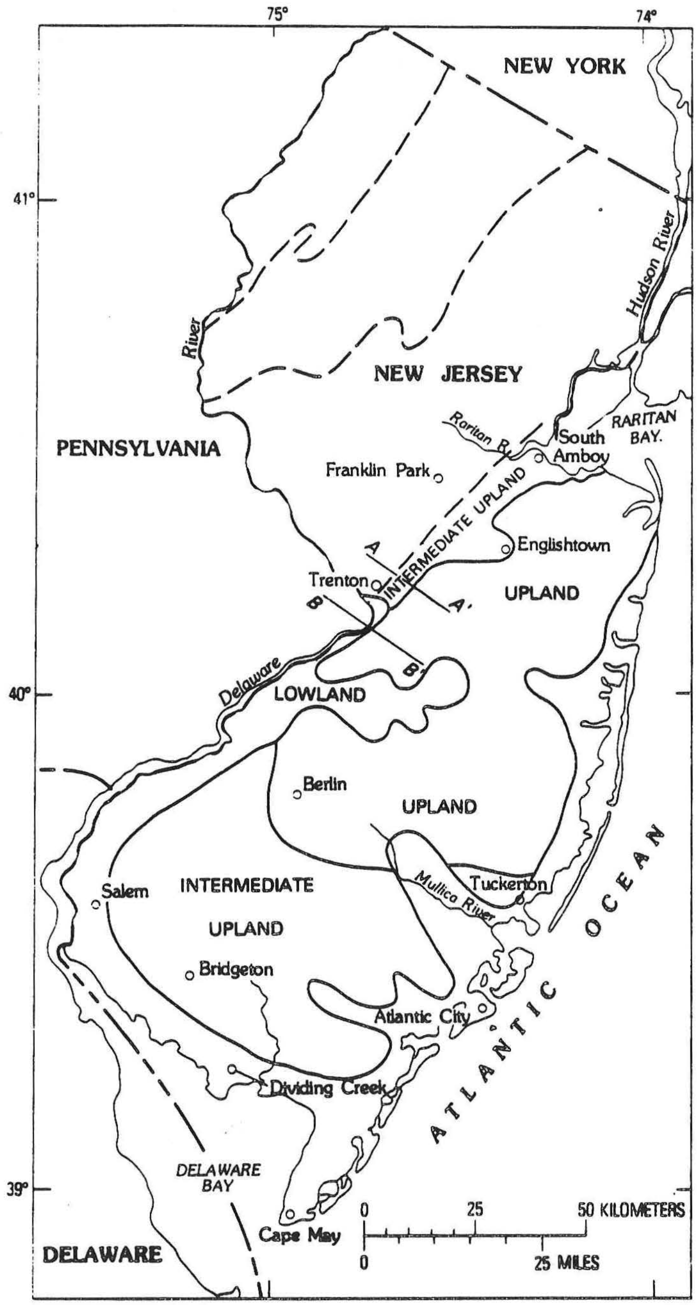
ICF's review of Du Pont's consultants hydrogeologic work indicates that the degree of interconnection between the surficial and regional systems in the vicinity of Chambers Works is still not clearly understood. Du Pont's consultants characterization of the ground-water flow in the surficial deposits may need revision. ICF found that the division of the surficial deposits into multiple aquifer systems with intervening confining units is not supported by field data. However, confining units of unknown vertical and lateral extent inhibit flow between the surficial deposits and regional aquifer system. Further study is required to clearly delineate the extent to which vertical flow is inhibited. This would involve pump testing of nested wells screened in both the surficial deposits and the shallow P-R-M system in the vicinity of the proposed incinerator and landfill complexes. At a minimum, plans to extend the interceptor well system (discussed later) to include the proposed landfill area should be finalized.

3.1.1 Regional Geology

The Coastal Plain Physiographic Province is a 100 to 200 mile wide feature which extends from Cape Cod along the length of the Atlantic seaboard and the Gulf Coasts. Owens and Minard (1979)[2] divided the New Jersey portion of the Coastal Plain into the lowland, intermediate upland, and upland subprovinces (Exhibit 3-1). The Chambers Works Property is situated within the lowland subprovince (areas with altitudes ranging between 0 and 70 ft)[3], which includes a large area along the ocean front, the Delaware Bay and along the Delaware River as far north as Trenton. The boundary of this primarily depositional physiographic province with the highly eroded Piedmont is at the Fall Line, which is located 2-3 miles west of the Property.

EXHIBIT 3-1[a]

SUBPROVINCES OF THE NEW JERSEY COASTAL PLAIN



[a]Owens, J.P. and Minard, J.P., 1979, Upper Cenozoic Sediments of the Lower Delaware Valley and the Northern Delmarva Peninsula, New Jersey, Pennsylvania, Delaware, and Maryland: U.S. Geological Survey Professional Paper 1067-D, 47 p.

The Fall Line is the surface expression of the eastward-dipping contact (unconformity) between the hard, crystalline rocks characteristic of the Piedmont province and the mostly unconsolidated sediments of the Coastal Plain province. The intermediate upland consists of the area at altitudes from 50 to 180 ft and which is generally underlain by the Bridgeton Formation (described below). This subprovince also extends along the inner edge of the Coastal Plain from Trenton to Raritan Bay.[4]

. The upland subprovince is generally at elevations between 200 and 400 ft.

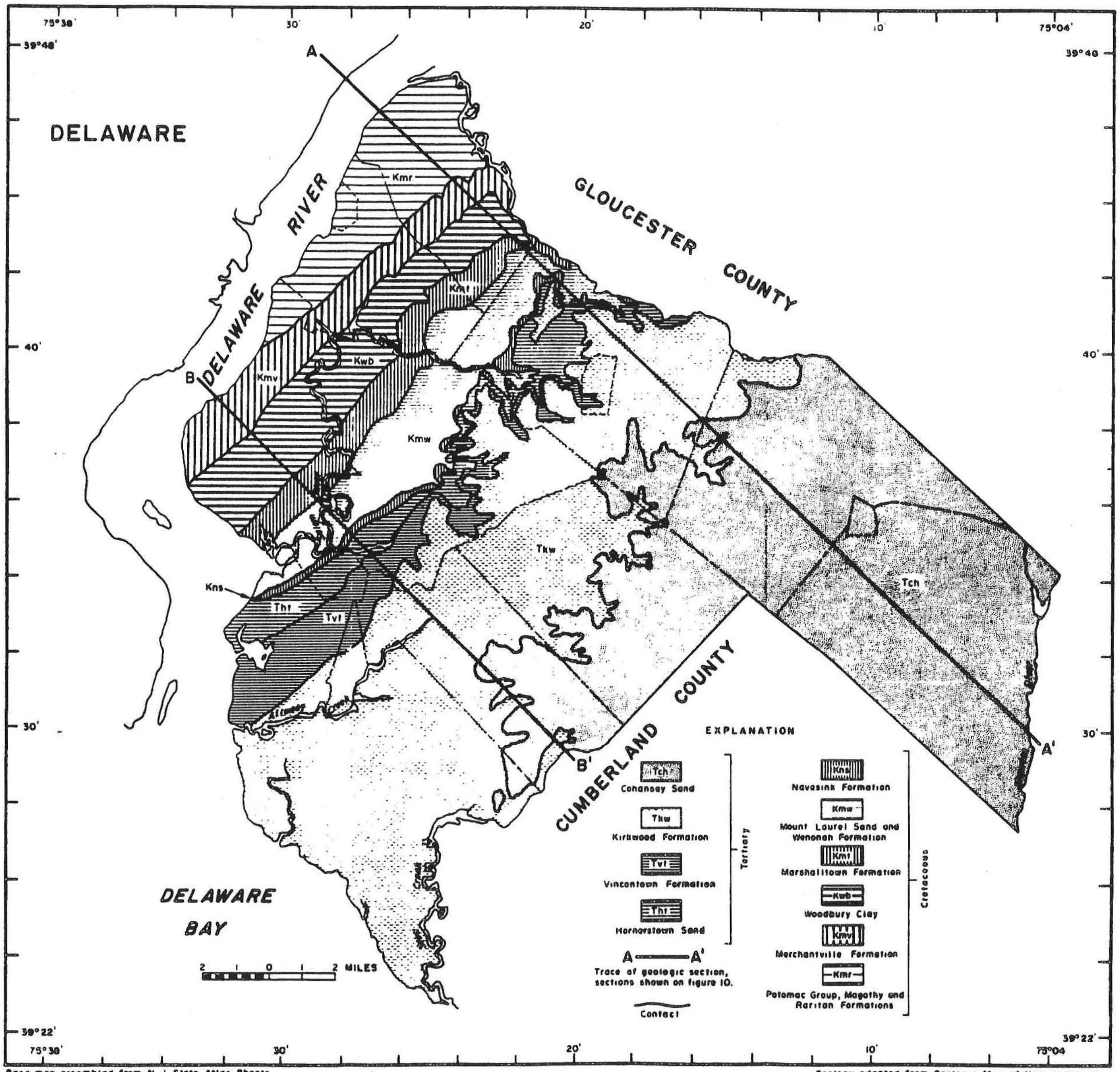
In Salem County, the formations of the Coastal Plain consist of a sedimentary wedge of Early Cretaceous through Quaternary-age deposits; unconsolidated and semi-consolidated sand, silt, clay, and gravel deposited in marine and fluvial environments. They dip southeast at between 65 and 90 feet per mile, and are underlain by the much older crystalline bedrock of late Pre-Cambrian or early Paleozoic age. With its western edge at the Fall Line, the wedge is approximately 200 feet thick in the northwest portion of Salem County and thickens to 2400 feet in the southeast portion of the County.[5] Further east beneath the Atlantic Ocean shoreline the thickness of the deposits is between 6000 and 8000 feet. Exhibit 3-2 displays the characteristic north-northeast strike (trend) of the Coastal Plain deposits as they are found in Salem County and throughout the State of New Jersey. Two cross-sections of this stratigraphy along lines to the north and south of the Chambers Works Property (A-A' and B-B') are displayed in Exhibit 3-3. Section A-A' clearly shows the sloping unconformity between the crystalline rocks of the Wissahickon Formation and the much younger Cretaceous through Tertiary age rocks which are characteristic of the Coastal Plain. This unconformity or erosion surface was created prior to the deposition of the Coastal Plain deposits and represents a significant break (over 400 million years) in the geologic record.

Salem County's surficial geology, represented in Exhibit 3-4, includes Pleistocene and Holocene alluvial deposits that unconformably cover the typical Coastal Plain deposits throughout most of the County. These Pleistocene deposits consist of complex interbedded clays and fine- to very coarse-grained sands, and range in thickness from 45 to 100 feet. Rosenau et.al. (1969)[6] considered the Bridgeton, Pensauken, and Cape May Formations to be of Pleistocene age while others (e.g., Vowinkel and Foster 1981[7]) consider only the Cape May Formation to be of Pleistocene age and the Bridgeton and Pensauken to be of late-Tertiary age. These deposits all lie unconformably on the older Cretaceous deposits. The characteristics of the Bridgeton, Pensauken, and Cape May formations in Salem County are summarized below.[8]

- Cape May - Adjacent to the Delaware and its tributaries; occupies approximately 85 square miles of the County; found at elevations as high as 90 feet but generally not higher than 70 feet; as much as 150 feet thick in the southwest portion of the County and 30 feet thick along stream courses; composed of medium to coarse sand with abundant gravel and minor amounts of clay.

EXHIBIT 3-2[a]

PRE-QUATERNARY GEOLOGY OF SALEM COUNTY



Base map assembled from N. J. State Atlas Sheets

Geology adapted from Geologic Map of New Jersey by G. S. Hilton and J. C. Rosenau.

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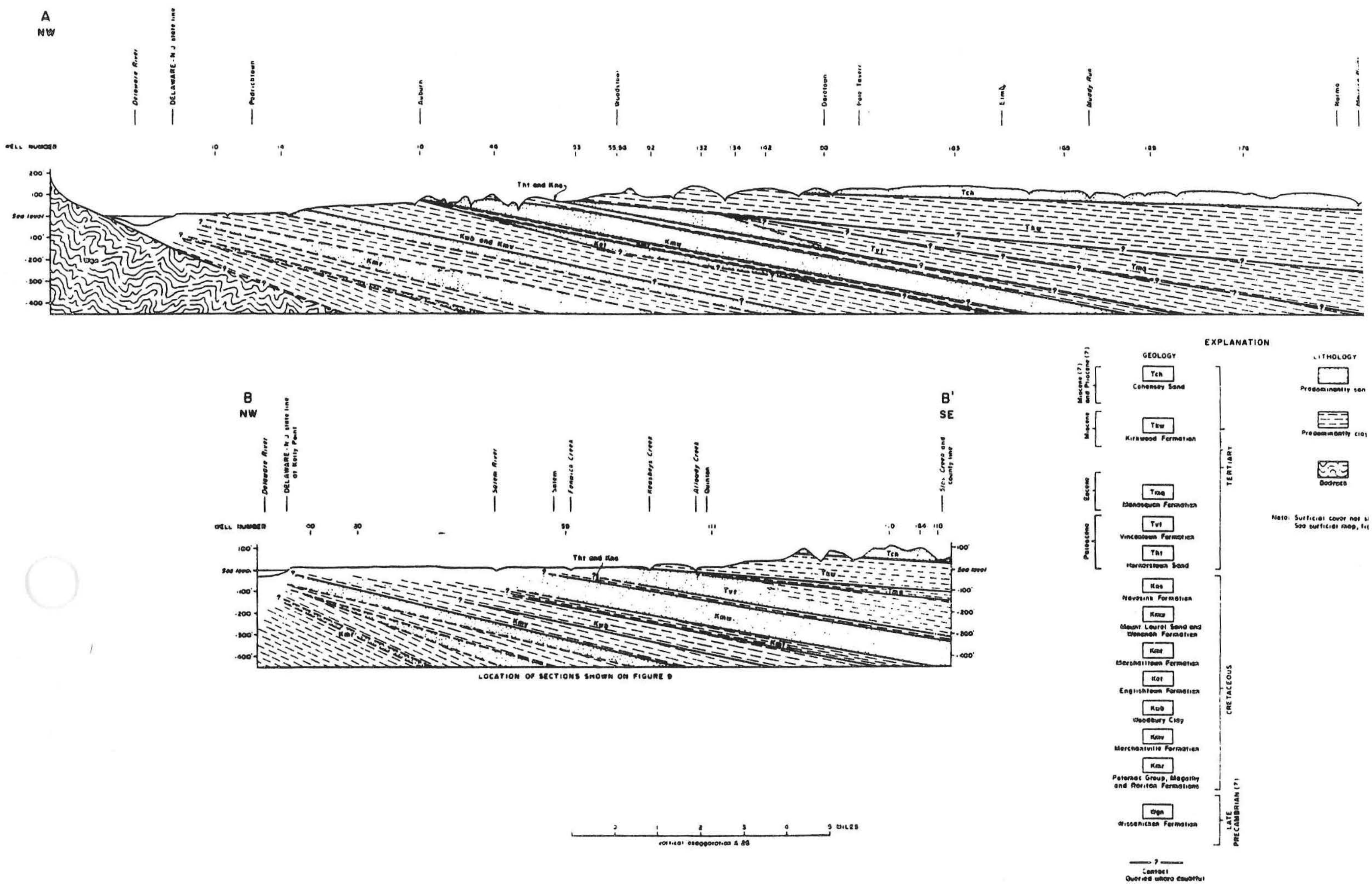
[a]Rosenau, J.C., Lang, S.M., Hilton, G.S., Rooney, J.G., <u>Geology and Groundwater Resources of Salem County, New Jersey</u>, State of New Jersey Department of Conservation and Economic Development, Special Report 33, 1969.

EXHIBIT 3-3[a]

GEOLOGIC CROSS SECTIONS
A-A' AND B-B'



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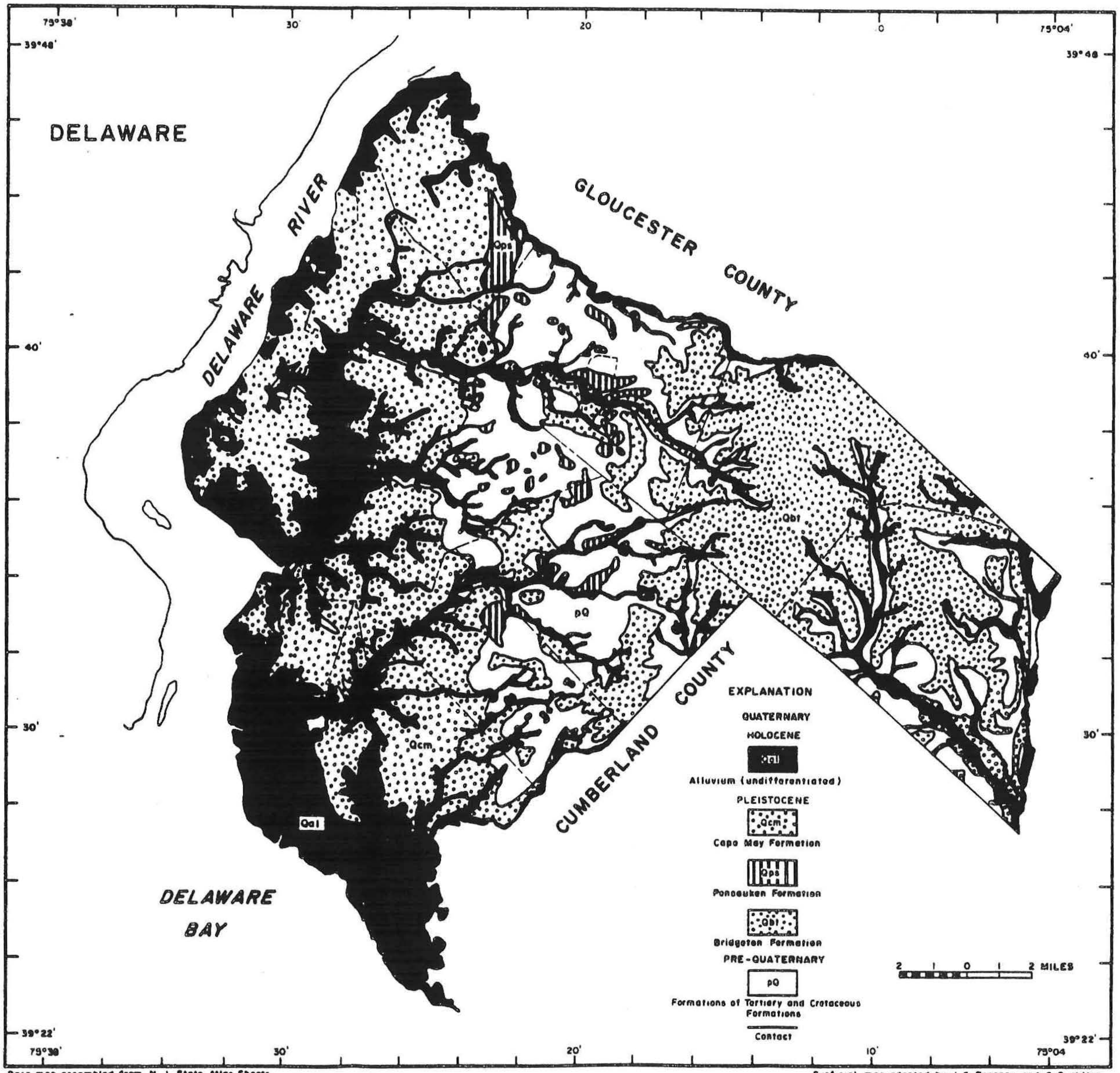
[a]Rosenau, J.C., Lang, S.M., Hilton, G.S., Rooney, J.G., Geology and Groundwater Resources of Salem County, New Jersey, State of New Jersey Department of Conservation and Economic Development, Special Report 33, 1969.

EXHIBIT 3-4[a]

SURFICIAL GEOLOGY OF SALEM COUNTY



Base map assembled from N. J State Atlas Sheets.

Surficial map adapted by J. C. Rosenau and G. S Hilton from Geologic Map of New Jersey and McCormack and others, 1964, Engineering Soil Survey of New Jersey.

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[a] Rosenau, J.C., Lang, S.M., Hilton, G.S., Rooney, J.G., Geology and Groundwater Resources of Salem County, New Jersey, State of New Jersey Department of Conservation and Economic Development, Special Report 33, 1969.

- Pensauken - Irregular patches in central Salem County at elevations of 40 to 100 feet above sea level; occupies an area of approximately 5 square miles and is up to 30 feet thick in the County; composed of medium- to coarse-grained sand, with some gravel and clay; the presence of glauconite, and iron stained/cemented sands are characteristic of the Formation.

- Bridgeton - Crops out in the eastern half of Salem County; covers an area of approximately 60 square miles; found at altitudes ranging from 100 to 160 feet above sea level; as much as 50 feet thick in the County; composed of fine- to very coarse-grained sand and gravel that may be cemented and iron-stained.

The formations that may be found in the Coastal Plain physiographic province are illustrated and described in the geologic column presented in Exhibit 3-5 (Note: The deposits above the Cape May are poorly defined in this column but may be important at Chambers Works). This exhibit also includes a general breakdown of the geohydrologic units that are associated with these deposits. These geohydrologic units are discussed in Section 3.2.1.1. Exhibit 3-6 provides a representation of the multiple confined regional aquifers developed within the pre-Quaternary deposits. These large regional aquifers have recharge areas to the west, in the north-northeast trending hills and valleys of New Jersey (including the area along the Delaware River). Because the deposits dip to the east, in order to tap a particular aquifer, an individual or community must drill to greater depths in the eastern part of the State than in the west. Missing from this exhibit of the geohydrologic units is a representation of all the possible aquifer systems developed in Quaternary deposits throughout the State. These deposits form the surficial aquifers in this hydrostratigraphic setting. As discussed in the following sections, these localized Quaternary, particularly the Pleistocene, deposits are critical controls in the recharge of the regional aquifer system since they regulate any infiltration into these systems.

The Pensauken and Bridgeton formations form minor unconfined aquifers which yield between 10 and 25 gpm at any given well. The Cape May Formation forms an unconfined aquifer system that, because of its elevation and thus hydraulic connection with the Delaware River, is a much more productive system than the other Pleistocene aquifers. In the area of the Chambers Works Property, the aquifer has yielded up to 1500 gpm to the Ranney collector wells[9].

The work of Owens and Minard (1979) indicates that the Quaternary stratigraphy represented in Exhibits 3-4 and 3-5 may not be complete. Through review of the work of several investigators, as well as conducting their own field investigations, they concluded that some deposits along the Delaware from Trenton south to the Delaware Bay, that should not be categorized with Cape May deposits. Although these deposits, referred to as the Van Sciver and Spring Lake Beds[10], interfinger with the marine and marginal marine Cape May deposits in the southern end of Delaware Bay, they should be differentiated in most areas. They equate these deposits with the Trenton gravels first described by Lewis (1880)[11] over a century ago. Although the Spring and Van Sciver Lake Beds are lithologically similar, the Spring Lake Beds, the older of the two, are found

EXHIBIT 3-5[a]

GEOLOGIC AND HYDROGEOLOGIC UNITS IN THE NEW JERSEY COASTAL PLAIN

SYSTEM	SERIES	GEOLOGIC UNIT	LITHOLOGY	GEOHYDROLOGIC UNIT	HYDROLOGIC CHARACTERISTICS
Quaternary	Holocene	Alluvial deposits	Sand, silt, and black mud.	Undifferentiated Holly Beach w-bz[1]	Surficial material, often hydraulically connected to underlying aquifers. Locally some units may act as confining beds. Thicker sands are capable of yielding large quantities of water.
		Beach sand and gravel	Sand, quartz, light colored, medium to coarse grained, pebbly.		
	Pleistocene	Cape May Formation	Sand, quartz, light colored, heterogeneous, clayey, pebbly.		
Tertiary	Miocene	Pensauken Formation			
		Bridgeton Formation		Kirkwood-Cohansey aquifer system	A major aquifer system. Ground-water occurs generally under water-table conditions. In Cape May County the Cohansey Sand is under artesian conditions.
		Beacon Hill Gravel	Gravel, quartz, light colored, sandy.		
		Cohansey Sand	Sand, quartz, light colored, medium to coarse grained, pebbly; local clay beds.		
		Kirkwood Formation	Sand, quartz, gray and tan, very fine to medium grained, micaceous, and dark-colored diatomaceous clay.	confining bed Rio Grande w-bz[2] confining bed	Thick diatomaceous clay bed occurs along coast and for a short distance inland. A thin water-bearing sand is present in the middle of this unit.
				Atlantic City 800-foot sand	A major aquifer along the coast.
				Composite confining bed	Alloway Clay Member or equivalent.
	Eocene	Piney Point Formation	Sand, quartz and glauconite, fine to coarse grained.	Piney Point aquifer	Yields moderate quantities of water locally.
		Shark River Formation	Clay, silty and sandy, glauconitic, green, gray and brown, fine-grained quartz sand.		Poorly permeable sediments.
		Manasquan Formation			
	Paleocene	Vincentown Formation	Sand, quartz, gray and green, fine to coarse grained, glauconitic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite.	Vincentown aquifer	Yields small to moderate quantities of water in and near its outcrop area.
		Hornerstown Sand	Sand, clayey, glauconitic, dark green, fine to coarse grained.		Poorly permeable sediments.
Cretaceous	Upper Cretaceous	Tinton Sand	Sand, quartz, and glauconite, brown and gray, fine to coarse grained, clayey, micaceous.		
		Red Bank Sand		Red Bank sand	Yields small quantities of water in and near its outcrop area.
		Navesink Formation	Sand, clayey, silty, glauconitic, green and black, medium to coarse grained.		Poorly permeable sediments.
		Mount Laurel Sand	Sand, quartz, brown and gray, fine to coarse grained, slightly glauconitic.	Wenonah-Mount Laurel aquifer	A major aquifer.
		Wenonah Formation	Sand, very fine to fine grained, gray and brown, silty, slightly glauconitic.		
		Marshalltown Formation	Clay, silty, dark greenish gray, glauconitic quartz sand.	Marshalltown-Wenonah confining bed	A leaky confining bed.
		Englishtown Formation	Sand, quartz, tan and gray, fine to medium grained; local clay beds.	Englishtown aquifer system	A major aquifer. Two sand units in Monmouth and Ocean Counties.
		Woodbury Clay	Clay, gray and black, micaceous silt.	Merchantville-Woodbury confining bed	A major confining bed. Locally the Merchantville Fm. may contain a thin water-bearing sand.
		Merchantville Formation	Clay, glauconitic, micaceous, gray and black; locally very fine-grained quartz and glauconitic sand.		
		Magothy Formation	Sand, quartz, light gray, fine to coarse grained; local beds of dark-gray lignitic clay.	Potomac-Raritan-Magothy aquifer system: upper aquifer	A major aquifer system. In the northern Coastal Plain, the upper aquifer is equivalent to the Old Bridge aquifer and the middle aquifer is equivalent to the Farrington aquifer. In the Dela. River Valley three aquifers are recognized. In the deeper subsurface, units below the upper aquifer are undifferentiated.
		Raritan Formation	Sand, quartz, light gray, fine to coarse grained, pebbly, arkosic, red, white, and variegated clay.	conf bd middle aquifer	
	Lower Cretaceous	Potomac Group	Alternating clay, silt, sand, and gravel.	conf bd lower aquifer	
Pre-Cretaceous		Bedrock	Precambrian and lower Paleozoic crystalline rocks, metamorphic schist and gneiss; locally Triassic and Jurassic basalt, sandstone and shale.	Bedrock confining bed	No wells obtain water from these consolidated rocks, except along Fall Line.

[1] Holly Beach water-bearing zone.
[2] Rio Grande water-bearing zone.

(Modified from Zapecza, 1984)

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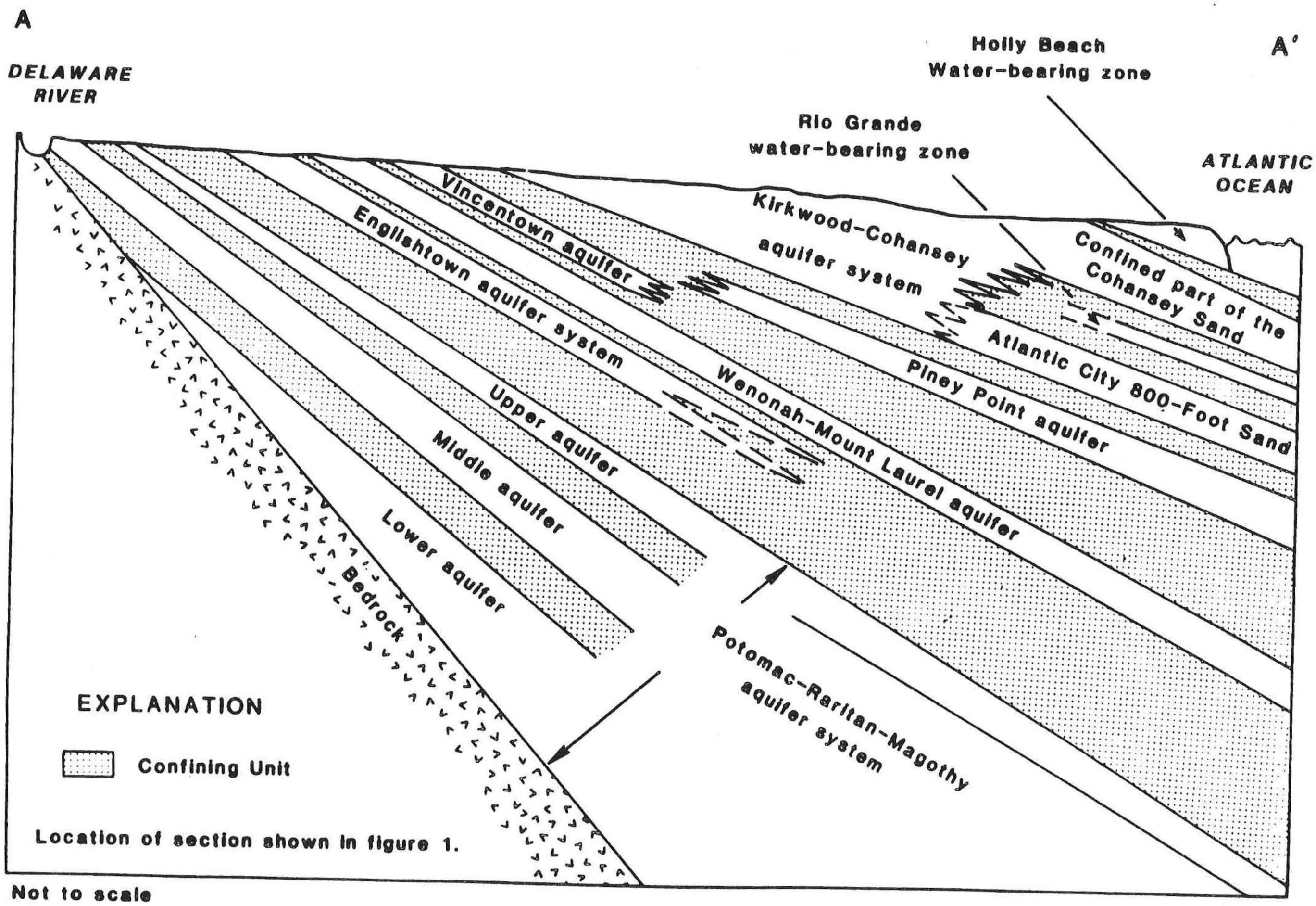
[a] Zapecza, O.S., Voronin, L.M., and M. Martin, 1987, Ground-Water Withdrawals and Water-Level Data Used to Simulate Regional Flow in the Major Coastal Plain Aquifers of New Jersey: U.S. Geological Survey Water Resources Investigations 87-4038.

EXHIBIT 3-6[a]

CROSS-SECTIONAL VIEW OF COASTAL PLAIN AQUIFERS



[a] Zapecza, O.S., Voronin, L.M., and M. Martin, 1987, Ground-Water Withdrawals and Water-Level Data Used to Simulate Regional Flow in the Major Coastal Plain Aquifers of New Jersey: U.S. Geological Survey Water Resources Investigations 87-4038.

at elevations typically between 35 and 70 ft above sea level, while the Van Sciver Lake Beds are found at altitudes typically between 10 and 20 feet above sea level.

Exhibit 3-7 provides Owens' and Minard's (1979) map showing the distribution of the Spring Lake and Van Sciver Lake Beds in the Delaware Valley, and Exhibit 3-8 provides a cross-section through the deposits from Port Penn to Artificial Island. Owens and Minard (1979) note that both deposits are lithologically similar and grade down valley from very-coarse, gravelly deposits near Trenton to interbedded clay-silt and cross-bedded sand near Artificial Island. However, the difference in their depositional elevations and paleocurrent evidence near Trenton suggest that they may have been deposited by slightly different proglacial[12] river systems.

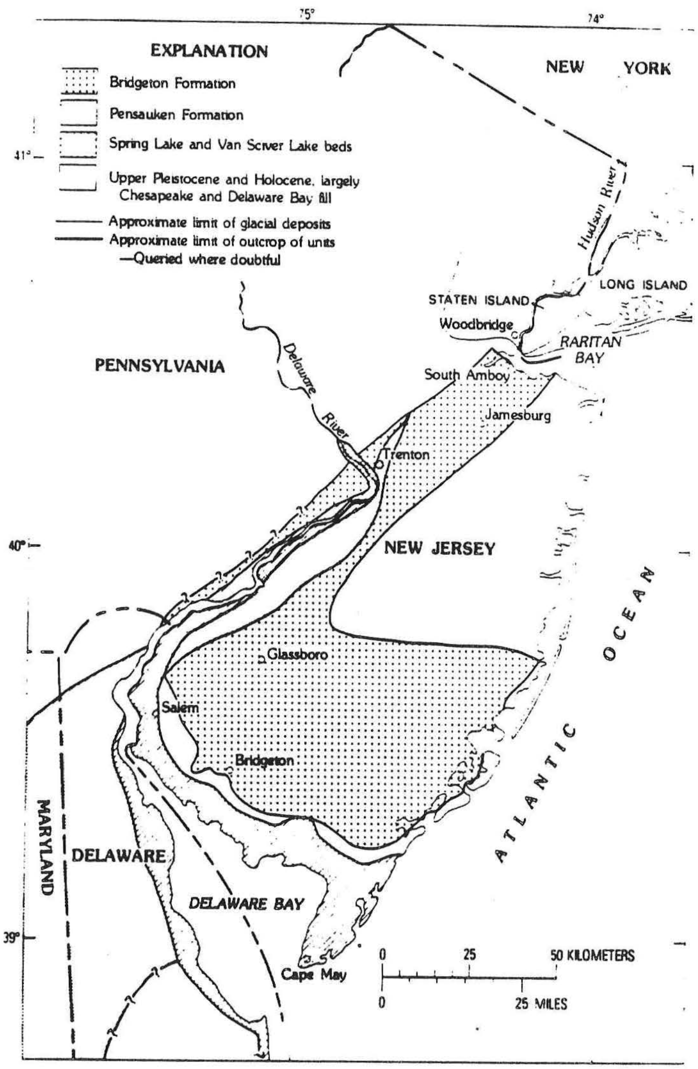
Owens and Minard (1979) interpret the Spring Lake Beds as being deposited as infillings in the Delaware Valley during sea level rise. This deposition occurred during an interglacial period which followed valley entrenchment and sea-level low stands during glaciation. The Van Sciver deposits are believed to be the result of a similar episode at a later time. Paleocurrent evidence near Trenton suggests that the Spring Lake Beds were probably deposited by a major river system which fed the Delaware Basin from the northeast while the Van Sciver Beds originated from a system which followed the present axis of the Delaware system. Owens and Minard (1979) believe that sea-level rose nearly 25 feet above the present level during the deposition of the Van Sciver Beds and nearly 70 feet during the deposition of the Spring Lake Beds.

Although there is some dispute concerning the age and origin of the surficial deposits near the Delaware River, it is clear that they are associated with fluvial-deltaic deposition, sea level fluctuation, glacial outwash, and erosional processes. In the vicinity of Chambers Works, the surficial deposits are probably a combination of Holocene flood deposits and Van Sciver Lake Beds which may or may not mantle Cape May Formation and possibly Tertiary deposits. Although the absolute age of the deposits may remain unknown and a consensus concerning genesis may never be reached, it is clear that the surficial deposits consist of interbedded gravelly sands, silts, and clays.

The remainder of this discussion and later sections deal solely with the characteristics of the surficial and the underlying Cretaceous deposits in the immediate vicinity of Chambers Works. Several lines of evidence, discussed later, indicate that the surficial deposits are hydraulically connected to the underlying lower Cretaceous Potomac Group and Raritan and Magothy (P-R-M) Formations, although, clays may act locally as confining layers restricting recharge.

EXHIBIT 3-7[a]

DISTRIBUTION OF VAN SCIVER LAKE AND SPRING LAKE BEDS



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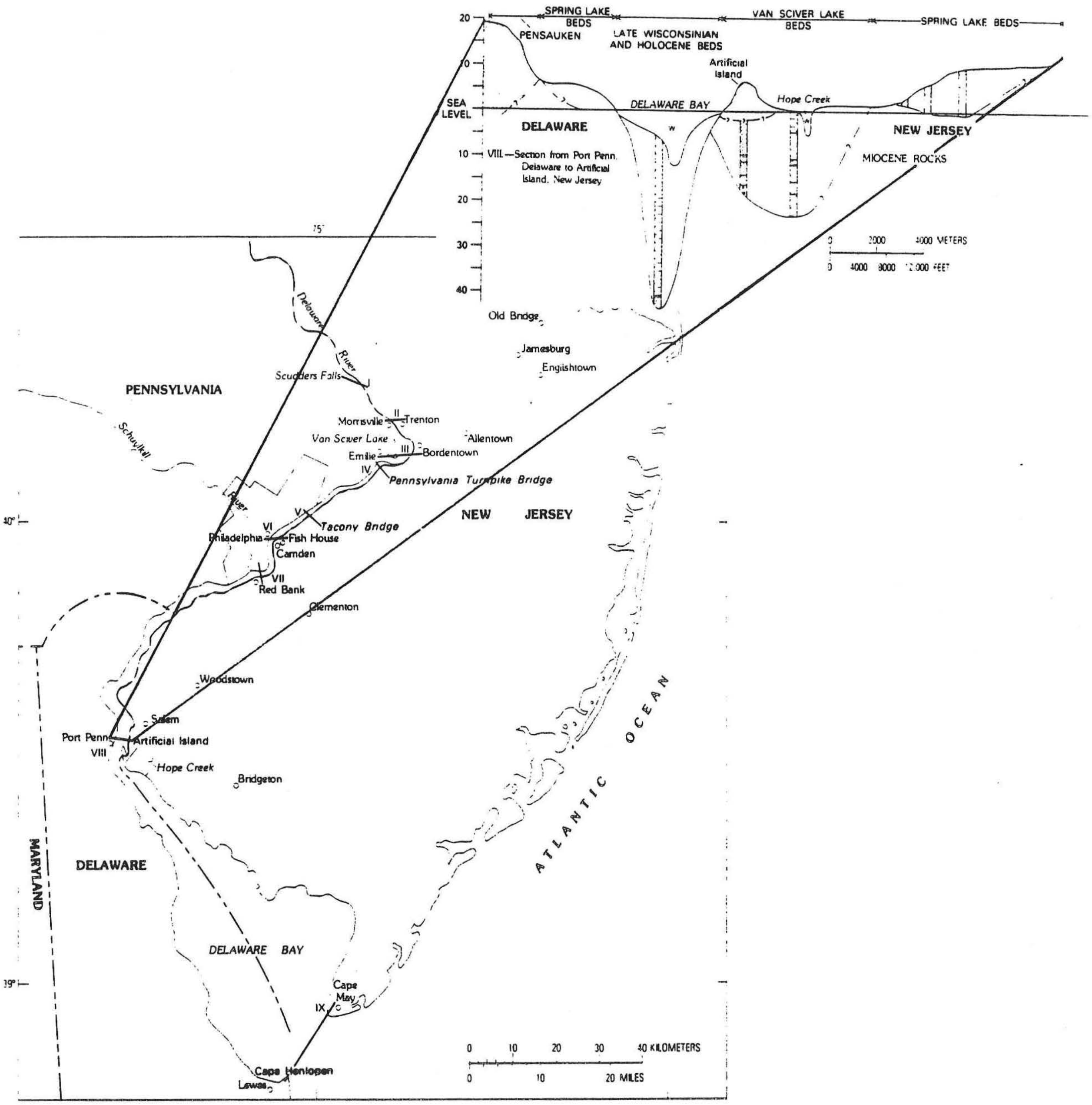
[a]Owens, J.P. and Minard, J.P., 1979, Upper Cenozoic Sediments of the Lower Delaware Valley and the Northern Delmarva Peninsula, New Jersey, Pennsylvania, Delaware, and Maryland: U.S. Geological Survey Professional Paper 1067-D, 47 p.

EXHIBIT 3-8[a]

CROSS-SECTION THROUGH QUATERNARY DEPOSITS
PORT PENN TO ARTIFICIAL ISLAND



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[a]Owens, J.P. and Minard, J.P., 1979, Upper Cenozoic Sediments of the Lower Delaware Valley and the Northern Delmarva Peninsula, New Jersey, Pennsylvania, Delaware, and Maryland: U.S. Geological Survey Professional Paper 1067-D, 47 p.

3.1.2 Geologic Framework at Chambers Works

The following two sections describe the information available concerning the stratigraphy of the surficial and Cretaceous deposits in and around the Chambers Works Property and provide an additional stratigraphic analysis, through the use of geophysical techniques for the proposed landfill area. Section 3.2.1.1 deals specifically with the hydraulic properties of the materials affecting ground-water flow. The expected lateral and vertical occurrence and variability of the subsurface materials must be clearly defined in order to develop conceptual and/or numerical models for ground-water flow.[13] Appendix A contains a bibliography of work that provides additional pertinent empirical information for the understanding of both the geology and hydrology of the Coastal Plain.

3.1.2.1 Site Stratigraphy

Generally, the best data available concerning site stratigraphy and its spatial variability come from well and boring logs associated with construction engineering studies and the installation of wells into both the water table and confined aquifer systems. Most of the soil boring data have been developed by Du Pont's consultants, primarily Woodward-Clyde Consultants (WCC) and Leggette, Brashears & Graham (LBG), working on site over the past 6 and 20 years, respectively. In addition to these data, associated with geotechnical and ground water investigations and well drilling on the Chambers Works, there is information from geotechnical investigations and well drilling in the area surrounding Chambers Works (e.g. borings drilled as part of the geotechnical investigations associated with the construction of the Delaware Memorial Bridge).

Both WCC and LBG have installed numerous borings and wells as part of the corrective action and compliance activities at Du Pont. LBG recommended that Du Pont install an interceptor well system (discussed further in Section 3.2.1.1) following the discovery of industrial contamination in drinking water wells in 1969. Over the past few years WCC has been compiling soil boring information, including geologic and geophysical logs for both geotechnical investigations and well drilling for Chambers Works and the surrounding area. This includes any boring installed since operations started at Chambers Works, for which there are logs. They have assembled a data base including over 1,400 borings. The information included in the data base includes the boring number, location (plant coordinates), depth, elevation, depth to water, and a confidence factor. With this data base WCC or Du Pont can easily access all the available boring data from a particular location on the Chambers Works Property or the surrounding area. This enables quick assembly of location-specific stratigraphic information, an assessment of the quality of the information, and use of this information in decision-making.

For the purposes of locating features (e.g., buildings, wells, soil borings, etc.) at Chambers Works, Du Pont developed a horizontal grid system and a vertical datum (Chambers Works Datum) unique to the property. From the southwest corner of the plant (near the Delaware Memorial Bridge) grid numbers increase to the east and north (the grid generally is presented with 800 ft grid lines). Most structured and architectural plans are referenced to this planimetric system. The Chambers Works Tide Datum is 3.262 feet above the United States Coast and Geodetic Survey (USC & GS) Tide Datum and 0.361 feet above the Army Corp of Engineers Tide Datum.

Exhibit 3-9 provides a simple map the Chambers Works Property showing the location of the proposed landfill and incinerator areas and the grid system (with 800 ft centers) generally used to locate structures on the Chambers Works Property. Exhibit 3-10 shows the further subdivision of the grid system to 400 foot centers with associated simple letter and number coordinates. This labeling system has been developed recently to facilitate determination of the general location of wells and borings, without requiring absolute coordinates, through the use of a unique number which acts both as a label and locational parameter. For example, the number R28-M01B is the first monitoring well installed in the R28 block (400 x 400 square). The last four characters for the number R28-M01B mean that it is the first monitoring well in the R28 grid cell and that it is developed in the B aquifer (discussed later). This system has been used over the past year for any new borings and wells; however, many of the older borings and wells have not yet been converted to the system, requiring the use of the plant grid system coordinates to locate these on a map.

Exhibit 3-11 provides the location, depth, and ground elevation for soil borings and test pits installed in the proposed incinerator and secure landfill areas. The borings installed in the incinerator complex in February and March of 1988 do not have the unique labels, while the soil borings for the proposed secure landfill, that were completed in March of 1989, do have the unique labels.

Most of the details of the subsurface stratigraphy at the Chambers Works Property have been developed over the past 20 years. This has been accomplished with the installation of numerous pumping and monitoring wells associated with the development of an interceptor well system that dates back to 1970. The geologic and down-hole geophysical logs provided by this well drilling activity and the installation of soil borings for construction investigation, form the basis for Du Pont's interpretation of the site stratigraphy. In addition a substantial amount of data is available from the drilling of test borings for the Delaware Memorial Bridge, deep wells for the Atlantic Electric Company, and other supply wells in the surrounding community. Exhibit 3-12 provides data concerning wells installed on Chambers Works Property and in the surrounding community.

EXHIBIT 3-9

800 FT GRID SYSTEM

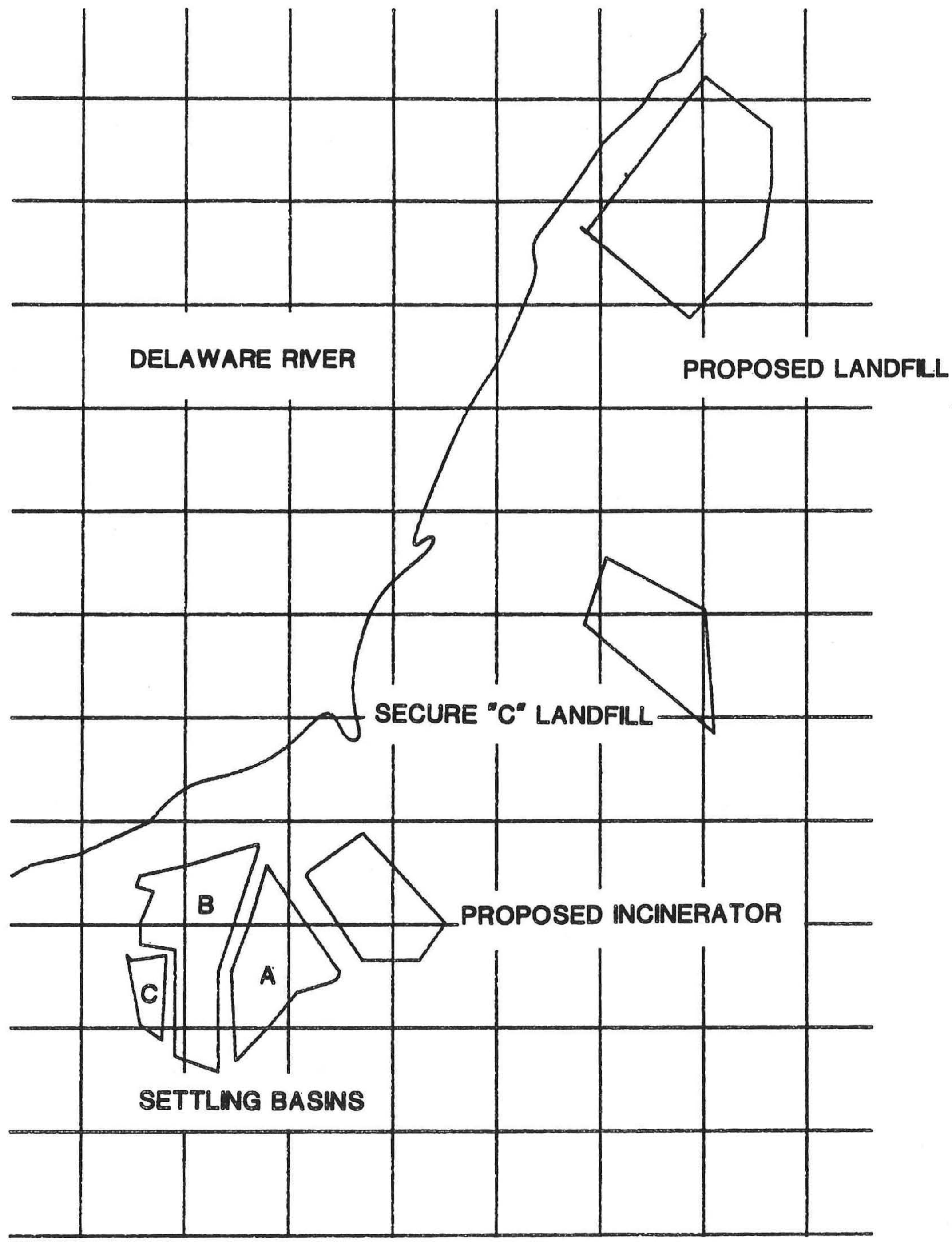


EXHIBIT 3-10

SIMPLE BORING AND WELL LOCATION SYSTEM
(400 FOOT GRID DIVISIONS).

(being developed)

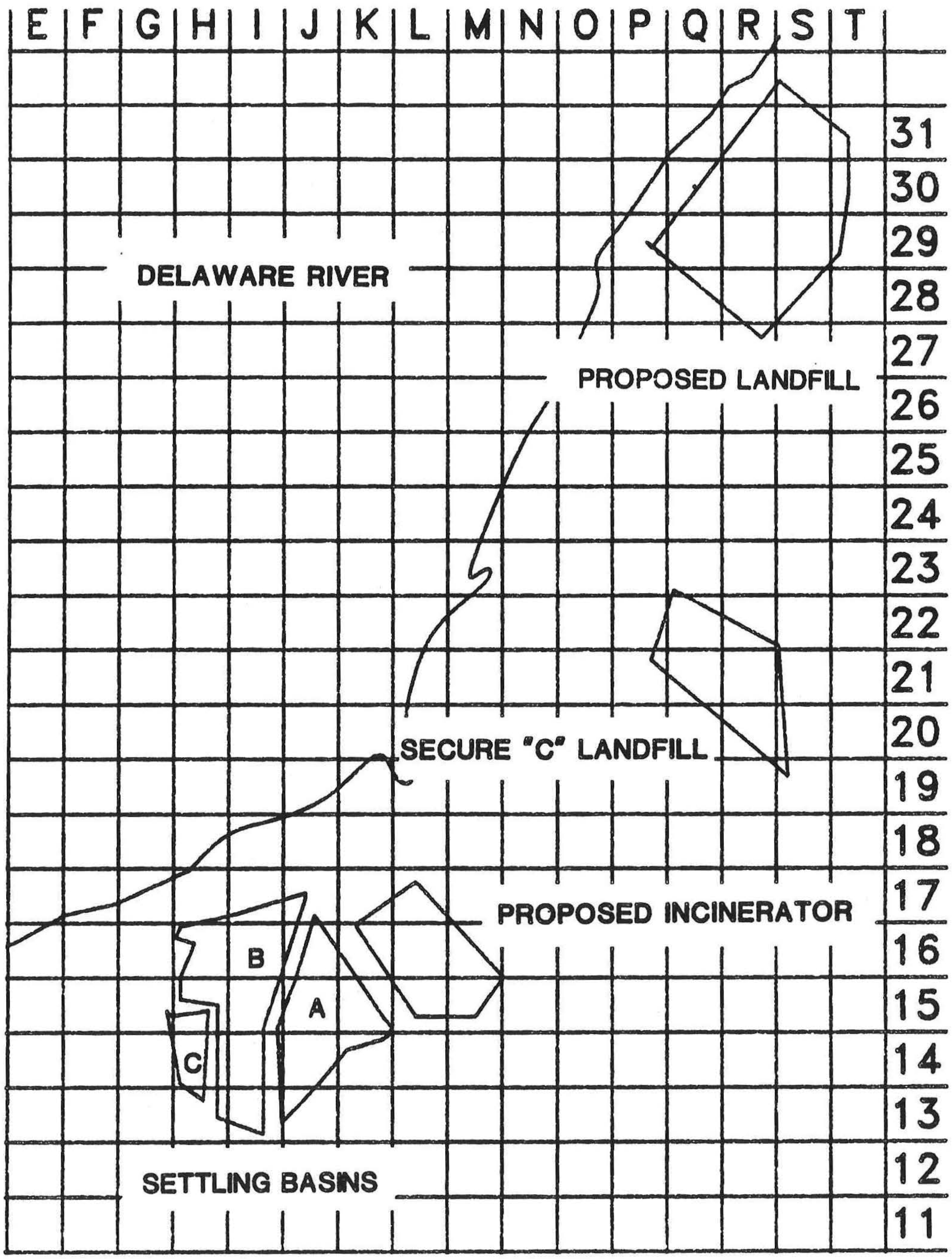


EXHIBIT 3-11

SOIL BORING AND TEST PIT LOCATIONS
PROPOSED HAZARDOUS WASTE INCINERATOR AND SECURE LANDFILL

Boring Number	Plant Coordinates North	East	Depth (feet)	Ground Elev. (ft)[a]
Incinerator Area				
S-1	6235	4770	50	4.0
S-2	6350	4870	50	4.7
S-3	6455	4970	50	5.1
S-4	6350	4980	30	4.9
S-5	6350	5070	50	5.2
S-6	6250	4980	50	4.7
S-7	6170	4890	30	5.3
S-8	6230	5110	76.5	4.2
S-9	6300	5165	30	4.2
S-10	6040	5070	50	6.1
S-11	6020	4935	50	7.7
S-12	6190	5160	50	5.1
S-13	6240	5265	75	5.0
S-14	6125	5160	76.5	5.4
S-15	6120	4975	30	6.3
S-16	6115	5210	50	5.5
S-17	6200	5360	30	5.4
S-18	6030	5175	50	6.4
S-19	5900	5040	45	7.5
S-20	5940	5290	30	7.1
S-21	6245	5185	50	4.7
S-22	6410	4840	30	4.6
S-23	5800	5380	30	5.6
S-24	5810	5260	30	6.3
S-25	5795	5140	30	7.1
TP-1	6310	4675	11.5	3.2
TP-2	6560	4930	9.0	6.1
TP-3	6075	5325	8.5	6.7
TP-4	5920	5175	9.0	7.2
TP-5	5800	5110	8.7	7.2
TP-6	5830	5390	7.0	5.9
TP-7	6385	4980	8.0	5.0
TP-8	6215	5160	9.0	4.9
TP-9	6120	6065	8.0	5.9
Landfill Area				
R30-B01	11633	7681	79.5	6.0
Q29-B04	11426	6910	80.0	12.0
Q29-B01	11419	7165	50.0	11.2
Q29-B03	11215	7198	48.8	11.2
Q28-B01	11032	7239	50.0	12.2
R31-B01	12259	7644	50.0	8.3
R30-B04	11909	7612	50.0	7.1
R29-B03	11268	7711	50.0	6.7
S31-B03	11931	7958	40.0	5.1
T31-B01	12067	8097	50.0	5.3
R30-B02	11599	7237	50.0	9.9
R30-B05	11889	7390	50.0	7.8
R29-B01	11432	7440	40.0	8.6
S28-B01	11171	7815	40.0	5.7
S27-B01	10777	7700	50.0	7.5
S29-B01	11338	7845	40.0	6.0
S30-B01	11994	7778	80.0	7.6
S28-B02	11003	7748	50.0	6.2
R28-B01	11071	7584	50.0	7.9

[a] Elevations are referenced to the Chambers Works Datum.

EXHIBIT 3-11

SOIL BORING AND TEST PIT LOCATIONS
PROPOSED HAZARDOUS WASTE INCINERATOR AND SECURE LANDFILL
(continued)

Boring Number	Plant Coordinates North	Plant Coordinates East	Depth (feet)	Ground Elev. (ft)
TP-1	11583	8318	11.0	4.8
TP-2	11253	8205	11.0	4.3
TP-3	12292	7843	10.0	7.9
TP-4	12421	7695	11.0	9.1
TP-5	11578	7973	8.0	4.7
TP-6	11685	8105	10.0	4.5
TP-7	11477	8195	9.0	4.7
TP-9	11380	7993	10.0	4.2
TP-10	11084	8010	12.0	4.6
TP-11	11265	8032	10.0	3.6
TP-12	11653	8039	8.0	4.8
TP-13	11932	8043	8.0	4.4

EXHIBIT 3-12

WELL DATA
CHAMBERS WORKS AND NEARBY WELLS

WELL #	SMP(1)	LOCATION PLT. COORD N	E	DEPTH	GRD. ELEV (ft)(2)	LEVEL MSRMT CORR (ft)(3)	CASING DIAM. (in.)	COMMENT
				INTERCEPTOR WELLS				
INT-101	481	3238	7521	128	7.32	9.32	10/16	MONITOR ONLY
INT-102A	482	3238	7486	84	7.57	8.79	12/18	REPLACED 102, 7/81
INT-103A	483	5300[4]	5667	83	8.0	10.42	12/18	REPLACED 103, 9/84
INT-104	484	4816	6977	105	14.83	15.83	12/18	
INT-105	485	2108	6555	121	8.44	9.74	12/18	SEALED
INT-106	486	1251	5274	129	13.09	13.69	12/18	WAS R-6
INT-107	487	1817	3634	110	9.2	9.18	12/18	MONITOR ONLY
R-5	480	2020[4]	4575	116	12.0	12.58	12/18	RPL INT-107,SEALED9/87
INT-108	488	4167[4]	3412	88	8.80	9.80	12/18	
R-5A	480	2020[4]	4615	122	12.0	9.18	12/18	REPLACED R-5 8/87
				SUPPLY WELLS				
DW-8(R)(5)	W-80	2520[4]	2360	356	10.5	12.44	16	
WS-1(R)	W-10	1650[4]	4300	240	13.3	14.24	12/18	
WS-2(R)	W-20	1935[4]	3210	247	9.7	9.95	12/18	
WS-3(R)	W-30	4135[4]	3530	462	9.3	10.94	12/18	
R-1		1175[4]	7600	55	9.7	13.3		OFF PLANT, SEALED
R-2(R)		1180[4]	7670	480	8.4	15.1		OFF PLANT, SEALED
R-3		1190[4]	7565	60	12.6			OFF PLANT, SEALED
R-4	WR-4	1625[4]	7920	60	10.8	12.73	6	OFF PLANT, MONITOR ONLY
R-7	WR-7	670[4]	4900	141	11.8	13.14	12/18	
CP-1(R)	WP-1	6600[4]	7225	199	4.82	4.97	12	
CP-2(R)	WP-2	5640[4]	7565	228	11.37	12.57	12	
CP-3	WP-3	5720[4]	7515	104	11.39		12	MONITOR ONLY
CP-4(R)	WP-4	6625[4]	7120	89	5.67	6.17	12	
CP-5	WP-5	8000[4]	9100	80	8.21		12	MONITOR ONLY
CP-6(R)	WP-6	8000[4]	9100	185	8.20		12/18	MONITOR ONLY
CP-7(R)	WP-7	(6)	(6)		429	15.23	15.67	12/18 OFF PLANT
RANNEY	WP-8	(6)	(6)		52	17.17	17.17	12 OFF PLANT
CP-6-1(R)		8000[4]	9100	180	8.20	11.38	4	OBSERVATION WELL

(1) Sample Spot Number.
(2) Figures are Chambers Works Datum (to convert to USC & GS subtract 3.26 ft).
(3) Level Measurement Correction, figures are Chambers Works Datum (to convert to USC & GS subtract 3.26 ft).
(4) Scaled coordinates, all others are actual.
(5) (R) after the well number indicates Raritan aquifer, all others are glacial.
(6) Located along Forked Hickory-Pedricktown Road.

EXHIBIT 3-12

WELL DATA
CHAMBERS WORKS AND NEARBY WELLS
(continued)

WELL #	SMP[1]	LOCATION PLT. COORD N	E	DEPTH	GRD. ELEV (ft)[2]	LEVEL MSRMT CORR (ft)[3]	CASING DIAM. (in.)	COMMENT
				MONITOR OR OBSERVATION WELLS				
Chambers Works								
M-1	401	2938	6006	114	8.79	10.19	6	
M-2	402	2943	6006	80	8.74	9.54	6	
M-3	403	2948	6002	69	8.86	9.76	6	
M-4	404	2953	6002	35	8.86	9.86	6	
M-5	405	2958	6002	14	8.84	9.84	6	
M-6	406	3202	7566	83	6.70	7.30	6	
M-7	407	3207	7568	57	6.68	7.18	6	
M-8	408	3212	7569	25	6.90	7.50	6	
M-9A	409	4672	6261	85	13.76	16.95	6	REPLACED 9 3/86
M-10A	410	4668	6266	56	13.91	15.32	6	REPLACED 10 3/86
M-11	411	4664	6270	23	12.77	14.07	6	
M-12	412	4699	4579	90	7.74	8.04	6	
M-13	413	4700	4584	57	7.79	8.59	6	
M-14	414	4701	4590	21	7.93	11.03	6	
M-15	415	2847	7350	104	8.93	11.63	6	
M-15A	479	2780	7215	134	9.10	9.80	6	
M-16	416	2849	7355	68	8.69	11.69	6	
M-17	417	2852	7359	29	8.59	11.49	6	
M-18	418	2181	6654	109	7.05	9.05	6	
M-19	419	2179	6649	61	7.12	9.87	6	
M-20	420	2177	6642	32	7.22	8.92	6	
M-21	421	1848	6167	112	10.85	12.35	6	
M-22	422	1853	6172	60	10.83	12.73	6	
M-23	423	1857	6177	29	10.78	12.38	6	
M-24	424	1400	5788	119	10.38	11.78	6	
M-25	425	1394	5785	72	10.10	13.10	6	
M-26	426	1390	5782	33	10.08	11.78	6	
M-27	427	3590	7700	116	10.91	11.97	6	
M-28	428	3594	7702	60	11.04	13.64	6	
M-29	429	3602	7709	33	11.03	13.63	6	
M-30	430	3172	8559	99	7.91	9.21	6	OFF PLANT
M-31	431	3169	8562	61	8.31	9.21	6	OFF PLANT
M-32	432	3166	8564	18	8.41	9.21	6	OFF PLANT
M-33	433	3239	8068	116	4.67	9.38	6	OFF PLANT
M-34	434	3242	8069	58	5.47	8.23	6	OFF PLANT
M-35A	435	3246	8073	16	5.44	8.61	6	OFF PLANT REPLACED 35
M-36	436	4076	7869	117	12.42	12.82	6	
M-37	437	4079	7871	69	12.36	12.96	6	
M-38	438	4072	7867	22	12.46	12.76	6	
M-39	439	4595	7884	118	10.27	11.07	6	
M-40	440	4594	7879	65	10.12	11.22	6	
M-41	441	4593	7875	17	9.86	10.96	6	
M-42	442	4997	7066	90	9.99	12.09	6	
M-43	443	4996	7071	69	9.93	10.63	6	
M-44A	444	4995	7070	26	9.92	11.11	6	REPLACED 44, 12/81
M-45(R)	445	4100[4]	6950	198		13.08	6	SEALED
M-45A(R)	445	4038	6970	208		14.63	6	SEALED
M-45B(R)	476	4100[4]	6790	444	15.56	16.56	6	
M-45C(R)	477	4165[4]	6725	186	15.17	16.17	6	

EXHIBIT 3-12

WELL DATA
CHAMBERS WORKS AND NEARBY WELLS
(continued)

WELL #	SMP(1)	LOCATION PLT. COORD N	E	DEPTH	GRD. ELEV (ft)(2)	LEVEL MSRMT CORR (ft)(3)	CASING DIAM. (in.)	COMMENT
M-45D	478	4140[4]	6760	131	15.38	16.38	6	
M-46	446	1143	5155	18	14.59	16.69	6	SEALED
M-47A	447						6	SEALED 12/87, REPL. 47 2/86
M-48	448	5618	5073	22	9.1	9.80	6	SEALED 12/86
M-49	449	2587	3501	21	11.55	11.55	2	
M-50	450	3160	2790	20	10.14	10.24	2	
M-51	451	3344	2285	21	9.32	10.37	2	
M-52	452	3609	1874	21	9.12	9.10	2	
M-53	453	5421	2605	21	6.73	7.53	2	
M-54A	454	4227	2858	17	9.59	12.32	6	REPLACED 54 3/85
M-55	455	4009	4192	21	10.32	10.32	2	
M-56	456	3922	4879	21	9.6	10.10	2	
M-57	457	3280[4]	2600	22	9.59	10.18	4	ORIGINALLY pH 1-SEALED
M-58	458	3280[4]	2610	23	9.59	10.23	4	ORIGINALLY pH 2-SEALED
WS-1-1(R)	W-11	1580[4]	4500	166	12.5	13.69	4	
WS-1-2	W-12	1500[4]	4640	165	13.5	15.15	4	SEALED
WS-1-3	W-13	1850[4]	4400	185	13.0	15.18	4	
WS-1-4	W-14	2060[4]	4450	180	11.4	14.23	4	SEALED
WS-2-1	W-21	1825[4]	3350	247	9.0	10.10	6	
WS-2-2	W-22	1820[4]	3325	200	9.0	9.97	6	
WS-2-3	W-23	1815[4]	3300	169	9.0	9.83	6	
WS-2-4	W-24	1810[4]	3275	146	9.0	10.97	6	
WS-2-5	W-25	1750[4]	3680	147	9.5	11.77	6	
WS-3-1	W-31	4200[4]	3340	461	8.9	8.95	6	SEALED
WS-3-2	W-32	4275[4]	3320	347	9.0	9.70	6	SEALED
WS-3-3	W-33	4175[4]	3360	207	9.5	10.64	6	
M-91	491	3475[4]	4760	467	10.5	14.03	6	
M-92	492	3475[4]	4800	197	10.5	13.96	6	
M-93	493	2230[4]	6700	490	7.18	8.49	6	SEALED
M-94	494	2240[4]	6760	198	7.18	8.89	6	
M-59	459	4830[4]	5180	20	8.96	11.48	6	
M-60	460	4795[4]	5900	21	8.12	10.35	6	
M-61	461	4400[4]	6290	21	7.93	9.95	6	
WCC-1						6.40	6.48	
WCC-2						8.07	8.14	
WCC-3						7.17	7.12	
WCC-4						7.00	6.71	
WCC-5						7.25	7.00	
A-01	A01	2109	1764	18	10.49	13.39	6	
A-02	A02	2761	1410	22	13.03	16.21	6	
A-03	A03	3332	1467	25	12.75	12.83	6	
A-04	A04	4059	1444	18	8.95	10.15	6	
A-05	A05	5376	1819	17	9.26	10.99	6	
A-06	A06	6064	2303	17.5	9.38	10.66	6	
A-07	A07	6336	3305	19	9.40	10.95	6	
T-01	T01	5670	2965	28	8.39	11.69	6/4	
T-02	T02	6103	2943	26	8.86	10.95	6/4	
T-03	T03	6057	3290	22	7.61	9.22	6/4	
T-04	T04	5709	3264	20	7.37	9.92	6/4	
T-15	T15	5840	3481	18	12.20	11.91	6/4	
T-26	T26	5561	3602	18	12.78	12.66	6/4	
T-27	T27	5151	3603	18.5	12.43	12.12	6/4	
M-62	462	4318[4]	1335	82	8.5	12.58	6	

EXHIBIT 3-12

WELL DATA
CHAMBERS WORKS AND NEARBY WELLS
(continued)

WELL #	SMP(1)	LOCATION PLT. COORD N	E	DEPTH	GRD. ELEV (ft)(2)	LEVEL MSRMT CORR (ft)(3)	CASING DIAM. (in.)	COMMENT
M-63	463	4318[4]	1350	36	8.6	10.05	6	
M-64	464	4318[4]	1345	15	8.6	10.72	6	
M-65	465	3725[4]	3580	83	9.0	10.96	6	
M-66	466	3725[4]	3585	50	8.9	11.09	6	
M-67	467	3725[4]	3590	18	8.9	10.77	6	
M-68	468	2515[4]	2561	99	10.0	11.73	6	
M-69	469	2504[4]	2561	48	9.9	11.88	6	
M-70	470	2493[4]	2564	21	10.0	11.85	6	
T-10	T10	5471	3334	24	12.41	11.79	4	
T-11	T11	5461	3336	52	12.41	11.94	4	
T-12	T12	5442	3337	87	12.41	11.99	4	
T-20	T20	5784	3590	21	12.49	11.34	4	
T-21	T21	5773	3590	51	12.49	11.87	4	
T-30	T30	4983	3581	24	12.28	11.57	4	
T-31	T31	4978	3577	38	12.28	11.64	4	
M-201	201	8017	7006	20	7.5	10.08	4	
M-204	204	8160	6865	21	8.8	10.32	4	
M-207	207	8225	6781	12	5.6	6.96	2	
M-211	211	8419	6844	12	8.0	10.29	2	TOP PVC PIPE
M-215	215	8667	6900	21	7.1	9.44	4	
M-218	218	8741	6950	20	6.7	9.14	4	
M-220	220	8698	7030	21	8.2	10.00	4	
M-239	239			20		10.50	4	SEALED
M-240	240	8622	7163	20	9.1	10.89	4	
M-241	241	7701	7363	20	6.8	8.21	4	
M-242	242	8565	7290	20	7.9	9.35	4	
M-243	243	7594	7512	20	10.6	12.64	4	
M-244	244			20			4	SEALED
M-245	245	7475	7644	20	7.6	9.51	4	
M-246	246	8402	7583	18	10.7	11.90	4	
M-247	247	7372	7787	20	6.3	8.28	4	
M-248	248	8329	7717	18	10.3	10.92	4	
M-249	249	7700	7789	20	10.3	11.90	4	SEALED 10/87
M-250	250	8005	7761	20	9.0	10.78	4	SEALED 10/87
M-252	252	9041	7119	20	5.91	8.70	4	
M-253	253	8635	6852	24	6.2	9.25	6	
M-255	255	8034	6873	21	6.7	9.25	6	
M-257	257	7880	7043	25	5.2	7.38	6	
M-259	259	7660	7304	24	6.1	8.55	6	
M-260	260	8336	7906	27.8	8.1	10.40	4/8	INST. 10/86 TEFLON
M-262	262	8080	8118	24	11.2	14.70	4/8	SEALED 10/87
M-264	264	7625	8118	27.5	10.60	13.20	4/8	SEALED 10/87
M-265	265	7370	8030	21.5	7.8	11.30	4/8	INST. 10/86 TEFLON
M-266	266	8080	8167				4/6	INSTALLED 10/87
M-268	268	7625	8167				4/6	INSTALLED 10/87
T22-M01B		8541	8120	30	9.0	11.23	4	SI -1.0 to -6.7
T23-M01B		9300	8095	30	5.9	8.41	4	SI -3.6 to -9.3
P27-M01B		10620	6990	35	14.5	16.83	4	SI 1.5 to -4.2
T22-M01C		8546	8126	75	8.4	10.84	4	SI -53.3 to -59.0
T23-M01C		9292	8102	75	5.7	7.82	4	SI -54.3 to -60.0
P27-MO1C		10627	6984	80	14.6	16.66	4	SI -46.6 to -52.2
Q23-M01C		9053	7112	80	6.0	7.45	4	SI -62.9 to -57.3
R28-M01B		11100	7580	35	8.1	10.06	4	SI -18.9 to -24.6

EXHIBIT 3-12

WELL DATA
CHAMBERS WORKS AND NEARBY WELLS

(continued)

WELL #	SMP[1]	LOCATION PLT. COORD N	E	DEPTH	GRD. ELEV (ft)[2]	LEVEL MSRMT CORR (ft)[3]	CASING DIAM. (in.)	COMMENT
R28-M01C		11112	7567	80	7.8	11.15	4	SI -65.2 to -70.3
S27-M01B	10447	8144	35	4.1	6.09	4		SI -5.9 to -10.9
S27-M01C	10445	8135	80	4.6	7.43	4		SI -34.6 to -40.3
M-291	291	8061	6965	70	9.4	11.46	6	
M-292	292	8444	7607	64	9.4	11.66	6	
M-293	293	7496	7545	54	5.7	8.19	6	
<u>Carneys Point</u>								
CP-1(R)	WP-1	6600	7225	199	4.82	4.97	12	
CP-2(R)	WP-2			228	11.37	12.57	12	
CP-3	WP-3			104	11.39		12	MONITOR ONLY
CP-4(R)	WP-4	6625	7120	89	5.67	6.17	12	
CP-5	WP-5	8000	9100	80	8.21		12	MONITOR ONLY
CP-6(R)	WP-6	8000	9100	185	8.20		12/18	MONITOR ONLY
CP-6-1(R)		8000	9100	180	8.20	11.38	4	OBSERVATION WELL
CP-7(R)	WP-7			429	15.23	15.67	12/18	
RANNEY	WP-8			52	17.17	17.17	12	
<u>Atlantic Electric (off plant)</u>								
AE-2(R)	WE-2				184	10.0	18.87	
AE-3(R)	WE-3				185	9.9	19.36	
AE-5(R)	WE-5				169	11.5	13.66	
AE-6(R)	WE-6				188	8.0	13.09	
PV-1(R)	WV-1				240			
PV-3(R)	WV-3				103			
PV-4(R)	WV-4				137			
PV-5(R)	WV-5				125			
PG-1(R)	WG-1				350			
<u>Courses Landing (off plant)</u>								
CL-1(R)	WL-1				599	10.0	12.34	12/18
CL-2(R)	WL-2				637	10.8	12.51	12/18
CL-3(R)	WL-3				458	12.3	14.27	12/18
CL-1A(R)					613		25.36	2 OBSERVATION WELL
CL-1B(R)					517		24.28	2OBSERVATION WELL
CL-1C(R)					415		24.63	2OBSERVATION WELL
CL-2A(R)					593		28.07	2OBSERVATION WELL
CL-2B(R)					544		27.61	2OBSERVATION WELL
CL-2C(R)					445		27.04	2OBSERVATION WELL
CL-3A(R)					578		33.39	2OBSERVATION WELL
CL-3B(R)					512		34.12	2OBSERVATION WELL
CL-3C(R)					385		33.66	2OBSERVATION WELL
CL-4A(R)					644		46.75	2OBSERVATION WELL
CL-4B(R)					561		47.07	2OBSERVATION WELL
CL-4C(R)					440		46.68	2OBSERVATION WELL

EXHIBIT 3-12

WELL DATA
CHAMBERS WORKS AND NEARBY WELLS
(continued)

WELL #	SMP[1]	LOCATION PLT. COORD N	E	DEPTH	GRD. ELEV (ft)[2]	LEVEL MSRMT CORR (ft)[3]	CASING DIAM. (in.)	COMMENT
Proposed Secure Landfill								
P29-M01B	11211	6846	33	12	13.74	4	SI 28-33	
P29-M01C	11221	6834	75.3	12	13.75	4	SI 70-75	
Q30-M01B	11704	7099	30	10.8	12.49	4	SI 25-30	
Q30-M01C	11694	7109	69	10.8	12.36	4	SI 64-69	
R26-M01B	10180	7675						
R28-M02B	10831	7418	41	10.6	11.03	4	SI 36-41	
R28-M01C	10829	7428	74.8	10.4	12.16	4	SI 70-75	
R31-M01B	12176	7350	32	9.3	11.57	4	SI 27-32	
R31-M01C	12187	7357	64	9.1	10.90	4	SI 59-64	
S27-M02B	10565	7800	29.5	7.2	9.11	4	SI 24-29	
S27-M02C	10570	7800	63.0	7.0	9.13	4	SI 57-63	
S32-M02B	12425	8021	39.3	9.5	10.95	4	SI 34-39	
S32-M02C	12437	8024	69	9.0	10.52	4	SI 64-69	
S32-M01B	12500	7768	29.3	8.6	9.53	4	SI 24-29	
S32-M01C	12499	7777	58.8	8.4	9.70	4	SI 54-59	
T28-M01B	11151	8208	19.5	4.7	7.89	4	SI 14-19	
T28-M01C	11153	8199	50.0	4.8	7.95	4	SI 45-50	
T29-M01B	11590	8295						
T29-M01C	11595	8295						
T31-M01B	12116	8254	33.8	5.7	7.97	4	SI 29-34	
T31-M01C	12118	8266	56.5	6.2	7.86	4	SI 51-56	
Proposed Incinerator								
M15-M01B	5825	5600	40	4.6	6.53	4	IW-1s;	SI -5.4 to -11.1
M15-M01C	5834	5607	75	4.9	7.18	4	IW-1d;	SI -45.6 to -51.3
L15-M01B	5722	5197	40	7.4	9.24	4	IW-2s;	SI 2.6 to -8.27
L15-M01C	5715	5196	75	7.4	9.57	4	IW-2d;	SI -33.9 to -39.6
K17-M01B	6480	4773	30	4.5	7.02	4	IW-3s;	SI -18.3 to -20.7
K17-M01C	6486	4763	75	4.4	6.46	4	IW-3d;	SI -45.4 to -51.1
L16-M01B	6349	5248	30	3.6	5.90	4	IW-4;	SI -19.4 to -25.1
M15-M02B	5709	5464	40	7.5	9.77	4	IW-5;	SI -15.5 to -21.2
H17-M01B	6550	3646	30	10.9	13.80	4	IW-6s;	SI -12.9 to -18.6
H17-M01C	6548	3642	45	10.8	12.94	4	IW-6m;	SI -24.2 to -29.2
J17-M01B	6549	4152	30	11.1	13.74	4	IW-7;	SI -8.4 to -13.9
H16-M01B	6372	3561	30	8.6	10.80	4	IW-8;	SI -16.0 to -21.4
L19-M01B	7241	4971	25	12.5	14.42	4		SI -7.5 to -13.2
L19-M01C	7239	4965	50	12.5	14.91	4		SI -40.0 to -48.6

The geologic information obtained from these borings and hydraulic testing of the subsurface (see Section 3.2.1.1) form the basis for the conceptual model for subsurface stratigraphy and, consequently, the hydrogeologic setting. This model was first developed by LBG and has since been refined by WCC, and is the basis for the assumptions and boundary conditions used by WCC in their numerical flow modeling effort that has been conducted since 1986 (see Appendix D for discussion of WCC computer model). In short, LBG interpreted the subsurface deposits to consist of interbedded gravelly sands, silts and clays, including the surficial deposits (which they called glacial deposits), which form a mantle over the Potomac Group, and the Raritan and Magothy Formations (P-R-M). Although it was believed that the glacial deposits consist of lenses of predominantly sandy material, interspersed with finer materials, it was demonstrated that clay-rich layers are laterally extensive enough to affect the hydraulic behavior of the system.

With the geologic information available from numerous logs and hydraulic testing, LBG began to delineate the characteristics of the system. They found the glacial deposits to contain three sandy zones (shallow, middle, and deep) interspersed with clay-rich and silty materials. The sandy zones acted as aquifers, often displaying semi-confined properties. They suggested that these deposits have a contact with the shallow aquifer of the P-R-M in the neighborhood of 100 to 120 ft below the surface. Borehole data from the drilling of well M-91 put the bottom of the P-R-M or the depth to weathered pre-Cretaceous basement rock at approximately 500 ft. This is consistent with the mapping work of Gill and Farlekas (1976)[14] who placed the 600 ft pre-Cretaceous bedrock contour immediately east of the site. WCC has modified the LBG model to include an additional perched aquifer horizon. They also believe that the zone referred to as the deep glacial zone by LBG may actually be a shallow aquifer zone of the P-R-M system. This interpretation puts the Shallow Raritan of LBG as the middle aquifer of the P-R-M system and the Deep Raritan as the deep aquifer of the P-R-M system. This characterization of the P-R-M is more consistent with other regional interpretations of the system which delineate three aquifers within the deposits. A correlation of the interpretations of Leggette, Brashears & Graham and Woodward-Clyde Consultants is given below:

Woodward-Clyde	Leggette, Brashears & Graham
Aquifer A (Perched Aquifer)	(not recognized)
Aquifer B (Upper Pleistocene)	Shallow Glacial Aquifer
Aquifer C (Lower Pleistocene)	Middle Glacial Aquifer
Aquifer D (Cretaceous Aquifer #1)	Deep Glacial Aquifer
Aquifer E (Cretaceous Aquifer #2)	Shallow Raritan
Aquifer F (Cretaceous Aquifer #3)	Deep Raritan

Historically, most of the site-specific well and boring data for Chambers Works comes from either the area south of Henby Creek or the area immediately adjacent to Secure Landfill "C". This information forms the basis of the conceptual model of subsurface stratigraphy which has been extrapolated to other areas of the Chambers Works Property. These areas include the proposed secure landfill at the north end of the property where the Carneys Point Plant was located until it closed in 1979. In general, the stratigraphic features in the

Carneys Point area of the Chambers Works Plant are not different from those features to the south, with surficial deposits of interbedded gravelly sands, clays and silts. However, to verify this model of the subsurface and to provide more detail concerning the geometries of these deposits in the Carneys Point area, Du Pont has completed a drilling program involving seventeen 40 to 50 ft boreholes, and three 80 ft boreholes, and twelve test pits.

Several cross-sections of the stratigraphy at Chambers Works and nearby have been developed from geologic logs by both Leggette, Brashears & Graham and Woodward-Clyde Consultants. Exhibit 3-13 displays a few typical cross-sections. Note the vertical and horizontal variability typical of alluvial deposits and the lens-like beds. Study of the logs and cross-sections developed by both contractors indicates that sandy (aquifer) units that may be separated by a thick clay-rich (confining) unit in one area may be in contact a short distance away. However, the lateral continuity of the clayey units seems to increase with depth. Section 3.1.2.2 provides an evaluation of the stratigraphic data obtained from this program and an assessment of the validity of extending the stratigraphic model developed for the southern end of the plant to this area. ICF observed drilling activities and conducted a surface geophysical survey in this area.

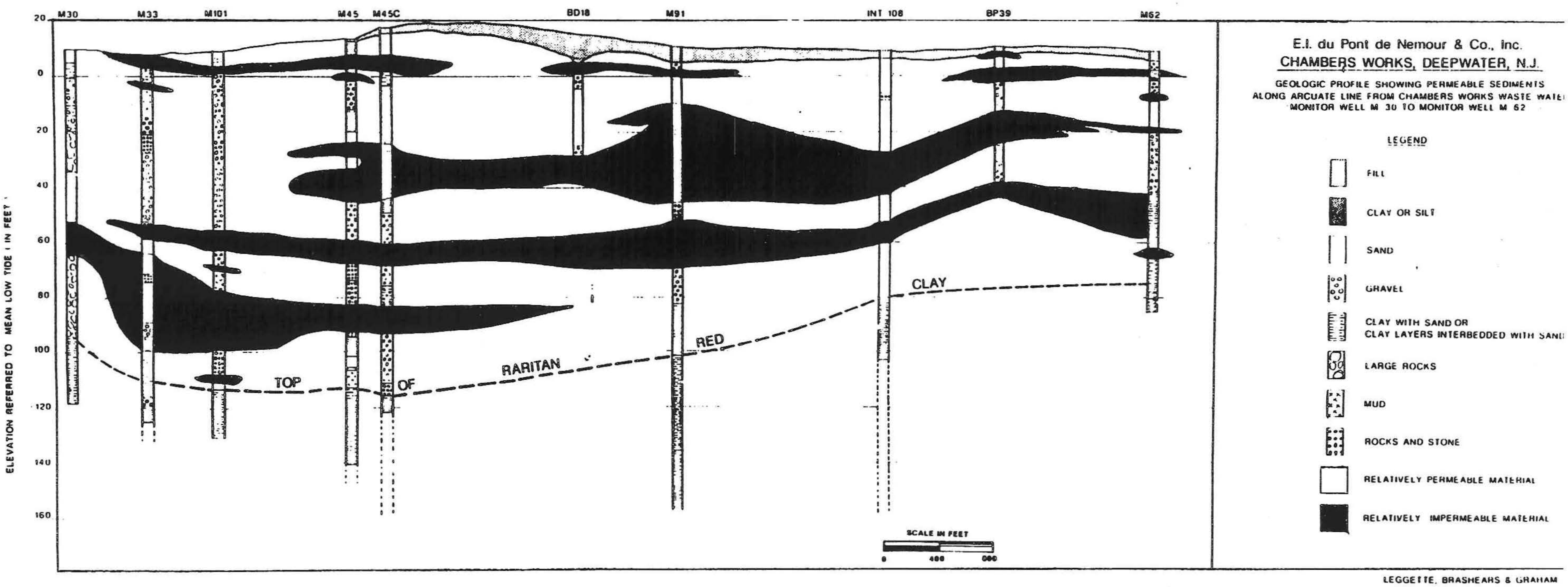
3.1.2.2 Evaluation of Available Data

To evaluate the stratigraphic data available for the Chambers Works Plant, ICF reviewed regional information, conducted a review of numerous stratigraphic logs available in reports produced by LBG and WCC, observed the installation of soil borings at the proposed secure landfill site, and conducted a geophysical survey of that area. The geophysical survey provided an independent means to assess the depths and extensiveness of clay or confining units.

Resistivity Survey. In an attempt to corroborate the observation well and boring data in the area of the proposed landfill, ICF proposed a geophysical survey at the landfill site. The site was originally located immediately adjacent to existing Secure Landfill "C". A review of subsurface lithology and water chemistry in this area led to ICF's choice of seismic refraction to define the lithology. Other geophysical techniques were also considered, including surface resistivity. Initially, surface resistivity was not recommended because of elevated levels of total dissolved solids (TDS) in ground water from adjacent wells. These elevated TDS levels would increase the conductivity of earth materials, especially the sand. The lowered resistance of the sandy material would reduce the difference or contrast between the resistance of sandy and clay-rich materials, making it difficult to distinguish the presence of clay lenses and layers from the surrounding sediments. In addition, the increased flow of current in materials near the surface limits the testing of deeper materials.

EXHIBIT 3-13

STRATIGRAPHIC CROSS-SECTIONS



Source: E.I. Du Pont de Nemours & Company, 1986, Information Required by USEPA Regarding Section 3005(j)13 of HSWA, Volume 1.

EXHIBIT 3-13

STRATIGRAPHIC CROSS-SECTIONS (continued)

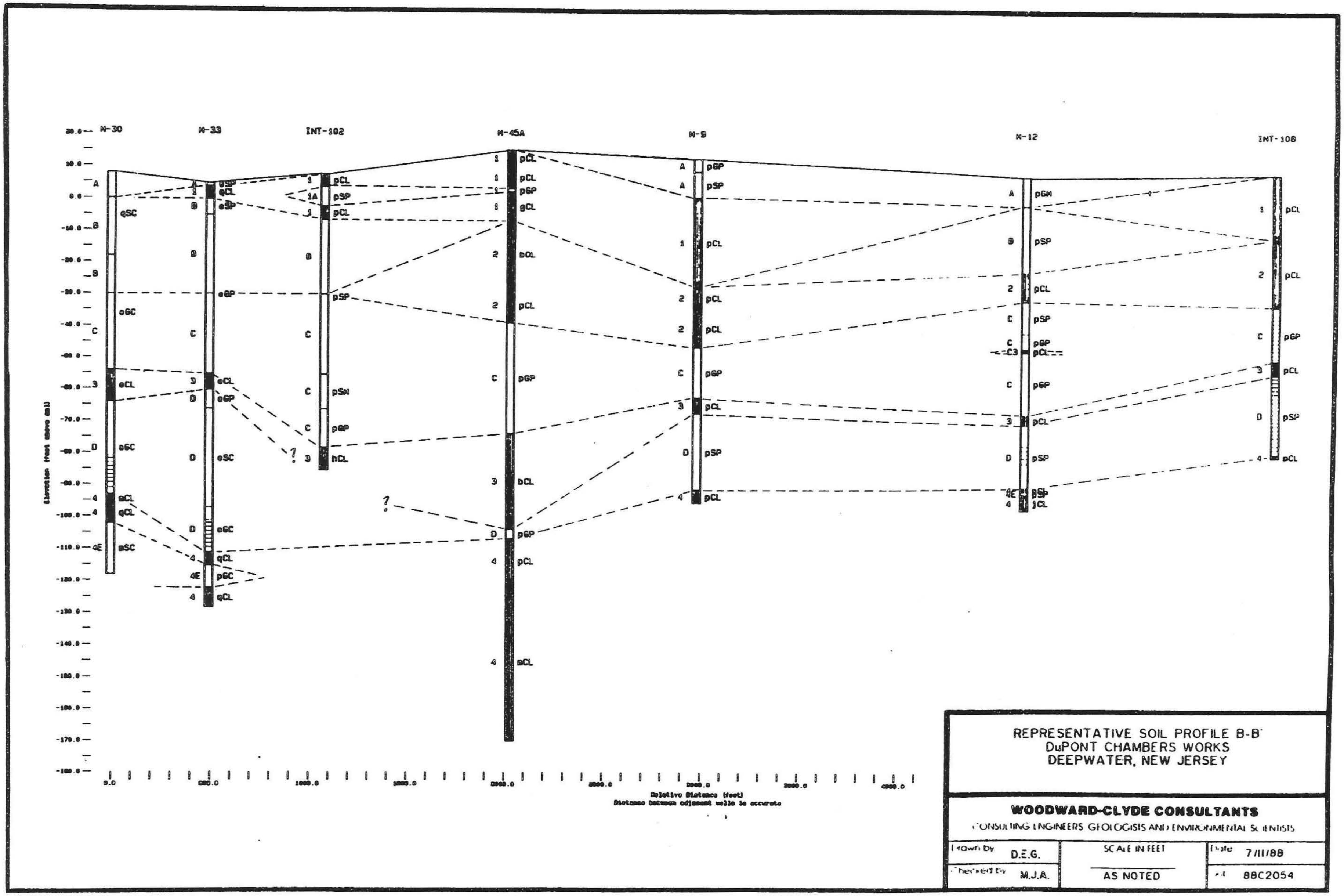


FIGURE C-7

Source: Woodward-Clyde Consultants, 1988, Draft Hydrogeologic Conditions Hazardous Waste Incinerator and Secure Landfill, Volume VII.

The proposed landfill site was subsequently relocated by Du Pont because of the presence of wetlands at the original proposed location. The movement of the proposed landfill site further northwest toward the Delaware Estuary on Carneys Point created a slightly different environment for the surface geophysical survey. The new site was a former industrial area where explosive materials had been manufactured and tested. Buildings were located in this area and were subsequently razed, however some of the building foundations still exist. These building foundations presented a problem for installing the seismic refraction source shot-holes. Also smokeless powder and other munitions had been produced in this area, and although no evidence of explosive materials at the site has been found, the seismic technique was not deemed appropriate without an extensive site assessment.

Thus, the use of surface resistivity was re-evaluated for this area. Concern focused on potentially high TDS concentrations which would mask the detection of the clays. Du Pont water quality analyses for wells in the area of the proposed landfill were reviewed. The TDS levels and in-situ conductivity readings were significantly lower than those found in wells near Secure Landfill "C". Therefore, ICF suggested that the survey be performed using surface resistivity techniques.

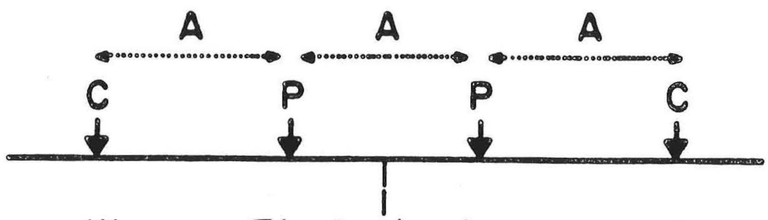
The objective of the surface resistivity survey was to define changes in lithology of the surficial deposits, which were estimated to extend to depths of approximately 100 feet in this area. A secondary objective was to corroborate data obtained by Du Pont's consultant, Woodward-Clyde Consultants, through their subsurface exploration program. Boring logs from observation wells and borings were made available to ICF for comparison with the geophysical interpretation.

<u>Theory Operation and Limitations</u>. The theory of surface resistivity is relatively simple. Four metal electrodes are pushed a few centimeters into the earth. The arrangement of the electrodes is called an array. The array chosen for this survey was the Schlumberger, in which the electrodes are placed in a straight line at measured distances from each other. Exhibit 3-14 shows three common array configurations. For the Schlumberger array, two outer electrodes are placed at a distance (L spacing) from the center of the array, at least 3 times the spacing between the inner electrodes. A current is applied and flows from one of the outer electrodes to the other outer electrode. These electrodes are commonly called the current electrodes, and the two inner electrodes are called the potential electrodes.

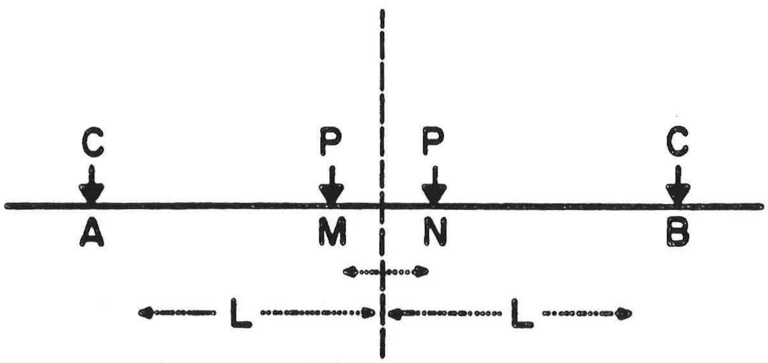
The potential electrodes measure the drop in current as it flows from one current electrode to the other. The value (amperage) of this current flow is related to the resistance of the subsurface materials. By increasing the distance between the current and potential electrodes, the method can be used to measure deeper subsurface regions. Changes in resistivity can then be associated with materials in certain settings. For example, a dry clean sand would have a higher resistivity than a saturated sand, which in turn would have a higher resistivity than a saturated clay. The resistivity of a subsurface material may be calculated from voltage and current measurements with the following formula:

EXHIBIT 3-14

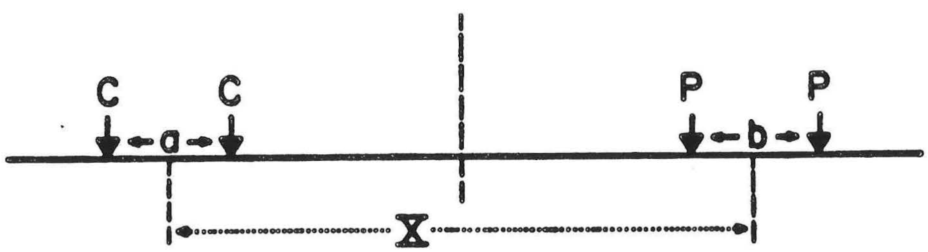
THREE COMMON ELECTRODE ARRANGEMENTS



Wenner Electrode Arrangement



Schlumberger Electrode Arrangement



Axial Bipole - Bipole Electrode Arrangement

C : designates a current electrode
P : designates a potential electrode

$$\rho_a = K [V/I]$$

where: K = a geometric factor described by $\{\pi MN [(L/MN)^2 - .25]\}$
V = voltage
I = current
L = distance of the electrode to the center point
MN = distance between potential electrodes

There are two main methods used to perform resistivity surveys, profiling and sounding. In developing profiles, the electrodes are spaced at constant distances and the entire array is traversed along a survey line. Thus, lateral changes in resistivity can be detected at a constant depth. In a sounding the electrodes are moved around a stationary mid-point, which allows evaluation of resistivity with increasing depth. Soundings were used for the survey at the proposed landfill site.

The Abem Terrameter resistivity meter, with the ability to produce 20 milliamps of current, was used to perform the survey. Since we were attempting to investigate depths greater than 100 feet with expected intervening clay layers of low resistance, to supplement the current of the Terrameter, a booster unit with the capacity to increase the current to 500 milliamps, was used.

The Abem directly measures the resistance, V/I, and uses signal stacking to constantly update the resistance readings through a predetermined number of measurement cycles. This allows the operator to measure resistance at greater depths using a relatively low current. The operator selects a reading during the measurement cycle, usually based on successive readings remaining constant. The reading is then used to determine the apparent resistivity at the particular spacing of the electrodes. The inner potential electrodes are only moved when the resistance becomes too small to be measured accurately. To compensate for any possible changes in lateral resistivity near the surface, the spacing between the current electrodes are reduced by at least two previously measured spacings. Measurements are then taken, overlapping the previous measurements at the smaller spacing between the potential electrodes with the successive measurements at a larger spacing.

<u>Field Procedures - Resistivity Soundings</u>. The first step in performing the geophysical survey was to establish a surface grid over the approximate 25 acre area of the proposed landfill. The grid was constructed by using standard surveying techniques and grid points were placed on 200 foot centers. This grid spacing was selected to allow coverage of expected changes in lateral lithology, which were presumed to be the intervening clay layers overlying the P-R-M system. The intervening clay layers had been mapped by previous investigations performed by LBG and WCC in areas south and east of the proposed landfill site. These clay layers were initially assumed to be of similar lateral extent in this area.

A total of 39 sounding locations were explored. Not all of the soundings reached the exploration depth of approximately 100 feet because 1) a maximum L-spacing could not be achieved due to barriers (i.e., water bodies) and 2) clay lenses of sufficiently low resistance above the P-R-M System caused the injected current to flow readily in the clay and not penetrate to greater depths. At a few grid points, the measurements for some spacings could not be made because of surface water or impervious materials (asphalt or concrete) on the surface. In most areas holes were drilled through the surface to facilitate electrode insertion to the subsurface.

The soundings were performed at each grid point and all resistivity values were assumed to reflect subsurface materials at that point. The electrode arrays were placed along the grid lines, and electrode positions verified. If the resistivity values measured were too small and considered inaccurate, the potential electrode spacing was increased and the measurement repeated. Measured values were recorded on a form, which contained the location of the sounding on the grid, the orientation of the electrode array (north, south, east and west), current and potential electrode spacings, resistivity values, and any notes concerning the site which may affect the readings. Current at 200 milliamps was applied to the outer electrodes since this value was the maximum current that could be caused to flow into the subsurface at this particular site, due to the contact resistance at the electrodes.

The apparent resistivity was then calculated using the formula provided above. The apparent resistivity can be defined as that combination of the potential, current, and electrode geometric factors which would equal the true resistivity of the earth if it were uniform. In effect, the measurements were normalized to a uniform earth. Any observed variations in the measurements, therefore, can be interpreted as deviations from a uniform earth, and represent the geological target of the resistivity survey.

Stratigraphic Interpretation. To interpret resistivity data, ICF used a software program known as RESIX developed by Interpex, Golden, Colorado. This program can be used to analyze resistivity data using a variety of electrode arrays. The data can then be modeled and the results interpreted. All resistivity sounding data were analyzed using this software.

The following conclusions concerning the stratigraphy at the proposed landfill were based on the results of the resistivity survey, observation of soil boring installation, and review of WCC and LBG reports:

- In general, the surficial deposits do not have continuous clay-rich (confining) layers and may be better characterized as a single hydraulically-connected unit; and

- The existence of laterally extensive clay-rich units at depths generally greater than 100 feet is confirmed.

ICF used borehole geophysical log data gathered by LBG on wells No. M-91 and M-93 located in the eastern portion of the property to calibrate the interpretations. These geophysical logs were used to assign resistivity ranges to certain materials, and the following ranges were used to interpret the resistivity sounding data:

Ohms	Description
0 - 50	Clay
50 - 80	Sandy Clay
80 - 120	Silty Sand
>120	Sand

These basic descriptions are necessary because interstitial water chemistry is not completely known in this area, especially in the vertical dimension. As previously mentioned the water chemistry can seriously affect resistivity values. By using resistivity ranges and general lithologic descriptions, we believe that any apparent inconsistencies caused by water chemistry differences can be overcome without reducing our ability to identify lithologic differences.

A review of the sounding data indicates a wide range of resistivity, with some fairly low (10 ohm-feet) readings measured at depth. We believe that these low readings are due to the material (saturated clay) and elevated concentrations of TDS possibly caused by the intrusion of the Delaware River. The data interpretation was made using the resistivity ranges mentioned above. Exhibit 3-15 presents the interpretations made regarding the depth and thickness of significant clay units.

The interpretation of the resistivity sounding data was compared with the interpretation of WCC that describes three separate surficial aquifers beneath the new landfill site. The resistivity soundings do not indicate such clearly defined zones in the proposed landfill area. The resistivity data generally indicate a 3 or 4 layer system, but the locations of the sand and clay layers do not appear to be continuous laterally or vertically. The soundings indicate that subsurface materials containing significant amounts of silts and clays may exist at depths ranging from 16 to 100 feet in some areas of the proposed landfill. At other sounding locations the materials appear to have less silt and clay to depths of approximately 100 feet, where fine materials are consistently encountered. There is a lot of variability in depth of the interpreted clay layers and their thicknesses. We were unable to make any substantial correlation of interpreted lithology for a sufficient number of soundings. A review of the geophysical borehole logs prepared by LBG indicates that the clear cut change in lithology may not exist, electrically.

EXHIBIT 3-15

DEPTHS OF SIGNIFICANT CLAY UNITS

Sounding	Depth (ft) from surface *
A-7	13.7 - 31.4, 50.6+
A-6	4.4+
A-5	30.1+
A-4	97.8+
A-3	60.2 - 93.1
A-2	28.4+
B-7	4.7 - 51.4, 127.8+
B-6	4.6 - 8.2, 24.2+
B-5	0.0 - 1.0, 9.8+
B-4	14.2 - 37.0+
B-3	2.9 - 28.7+
B-2	0.0 - 9.3, 55.4+
C-7	None Detected
C-6	2.3 - 4.9, 24.7+
C-5	89.1+
C-4	38.2 - 70.2
C-3	7.5 - 15.1, 33.4
C-2	37.6+
D-7	28.4 - 82.4
D-6	10.2+
D-5	0.0 - 0.6, 8.9 - 68.3+
D-4	38.0 - 67.5+
D-3	1.9 - 7.2, 26.9 - 88.7+
E-7	0.0 -1.5, 6.0 - 22.4+
E-6	16.2 - 100.4
E-5	0.0 -1.3, 108.3+
E-4	6.3 - 12.2, 37.5+
E-3	3.4 - 8.6, 24.6+
E-2	Not surveyed
F-6	57.3+
F-5	114.5+
F-4	0.9 - 15.9
G-6	Not Surveyed
G-5	1.4 - 15.3, 151.4+
G-4	Not Surveyed
H-6	30.2 - 78.7+
H-5	2.7 - 20.6, 24.4+
H-4	1.5 - 3.2+

(+) Symbol denotes that material below this depth had a low resistivity causing no exploration below this depth.

(*) Not corrected for elevation.

Our interpretation is further supported by slug test data from the WCC report entitled "Supplemental Report Geotechnical/Hydrological Investigation Proposed New Secure Landfill" dated April 19, 1989. Slug tests were performed in the B and C zone aquifers in the area of the proposed landfill. WCC reports that in the B aquifer, hydraulic conductivities varied between 7.1 x 10^{-6} ft/sec to 1.0 x 10^{-2} ft/sec (silty sand to gravel) and in the C aquifer the hydraulic conductivities varied from 3.5 x 10^{-6} ft/sec to 1.7 x 10^{-3} ft/sec (sand to gravel). This represents a large range, especially for the B aquifer. WCC excluded the greater hydraulic conductivity value in the C aquifer based on "uncharacteristically slow" results for the logged soil type. We cannot comment on this exclusion since we did not perform any geophysical soundings in the vicinity of this well (X27-M01C). However, we believe that the variability of the slug test results in the B aquifer is supported by our findings of variability in the resistivity values in this zone. It does appear, however, that the C zone materials are generally more consistent as interpreted from the resistivity soundings.

3.1.3 Topography

The proposed landfill and incinerator units are located on the surficial exposures and Holocene and Pleistocene-age deposits within the 100-year floodplain of the Delaware River Estuary. During the Holocene, Pleistocene surficial materials were reworked to some degree by both daily and extreme fluvial and tidal activity in the Delaware River Estuary, the processes of soil development, bioturbation, and man's activities. It is these processes that are responsible for the final form and geometry of the floodplain today. Accordingly, the surrounding topography is gently rolling, with elevations ranging from approximately +3 feet National Geodetic Vertical Datum (NGVD) to approximately +85 feet NGVD. The high elevations tend to be isolated areas, with the typical elevation ranging from 10 to 20 feet. Some naturally low-lying areas contain fill deposits reaching elevations greater than +8.5 feet. Bedrock outcrops do not occur on the floodplain in the vicinity of the proposed landfill and incinerator, and thus, topographic features are likely attributable to irregular fluvial/tidal, glacial outwash, and fill deposits, and differential erosion.

3.1.4 Soils

Based on information obtained from the 1969 Soil Survey of Salem County, New Jersey[15], the soils underneath and surrounding the Chamber Works property consist primarily of two types: Mattapex silt loam and made land (from dredged river materials). Where these two soil types are not present, the area consists of freshwater marsh sediments.

The Mattapex series consists of moderately well drained, slowly permeable soils that are silty in the upper 30 inches and have a high water-holding capacity. Organic matter content and natural fertility are moderate for these soils, and frost heaving is severe. The water table rises to within 2-3 feet of the surface during the late winter and spring, as well as during wet periods of the summer. These soils developed in a silty mantle deposited over partly weathered beds of coarse sediments, and have slopes of two to five percent.

The man-made fill, which underlies the bulk of the Chamber Works property, is composed of materials (ranging from clay to boulders) that were dredged from the Delaware River and its tributaries. Deposits of silt, very fine sand, and clay make up the bulk of the made land deposits. These fill materials range from 10 to 20 feet in thickness and are characterized by low organic-matter content, high water-holding capacity, moderately low permeability, and severe frost heaving. Foundations built in this soil are likely to be relatively unstable, and the soil is subject to wind erosion. In areas where it is determined that subsurface materials are unstable, Du Pont builds structures on pilings.

3.2 HYDROLOGY AND WATER QUALITY

The hydrology and quality of surface and ground water in the vicinity of the Chambers Works Property are affected by several processes. The more important processes include the estuarine mixing of surface water from marine and non-marine sources (additional information on this topic is provided in Section 3.4.2), the subsequent mixing of this estuary water with the ground water of the Pleistocene aquifer system and its transmission into the P-R-M aquifer system, or the discharge of water from the Pleistocene aquifer system, and the anthropogenic input of contaminants and physical modifications to the system caused by human activities.

The sections that follow describe the unconfined and confined aquifer systems at the scale of Salem County and, in some cases, regionally. Site data concerning past modifications of the natural system in the Chambers Works area are presented. The details of the stratigraphy of both the P-R-M system and the Pleistocene system and how they affect the dynamics of ground-water flow are discussed. This section also contains data specific to the Chambers Works Property, a review of field studies and modeling that Du Pont has conducted to better understand the dynamics of the flow at Chambers Works, and results of studies that ICF has conducted to validate Du Pont's field investigations. Appendix A contains a bibliography of additional pertinent empirical information on the geology and hydrology of the Coastal Plain.

3.2.1 Ground Water Uses and Quality

The ground-water hydrology of the area of Deepwater and the Du Pont Chambers Works Property consists of the confined, regional aquifer system formed by the Potomac Group and the Raritan and Magothy Formations (P-R-M aquifer), in conjunction with the localized aquifers of surficial Pleistocene/Holocene sediments that were deposited during and after the Ice Ages of the Quaternary.

The P-R-M system is the most heavily pumped, confined, Coastal Plain aquifer and represents 60 percent of the total pumpage from the Coastal Plain.[16] However, the P-R-M is not the primary source of water for every county. Exhibit 3-16 presents data concerning water withdrawals from the Coastal Plain aquifers

EXHIBIT 3-16[a]

WATER WITHDRAWALS AND WELL CHARACTERISTICS

*Mgal/d = millions of gallons per day; gal/min = gallons per minute; ft = feet.

Aquifer name and description	Aquifer with-drawals in 1980 (Mgal/d)*	Well characteristics: Depth (ft)* Common Range	Well characteristics: Yield (gal/min)* Common Range	Well characteristics: Yield (gal/min)* May Exceed	Remarks
Coastal Plain aquifers: Kirkwood-Cohansey aquifer system: Sand, quartz, fine to coarse grained, pebbly; local clay beds. Unconfined.	70	20-350	50-1,000	1,500	Ground water occurs generally under water-table conditions. Aquifer system extends from southern Monmouth County to Delaware Bay and from 12 mi. southeast of the Delaware River to the Atlantic Ocean. Aquifer thickness can exceed 350 ft. Brickish and salty water may occur in coastal areas.
Atlantic City 800-foot sand: Sand, quartz, medium to coarse grained, gravel, fragmented shell material. Confined.	20	450-950	600-800	1,000	Principal confined artesian aquifer supplying water along the barrier beaches in Cape May, Atlantic, and Ocean Counties. Aquifer thickness generally ranges between 100 and 150 ft. Water quality suitable for most uses.
Wenonah-Mount Laurel: Sand, quartz, slightly glauconitic, very fine to coarse grained, layers of shells. Confined.	5	50-600	50-250	500	Important confined aquifer in the northeast and southwest part of the Coastal Plain. Aquifer thickness generally range between 60 and 120 ft. Water quality suitable for most purposes.
Englishtown aquifer: Sand quartz, fine to medium grained, local clay beds. [illegible]fined.	12	50-1,000	300-500	1,000	Important source of water for Ocean and Monmouth Counties. Confined aquifer thickness generally ranges between 60 and 140 ft. Excellent water quality.
Potomac-Raritan-Magothy aquifer system: Alternating layers of sand, gravel, slit, and clay. Confined.	243	50-1,800	500-1,000	2,000	Highly productive and most used confined aquifer in the Coastal Plain. Aquifer system extends throughout Coastal Plain and attains maximum thickness of 4,100 ft. Includes two aquifers in northern Coastal Plain: Farrington and Old Bridge aquifers. Salty water increases with depth and in downdip direction. Excellent water quality but large iron concentrations in some areas.

[a]U.S. Geological Survey, 1984, National Water Summary, Hydrologic Events, Selected Water-Quality Trends, and Ground Water Resources: U.S. Geological Survey Water-Supply Paper 2275.

in 1980, in addition to information concerning the typical completion depths of wells, their individual yields, and the dominant source of water for Coastal Plain counties in New Jersey. Between the period of 1956 and 1980, the withdrawals from the P-R-M system have more than doubled from 120 Mgal/day to about 243 Mgal/day[17]. Over this time period, the water levels in the system have declined dramatically. The Delaware River Basin Commission reports that in Camden County, cones of depression from heavy pumping have lowered the hydraulic heads approximately 80 feet below sea level and that in the vicinity of Wilmington and Penns Grove, New Jersey "heads have been lowered to 50 to 100 feet below sea level at specific well fields."[18] In Salem County, yields from the P-R-M as high as 860 gpm have been reported.[19]

Fusillo and Voronin (1981)[20] conducted chemical analyses of 262 wells tapping the P-R-M aquifer system from Trenton to Pennsville, New Jersey. Exhibits 3-17 and 3-18 show a summary of the results of their analyses for both dissolved inorganic parameters and volatile organic compounds, respectively. The data for the inorganic parameters show a wide range of values. Specific conductance ranged from 39 to 4200 micromhos, with a median of 246, and chloride concentrations ranged from less than 1 mg/L to 810 mg/L, but the median concentration was only 15 mg/L. Other ions showed similar ranges, with iron exhibiting the widest range in concentration.

Shaefer (1983)[21] sampled 202 wells in the Coastal Plain for chloride. These wells were screened in 13 different aquifers in eight counties including Salem County. This work augments the work of Gill and Farlekas (1976)[22] which documents the movement of intruding saltwater by mapping the 250 mg/L liter chloride line in the P-R-M aquifer. The results from 24 well samples taken in Salem County from the P-R-M system indicated a range from 8.4 to 210 mg/L. In general, this is consistent with the past investigation; however, five wells, including Du Pont Drinkwater 8, had record high concentrations. The Du Pont well had a concentration of 64 mg/l. This level, although high, does not approach the 250 mg/L drinking water standard. The other wells with highs were generally located along the Delaware Estuary. It is possible that the increased chloride concentration is the result of recharge from the Delaware Estuary and not the up-dip intrusion of the salt-wedge in the P-R-M aquifer from the southeast. Exhibit 3-19 shows the typical characteristics of the salt-wedge along an approximately 50-mile transect from the Delaware River east. In fact, the digital simulations of the P-R-M system by Luzier (1980)[23] indicate that the heavy pumping of the system along an axis from Trenton-Philadelphia-Wilmington may be inducing recharge of water with 250 to 3000 mg/l chloride concentration from the Delaware Estuary into the system in addition to promoting the movement of the salt wedge landward and up-dip.

The following section focuses on the site-specific hydrogeology of the Chambers Works. In particular, the hydrogeologic information that has been developed over the past 20 years is considered. This is the best information available to characterize the hydraulic characteristics of the surficial deposits and, consequently, to assess the potential for contaminant movement into the regional system. Following the discussion of hydrogeology the topic of ground water quality will again be considered.

EXHIBIT 3-17[a]

MINIMUM, MEDIAN, AND MAXIMUM VALUES OF PHYSICAL AND DISSOLVED CHEMICAL PARAMETERS IN WELLS SAMPLED

Concentrations in milligrams per liter, except as noted

Parameter	Minimum	Median	Maximum
Temperature (°C)	12.7	14.5	26.0
Specific conductance (umhos/cm)	39	246	4200
pH	4.4	6.6	8.3
Carbon dioxide	0	31	616
Alkalinity (as $CaCo_3$)	0	76	1580
Nitrogen, NO_2 + NO_3	0	.03	18
Phosphorus, orthophosphate	0	.01	.84
Organic carbon	0	1.7	108
Hardness (as $CaCO_3$)	0	60	570
Hardness, noncarbonate (as $CaCO_3$)	0	0	230
Calcium	.1	16	118
Magnesium	.1	4.7	100
Sodium	1.8	14	670
Potassium	.5	4.4	100
Chloride	.8	15	810
Sulfate	0	18	770
Bicarbonate (as HCO_3)	0	93	1930
Silica (as SiO_2)	0	9.5	53
Barium (ug/L)	<2	70	410
Beryllium (ug/L)	<1	<1	8
Cadmium (ug/L)	<1	2	22
Cobalt (ug/L)	<3	<3	240
Copper (ug/L)	<10	<10	930
Iron (ug/L)	3	1400	79000
Lead (ug/L)	<10	<10	47
Lithium (ug/L)	<4	7	68
Manganese (ug/L)	<1	71	15000
Molybdenum (ug/L)	<10	<10	60
Strontium (ug/L)	<1	300	4400
Vanadium (ug/L)	<6	<6	20
Zinc (ug/L)	<4	9	600
Dissolved solids	25	148	2200

[a]Fusillo, T.V. and Voronin, L.M., 1981, Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980. U.S. Geological Survey Open-File Report 81-814.

EXHIBIT 3-18[a]

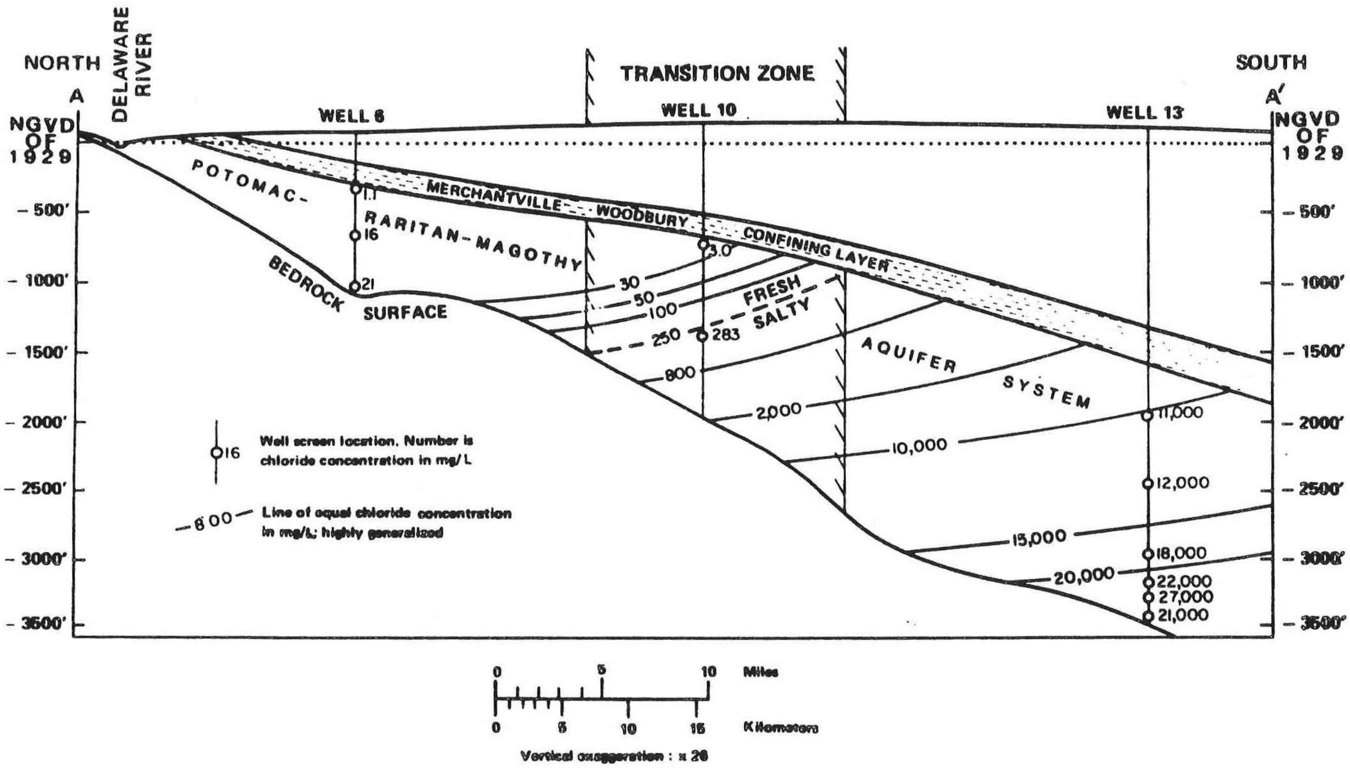
VOLATILE ORGANIC COMPOUNDS AND MAXIMUM DETECTED CONCENTRATIONS IN WELLS SAMPLED

Compound	Number of wells with detectable concentrations	Maximum concentration detected (ug/L)
Benzene	18	1960
Chloroform	4	70
1, 1-Dichloroethylene	12	670
1, 2-(Trans)-Dichloroethylene	4	68
Methylene chloride	3	22
Tetrachloroethylene	12	335
Toluene	15	10
1, 1,2-Trichloroethane	3	90
Trichloroethylene	24	472
One or more compounds	46 (19 percent of 246 wells sampled)	

a Fusillo, T.V. and Voronin, L.M., 1981, Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980. U.S. Geological Survey Open-File Report 81-814.

EXHIBIT 3-19[a]

CROSS SECTION SHOWING THE APPROXIMATE DISTRIBUTION OF
OF CHLORIDE IN THE POTOMAC-RARITAN-MAGOTHY AQUIFER SYSTEM



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[a]Luzier, J.E., 1980, Digital-simulation and Projection of Head Changes in the Potomac-Raritan-Magothy Aquifer System, Coastal Plain, New Jersey: U.S. Geological Survey Water-Resources Investigations 80-11, 72 p.

3.2.1.1 <u>Chambers Works Hydrogeology</u>

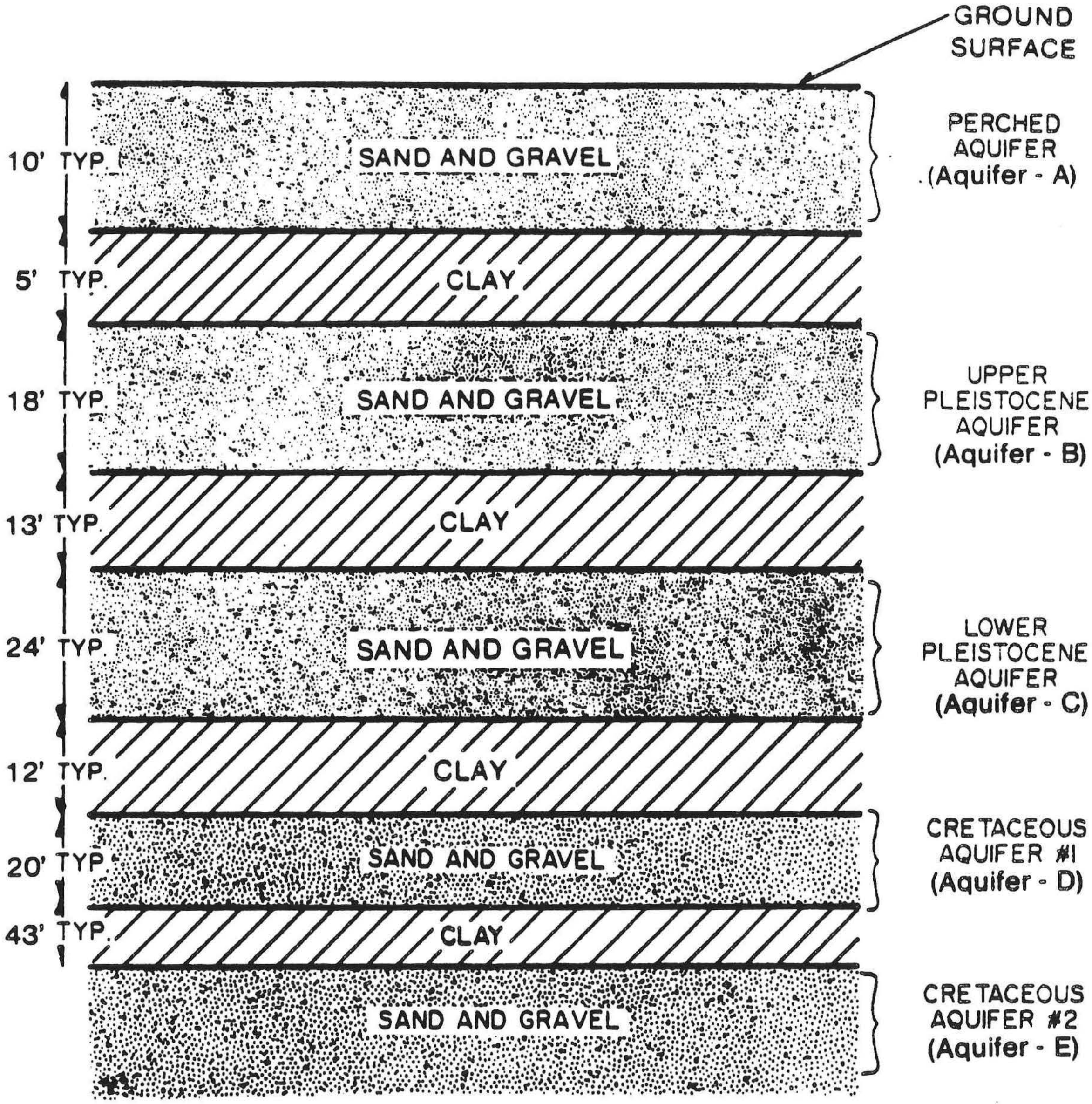
Since the early 1970's a large amount of work has been conducted in several areas of the Chambers Works property to define the characteristics of the hydrogeologic system. These investigations were initially conducted to determine the source of drinking water well contamination. Leggette, Brashears & Graham (LBG) conducted the initial assessment and in 1970 recommended that Du Pont install an interceptor well system to stop contamination from reaching the P-R-M system. By 1971, Du Pont had an interceptor well system installed and began pumping and treating ground water. This system presently pumps approximately 2 million gallons per day. This volume is fed through the WWTP and becomes part of the 40 million gallons of treated waste water released to the Delaware Estuary in accordance with Du Pont's New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Surface Water (DSW) permit issued pursuant to NJAC 7:14A-1 et seq.

The subsurface investigations that LBG conducted, represent some of the first definitive work describing the hydrogeologic system of the Chambers Works area. Their work demonstrated that the surficial system and the P-R-M system are connected to some degree. Following the installation of interceptor wells, observations were made of the effect that these wells were having on the flow regime both aerially and at a variety of depths in various parts of the property. These observations, in conjunction with information from drilling logs, led LBG and Woodward-Clyde Consultants (WCC) to the conclusion that the surficial deposits act as a multi-aquifer system. LBG characterized the surficial or glacial system as containing an upper, a middle and deep aquifer unit with intervening confining units. The P-R-M system, referred to as the Raritan by LBG, was characterized as having a shallow and deep aquifer beneath the site. WCC have further developed the stratigraphy of the site as consisting of six layers. Exhibit 3-20 shows a typical stratigraphic column developed by WCC for the Chambers Works area. The deep P-R-M system at depths generally in excess of 400 feet is referred to as Aquifer F. Section 3.1.2.1 describes the similarities and differences between LBG's and WCC interpretation of the systems.

The stratigraphic cross-sections compiled over several years by both LBG and WCC, represent a large volume of borehole geologic data. This information is often used directly to construct the hydrogeologic framework of the subsurface. However, this type of direct extrapolation may lead to problems since boreholes only expose a sliver of subsurface stratigraphic information. To illustrate why this can be a problem, in a simple system in which interbedded sand and clays occur in expansive horizontal layers, it is likely that sand layers bounded by clays represent confined or, at least, semi-confined aquifers. However, this ideal case assumes that the deposits are very uniform and the layers are continuous. This is seldom the case, particularly in deposits that are of fluvial origin (produced by rivers). In fact, the layers in these deposits are more often lens-shaped, which means that a clay or clay-rich layer exposed in a borehole may thicken or thin markedly in any direction away from a borehole and may possibly pinch out.

EXHIBIT 3-20

TYPICAL HYDROSTRATIGRAPHIC SECTION



Therefore, clay materials appearing in borehole logs in interbedded fluvial deposits are not necessarily acting as confining units. The variability of these deposits becomes evident if a large number of boreholes are drilled and attempts to correlate individual layers are made. However, the fact that the beds in these deposits thicken and thin and may pinch out does not preclude the possibility that the package of sediments may act as a multi-layered aquifer system.

LBG recognized this problem early in their investigations and conducted aquifer tests to determine how the subsurface materials behave hydraulically. Hydraulic testing not only allows the characterization of the hydraulic properties of the media but it also provides valuable information that, in conjunction with borehole geologic logs, allows the investigator to develop a good conceptual model of subsurface stratigraphy and hydrogeology. LBG conducted aquifer tests to evaluate how these materials behave and consequently recognized three aquifer zones in the surficial deposits.

Exhibit 3-21 provides a summary of the pump tests that have been conducted at Chambers Works since 1970. Included in this summary are 9 large-scale (300-900 gpm pumping rates at individual wells) pump tests, primarily at wells intersecting and screened in the middle and deep (C & D) zones of the subsurface materials. These tests have been followed in recent years by a number of small-scale, short duration tests at wells completed in the B zone.

In a the report entitled "Information Required by USEPA Regarding Section 3005(j) of HSWA"[24], LBG came to the following conclusions from the hydraulic data generated by the pump tests conducted at M-101, INT-102, and INT-108:

- Pumping in the middle zone, from INT-102, causes substantial drawdown in both the middle and shallow zones and considerably less drawdown in the deep zone within 500 feet of the well;

- Beyond 500 feet, the middle and deep zones react similarly while considerably less drawdown is experienced in the shallow zone;

- INT-102 is effective in containing and removing contaminated ground water from the entire glacial aquifer within the radius of about 1500 ft;

- Pumping of M-101, screened in the deep glacial or D zone, caused substantial drawdown in this zone for a radius of 1500 to 2500 feet from the well;

- Pumping of INT-108, screened in the middle and deep glacial (C and D) zones, caused little or no effect on the shallow glacial (B) zone, therefore, a laterally continuous confining unit must exist between the B and C zones in the vicinity of INT-108;

- In addition, the test at INT-108 indicated that the middle and deep zones are very complex; and

EXHIBIT 3-21

SUMMARY OF PUMP TESTS CONDUCTED
PUMP TESTS

Pumped Well	Date Test Conducted	Length of Test	Discharge (gal/min)	Zones Screened	Storage Coeff.	T[a] (ft^2/sec)
M-101	July/Aug 1970	8 days	400 gpm	deep (D)[2]	10^{-3}	$1x10^{-2}$
INT-102	May/June 1970	10 days	900 gpm	middle (C)	10^{-2}	$5x10^{-2}$
INT-103	Dec. 1972	2 days	600 gpm	mid. & dp (C&D)	10^{-3}	$1x10^{-1}$
INT-104	Sept. 1972	2 days	800 gpm	mid. & dp (C&D)	10^{-3}	$1x10^{-1}$
INT-105	Aug. 1972	2 days	600 gpm	mid. & dp (C&D)	10^{-3}	$1x10^{-1}$
INT-106	April 1971	3 days	750 gpm	mid. & dp (C&D)	10^{-3}	$8x10^{-2}$
INT-107	Dec. 1972	4 days	300 gpm	mid. & dp (C&D)	10^{-3}	$1x10^{-1}$
INT-108	Jan. 1985	6 days	700 gpm	mid. & dp (C&D)	10^{-3}	$1x10^{-1}$
R-5	Feb/Mar 1970	10 days	500 gpm	mid. & dp (C&D)		$6x10^{-2}$
AO-1	June 1986	4 hours	6.25	Upper (B)	--	$4x10^{-4}$
AO-2	June 1986	22 hours	17.5	Upper (B)	--	$5x10^{-3}$
AO-3	June 1986	4 hours	17.5/22	Upper (B)	--	$4x10^{-3}$
AO-4	June 1986	24 hours	3.75	Upper (B)	--	$2x10^{-4}$
AO-5	June 1986	4 hours	18	Upper (B)	--	$2x10^{-2}$
AO-6	June 1986	22 hours	13	Upper (B)	--	$7x10^{-3}$
AO-7	June 1986	4 hours	10.3	Upper (B)	--	$3x10^{-3}$
TO-4	Apr. 1987	1 hour	0.4	Upper (B)	--	$1x10^{-4}$
WC	May 1988	1 hour	30	Upper (B)	10^{-4}	$2x10^{-2}$

[a] Transmissivity.

- INT-108 is very effective at removing contamination from the surficial deposits for the radius of a mile from the well.

Exhibit 3-22 presents the aquifer hydraulic characteristics derived at several monitoring locations from these pump tests. Using the pumping tests coupled with well and boring logs, LBG was able to develop a stratigraphy for the glacial aquifer that consisted of a complex system of lens-shaped stratifications with sediment types ranging in diameter from 6 inch (gravel) down to clay- and silt-sized fractions. Results of the other pumping tests led LBG to the following additional conclusions about the stratigraphy in the area south of Henby Creek:

- The continuity of the middle (C zone) and deep (D zone) glacial zones appears to be good across the site; however, there was insufficient data available to characterize the shallow (B) zone;

- The shallow (B) zone in part of the western plant area may be separated from the shallow zone in the eastern portion of the plant;

- The confining layers between the shallow and middle zones and the middle and deep zones in the eastern part of the plant are definitely lens-shaped; and

- In the western part of the plant, shallow (B) and middle (C) zones are separated by a confining horizon that is less lens-shaped than in the east and may, in fact, be a fairly continuous unit.

In the last few years, WCC has conducted a number of single well tests to determine the hydraulic characteristic of the A, B, and C zones of the surficial aquifer system at points south of Henby Creek and adjacent to Secure Landfill "C". Exhibit 3-23 summarizes the results of these tests. Note that a few of these rising and falling head tests were conducted during the summer of 1988 in the vicinity of the proposed incinerator complex. In addition, estimates of hydraulic parameters have been made through the analyses of soil characteristics in the areas of the proposed incinerator and secure landfill units. Exhibit 3-24 contains the estimates resulting from these analyses which focused on characterizing the B zone.

Exhibit 3-25 contains a summary of the ranges in aquifer hydraulic parameters for the A, B, and C zones. It is important to note that virtually all of the data presented concerning aquifer hydraulic parameters come from the area south of Henby Creek and the area adjacent to Secure Landfill "C". For the most part, there have not been any test data, other than the estimates made from soil characteristics, available for the area. The interpretations of the system in that area have been derived from geologic logs and extrapolation of information developed for the areas to the south. However, recently (April and May, 1989) WCC conducted slug tests in the landfill area for Zones B and C. The results of these tests are included in Exhibit 3-26.

EXHIBIT 3-22

AQUIFER HYDRAULIC PARAMETERS DERIVED FROM THREE PUMP TESTS

Pump Test at INT-102[a] (May 1970)			Pump Test at INT-101[b] (July 1970)			Pump Test at INT-108[c] (January 1985)		
Well	T (ft^2/sec)	Stor. Coeff.	Well	T (ft^2/sec)	Stor. Coeff.	Well	T (ft^2/sec)	Stor. Coeff.
M-28	3.3×10^{-1}	$1.3x10^{-3}$	M-27	3.6×10^{-2}	$6.9x10^{-5}$	M-65	6.8×10^{-2}	$2.0x10^{-4}$
M-15	1.1×10^{-1}	$9.2x10^{-2}$	M-15A	3.1×10^{-2}	$2.4x10^{-4}$	M-66	5.9×10^{-2}	$1.3x10^{-4}$
M-34	4.1×10^{-1}	$1.6x10^{-3}$	M-33	3.7×10^{-2}	$6.0x10^{-5}$	M-13	1.2×10^{-2}	$5.8x10^{-5}$
M-37	3.5×10^{-1}	$1.2x10^{-3}$	M-36	4.3×10^{-2}	$7.6x10^{-5}$	M-68	5.0×10^{-2}	$2.5x10^{-5}$
M-31	3.7×10^{-1}	$1.4x10^{-3}$	M-30	5.0×10^{-2}	$2.4x10^{-4}$	M-69	6.6×10^{-2}	$2.3x10^{-5}$
M-19	3.9×10^{-1}	$7.9x10^{-3}$	M-18	6.5×10^{-2}	$2.0x10^{-4}$	M-62	5.2×10^{-2}	$4.4x10^{-4}$
M-40	3.7×10^{-1}	$1.1x10^{-3}$	M-39	5.3×10^{-2}	$6.9x10^{-5}$	M-63	1.2×10^{-1}	$1.4x10^{-4}$
M-2,3	7.3×10^{-1}	$4.2x10^{-3}$	M-1	1.6×10^{-1}	$8.9x10^{-4}$	M-107	7.1×10^{-2}	$2.2x10^{-4}$
M-43	2.8×10^{-1}	$2.1x10^{-3}$	M-42	2.4×10^{-1}	$1.4x10^{-3}$	M-1	1.5×10^{-1}	$6.4x10^{-4}$
M-10	5.5×10^{-1}	$3.2x10^{-3}$	M-9	7.1×10^{-1}	$4.2x10^{-3}$	M-2	2.1×10^{-1}	$9.0x10^{-4}$
M-22	1.1	$3.6x10^{-3}$	M-21	6.5×10^{-2}	$2.6x10^{-4}$	M-3	2.5×10^{-1}	$8.5x10^{-5}$
M-25	1.0	$5.3x10^{-3}$	M-24	6.5×10^{-2}	$5.4x10^{-4}$	M-9	3.1×10^{-1}	$9.1x10^{-4}$
M-13	5.2×10^{-1}	$2.0x10^{-3}$	M-101	1.7×10^{-2}	---	M-10	2.1×10^{-1}	$6.1x10^{-3}$
INT-102	1.7×10^{-1}	---						

[a] Completed in the Middle Glacial aquifer zone (aquifer C), the monitor wells used in the analysis are also in this zone.

[b] Completed in the Deep Glacial aquifer zone (aquifer D), the monitor wells used in the analysis are also in this zone.

[c] Completed in both the Middle and Deep Glacial aquifer zones (aquifer C and D), the monitor wells used in the analysis are also in this zone.

EXHIBIT 3-23

SINGLE WELL TESTS

Well	Date Test Conducted	Type of Test[b]	T (ft^2/sec)	Average T (ft^2/sec)	K[a] (ft/sec)	Zone Screened
T-15	4/20/87	F*	1×10^{-4}		2×10^{-5}	A
T-26	6/19/86	F*	2×10^{-5}		4×10^{-6}	A
T-27	4/20/87	F*	1×10^{-4}		2×10^{-5}	A
PA	4/15/88	F*	5×10^{-5}		1×10^{-5}	A
PB	4/15/88	F*	1×10^{-4}		2×10^{-5}	A
PC	4/15/88	F*	5×10^{-4}		1×10^{-4}	A
PD	4/15/88	F*	3×10^{-5}		6×10^{-6}	A
PE	4/15/88	F*	4×10^{-5}		7×10^{-6}	A
PF	4/15/88	F*	4×10^{-4}		9×10^{-5}	A
PG	4/15/88	F*	1×10^{-3}		2×10^{-4}	A
PH	4/15/88	F*	2×10^{-3}		3×10^{-4}	A
WC1	3/29/88	F*	4×10^{-4}		9×10^{-5}	A
WC2	3/29/88	F*	3×10^{-3}		8×10^{-4}	A
WC3	3/29/88	F*	2×10^{-5}		4×10^{-6}	A
WC4	3/29/88	F*	2×10^{-5}		4×10^{-3}	A
WC5	3/29/88	F*	1×10^{-3}		2×10^{-4}	A
M-201	5/15/88	R	2×10^{-4}			
	5/15/88	F	3×10^{-4}	2×10^{-4}	4×10^{-5}	B (shallow)
M-204	5/15/88	R	3×10^{-4}			
	5/15/88	F	3×10^{-5}	3×10^{-5}	8×10^{-6}	B (shallow)
M-215	5/15/88	R	5×10^{-3}			
	5/15/88	F	9×10^{-3}	7×10^{-3}	1×10^{-3}	B (shallow)
M-218	5/15/88	R	4×10^{-4}			
	5/15/88	F	6×10^{-4}	5×10^{-4}	1×10^{-4}	B (shallow)
M-220	5/15/88	R	1×10^{-3}	1×10^{-3}	2×10^{-4}	B (shallow)
M-240	5/15/88	R	7×10^{-6}			
	5/15/88	F	1×10^{-5}	8×10^{-6}	2×10^{-6}	B (shallow)
M-241	5/15/88	R	2×10^{-2}			
	5/15/88	F	1×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
M-242	5/15/88	R	2×10^{-2}			
	5/15/88	F	1×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
M-243	5/15/88	R	2×10^{-2}			
	5/15/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
M-245	5/15/88	R	1×10^{-2}			
	5/15/88	F	1×10^{-2}	1×10^{-2}	2×10^{-3}	B (shallow)

[a] Hydraulic Conductivity.

[b] R = Rising instantaneous slug data.
F = Falling instantaneous slug data.
F* = Hvorslev falling head test, based on falling water levels following rapid filling of the casing.

EXHIBIT 3-23

SINGLE WELL TESTS
(continued)

Well	Date Test Conducted	Type of Test	T (ft^2/sec)	Average T (ft^2/sec)	K (ft/sec)	Zone Screened
M-246	5/15/88	R	2×10^{-2}			
	5/15/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
M-247	5/15/88	R	3×10^{-2}			
	5/15/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
M-248	5/15/88	R	8×10^{-3}			
	5/15/88	F	1×10^{-2}	9×10^{-3}	2×10^{-3}	B (shallow)
M-252	5/15/88	R	2×10^{-2}			
	5/15/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
M-253	5/15/88	R	1×10^{-2}			
	5/15/88	F	1×10^{-2}	1×10^{-2}	2×10^{-3}	B (shallow)
M-255	5/15/88	R	4×10^{-3}			
	5/15/88	F	5×10^{-3}	4×10^{-3}	8×10^{-4}	B (shallow)
M-257	5/15/88	R	1×10^{-3}			
	5/15/88	F	2×10^{-3}	2×10^{-3}	4×10^{-4}	B (shallow)
M-260	5/15/88	R	5×10^{-4}			
	5/15/88	F	4×10^{-4}	4×10^{-4}	8×10^{-5}	B (shallow)
M-266	5/15/88	R	2×10^{-2}			
	5/15/88	F	2×10^{-2}	2×10^{-4}	4×10^{-5}	B (shallow)
M-268	5/15/88	F	5×10^{-2}	5×10^{-2}	1×10^{-2}	B (shallow)
M-265	5/15/88	R	3×10^{-2}			
	5/15/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
P27-M01B	6/21/88	R	$3 \times 10^{-3}4$			
	6/21/88	F	2×10^{-3}	2×10^{-3}	4×10^{-4}	B (shallow)
T22-M01B	6/20/88	R				
	6/20/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
T23-M01B	6/21/88	R	5×10^{-3}			
	6/21/88	F	4×10^{-3}	4×10^{-3}	8×10^{-4}	B (shallow)
T-01	4/14/87	R	5×10^{-3}			
	4/14/87	F	5×10^{-3}			
	4/07/88	R	7×10^{-3}			
	4/07/88	F	8×10^{-3}	6×10^{-3}	1×10^{-3}	B (shallow)
T-02	4/14/87	R	2×10^{-4}			
	4/07/88	R	8×10^{-5}			
	4/07/88	F	2×10^{-4}	2×10^{-4}	4×10^{-5}	B (shallow)

EXHIBIT 3-23

SINGLE WELL TESTS
(continued)

Well	Date Test Conducted	Type of Test	T (ft^2/sec)	Average T (ft^2/sec)	K (ft/sec)	Zone Screened
T-03	4/14/87	R	3×10^{-5}			
	4/14/87	F	2×10^{-5}			
	4/07/88	R	5×10^{-5}			
	4/07/88	F	7×10^{-5}	4×10^{-5}	8×10^{-6}	B (shallow)
T-04	4/20/87	R	2×10^{-4}			
	4/20/87	F	2×10^{-4}			
	4/07/88	R	9×10^{-5}			
	4/07/88	F	1×10^{-4}	1×10^{-4}	2×10^{-5}	B (shallow)
T-05	4/07/88	R	6×10^{-3}	6×10^{-3}	1×10^{-4}	B (shallow)
T-06	4/07/88	R	2×10^{-3}			
	4/07/88	F	2×10^{-3}	2×10^{-3}	4×10^{-4}	B (shallow)
T-10	6/19/86	R	2×10^{-5}			
	6/19/86	R	9×10^{-5}			
	6/19/86	F	4×10^{-5}	5×10^{-5}	1×10^{-5}	B (shallow)
T-20	6/19/86	R	5×10^{-5}			
	6/19/86	R	6×10^{-5}			
	6/19/86	F	6×10^{-5}	6×10^{-5}	1×10^{-5}	B (shallow)
T-30	6/19/86	R	6×10^{-4}			
	6/19/86	R	8×10^{-4}			
	6/19/86	F	6×10^{-4}	7×10^{-4}	1×10^{-4}	B (shallow)
AO-1	4/15/88	R	3×10^{-3}			
	4/15/88	F	2×10^{-3}	2×10^{-3}	4×10^{-4}	B (shallow)
AO-2	4/15/88	R	1×10^{-2}			
	4/15/88	F	8×10^{-3}	1×10^{-2}	2×10^{-3}	B (shallow)
AO-3	4/15/88	R	3×10^{-2}			
	4/15/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
AO-4	4/15/88	R	4×10^{-4}			
	4/15/88	F	3×10^{-4}	4×10^{-4}	8×10^{-5}	B (shallow)
AO-5	4/15/88	R	2×10^{-2}			
	4/15/88	F	1×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
AO-6	4/15/88	R	1×10^{-2}			
	4/15/88	F	8×10^{-3}	9×10^{-3}	2×10^{-3}	B (shallow)
AO-7	4/15/88	R	3×10^{-3}			
	4/15/88	F	4×10^{-3}	4×10^{-3}	8×10^{-4}	B (shallow)

EXHIBIT 3-23

SINGLE WELL TESTS
(continued)

Well	Date Test Conducted	Type of Test	T (ft^2/sec)	Average T (ft^2/sec)	K (ft/sec)	Zone Screened
M-51	3/29/88	F*		4×10^{-4}	7×10^{-5}	B (shallow)
M-52	3/29/88	F*		2×10^{-3}	3×10^{-4}	B (shallow)
M-53	3/29/88	F*		2×10^{-3}	4×10^{-4}	B (shallow)
M-59	6/19/86	R	5×10^{-4}			
	6/19/86	R	4×10^{-4}			
	6/19/86	F	4×10^{-4}	4×10^{-4}	8×10^{-5}	B (shallow)
M-60	6/19/86	R	7×10^{-4}			
	6/19/86	R	7×10^{-4}			
	6/19/86	F	6×10^{-4}			
	5/15/88	R	6×10^{-3}			
	4/15/88	F	7×10^{-3}	2×10^{-3}	4×10^{-4}	B (shallow)
M-61	4/15/88	R	3×10^{-3}			
	4/15/88	F	4×10^{-3}	4×10^{-3}	8×10^{-4}	B (shallow)
WA	4/15/88	R	2×10^{-2}			
	4/15/88	F	1×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
WB	4/15/88	R	1×10^{-2}			
	4/15/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
WC	4/15/88	R	3×10^{-2}			
	4/15/88	F	3×10^{-2}	3×10^{-2}	6×10^{-3}	B (shallow)
WD	4/15/88	R	1×10^{-2}			
	4/15/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
M15-M01B	6/22/88	R	3×10^{-4}			
	6/22/88	F	2×10^{-3}	1×10^{-3}	2×10^{-4}	B (shallow)
L15-M01B	6/23/88	R	2×10^{-2}			
	6/23/88	F	2×10^{-2}	2×10^{-2}	4×10^{-3}	B (shallow)
K17-M01B	6/22/88	R	2×10^{-3}			
	6/22/88	F	2×10^{-3}	2×10^{-3}	4×10^{-4}	B (shallow)
L16-M01B	6/21/88	R	3×10^{-3}			
	6/21/88	F	2×10^{-3}	2×10^{-3}	4×10^{-4}	B (shallow)
M15-M02B	6/22/88	R	7×10^{-3}			
	6/22/88	F	6×10^{-3}	6×10^{-3}	1×10^{-3}	B (shallow)
H17-M01B	6/23/88	R	2×10^{-3}			
	6/23/88	F	1×10^{-3}	2×10^{-3}	4×10^{-4}	B (shallow)
J17-M01B	6/23/88	R	2×10^{-5}			
	6/23/88	F	9×10^{-4}	6×10^{-5}	1×10^{-5}	B (shallow)

EXHIBIT 3-23

SINGLE WELL TESTS
(continued)

Well	Date Test Conducted	Type of Test	T (ft^2/sec)	Average T (ft^2/sec)	K (ft/sec)	Zone Screened
H16-M01B	6/23/88	R	3×10^{-3}			
		F	5×10^{-4}	2×10^{-3}	4×10^{-4}	B (shallow)
L19-M01B	6/22/88	R	4×10^{-2}			
	6/22/88	F	3×10^{-2}	4×10^{-2}	8×10^{-3}	B (shallow)
M-291	5/15/88	R	4×10^{-2}			
	5/15/88	F	2×10^{-2}	3×10^{-2}	6×10^{-3}	C (middle)
M-292	5/15/88	F	2×10^{-2}	2×10^{-4}	4×10^{-3}	C (middle)
P27-M01C	6/21/88	R	9×10^{-4}			
	6/21/88	F		9×10^{-4}	2×10^{-3}	C (middle)
T22-M01C	6/20/88	R	9×10^{-3}	9×10^{-3}	2×10^{-4}	C (middle)
M15-M01C	6/22/88	R	2×10^{-2}			
	6/22/88	F	2×10^{-2}	2×10^{-2}	2×10^{-3}	C (middle)
L15-M01C	6/23/88	R	3×10^{-3}			
	6/23/88	F	3×10^{-3}	3×10^{-3}	3×10^{-4}	C (middle)
K17-M01C	6/21/88	R	8×10^{-3}			
	6/21/88	F	5×10^{-4}	4×10^{-3}	4×10^{-4}	C (middle)
H17-M01C	6/23/88	R	6×10^{-3}			
	6/23/88	F	8×10^{-3}	7×10^{-3}	7×10^{-4}	C (middle)
L19-M01C	6/22/88	R	6×10^{-3}			
	6/22/88	F	5×10^{-3}	6×10^{-3}	6×10^{-4}	C (middle)

EXHIBIT 3-24

ESTIMATES OF HYDRAULIC CONDUCTIVITY FROM SOIL CHARACTERISTICS FOR THE PROPOSED LANDFILL AND INCINERATOR AREAS

Boring Number	Depth (ft)	Coeff. of Uniformity	D50 (mm)	Blow Count	Conductivity (ft/sec)	Zone
Landfill Area						
Q29-B04	19	5.0	0.09	22	3×10^{-5}	B (shallow)
Q29-B04	34	57.1	2.30	101	1×10^{-4}	B (shallow)
R30-B01	5	7.0	0.23	7	3×10^{-5}	B (shallow)
R30-B01	19	4.0	0.35	26	7×10^{-4}	B (shallow)
Incinerator Complex (shallow)						
S1	9	2	0.45	9	3×10^{-3}	B (shallow)
S1	10.5	4.5	0.43	12	1×10^{-3}	B (shallow)
S4	5	2.1	0.35	6	2×10^{-3}	B (shallow)
S4	9	2.4	0.39	9	2×10^{-3}	B (shallow)
S4	13	2.7	0.75	9	4×10^{-3}	B (shallow)
S4	24	6.5	0.45	17	2×10^{-3}	B (shallow)
S8	5	3.3	0.26	16	6×10^{-4}	B (shallow)
S8	9	2.2	0.30	9	2×10^{-3}	B (shallow)
S8	11	2.4	0.40	4	3×10^{-3}	B (shallow)
S8	24	2.2	0.25	15	7×10^{-4}	B (shallow)
S15	11	2.4	0.38	14	2×10^{-3}	B (shallow)
S15	19	4	0.35	26	6×10^{-4}	B (shallow)
S16	9	3.3	0.23	15	7×10^{-4}	B (shallow)
S16	34	3.8	0.55	26	1×10^{-3}	B (shallow)
S19	13	2.7	0.35	6	2×10^{-3}	B (shallow)
S19	29	1.8	0.50	14	3×10^{-3}	B (shallow)

EXHIBIT 3-25

SUMMARY OF AQUIFER CHARACTERISTICS

	Layer A	Layer B	Layer C
Porosity	0.15 to 0.40	0.15 to 0.40	0.15 to 0.40
log average	.25	.25	.25
Intrinsic permeability(ft^2)	10^{-6} to 10^{-2}	10^{-6} to 10^{-2}	10^{-6} to 10^{-2}
log average	10^{-4}	10^{-4}	10^{-4}
Hydraulic Conductivity	10^{-6} to 10^{-4}	10^{-6} to 10^{-2}	10^{-4} to 10^{-3}
log average	10^{-5}	10^{-3}	10^{-4}
Transmissivity ($ft^{2/sec}$)	10^{-5} to 10^{-3}	10^{-6} to 10^{-1}	10^{-4} to 10^{-2}
log average	10^{-4}	10^{-2}	10^{-3}
Storage Coefficient	0.2	10^{-5} to 0.2[a]	10^{-3} to 10^{-2}
log average	0.2	10^{-2}	10^{-3}

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a Where unconfined.

EXHIBIT 3-26[a]

AQUIFER PARAMETERS DERIVED FROM SLUG TEST DATA AND SOIL ANALYSIS FROM THE PROPOSED SECURE LANDFILL SITE

Well No.	Slug Test(1)	Slug Test(2)	Test Type(3)	Soil Analysis(4)	Depth	Aquifer Well	Aquifer Soil Test
P29-M01B	3.5×10^{-3}	-	F	-		B	
	3.5×10^{-3}	-	R				
R31-M01B	5.5×10^{-4}	-	F	2×10^{-4}		B	B
	5.5×10^{-4}	-	R				
S27-M02B	5.0×10^{-3}	-	F	-		B	
	1.0×10^{-2}	-	R				
T28-M01B	1.7×10^{-3}	-	F	1×10^{-3}	29	B	B
	2.4×10^{-3}	-	R				
T31-M01B	2.1×10^{-5}	8.1×10^{-4}	F	-	-	B	
	7.1×10^{-6}	2.7×10^{-4}	R				
R26-M01B		8.1×10^{-4}	F				
		8.1×10^{-4}	R				
X27-M01B	4.0×10^{-4}	-	F	1×10^{-4}	44	B	C
	8.3×10^{-4}	-	R				
P29-M01C	5.5×10^{-4}	-	F	-	-	C	
	3.8×10^{-4}	-	R				
R31-M01C	ND	3.9×10^{-4}	F	6×10^{-4}	54	C	C
		3.9×10^{-4}	R				
[illegible]7-M02C	2.7 X10-4	-	F	-	-	C	
	2.7×10^{-4}	-	R				
T28-M01C	2.7×10^{-4}	-	F	1×10^{-3}	29	C	B
	1.8×10^{-4}	-	R				
T31-M01C	1.2×10^{-3}	-	F	-	-	C	
	1.7×10^{-3}	-	R				
X27-M01C	3.5×10^{-6}*	-	F	1×10^{-3}	59	C	C
	3.5×10^{-6}	-	R				

(1) Using method of Cooper et.al. (1967); tested April 6 and 7, 1989 (cm/sec).
(2) Using method of Cooper et.al. (1967); tested April 26 and May 1, 1989 (cm/sec).
(3) "F" = Falling Head; "R" = Rising Head.
(4) Hydraulic conductivity based on grain size distribution of soil samples (cm/sec).
ND = No data due to equipment malfunctions
* Suspect data

[a] Woodward-Clyde Consultants, 1989d, Supplemental Report, Geotechnical/ Hydrogeologic Investigation, Proposed New Secure Landfill, E.I. Du Pont de Nemours and Company, Inc., Chambers Works, Deepwater, New Jersey. Project Number: 88C2833 April 19, 1989.

For the area north of Henby Creek, water level data collected in 1939 by the Ranney Water Collector Corporation of New York indicate that at that time ground-water flow was toward the Delaware River in the area of the proposed secure landfill.[25] Simulations of the ground water flow model, being developed by Du Pont (presented in Appendix D), show flow toward the southeast while preliminary water level data collected by WCC in January, 1989 indicate some flow to the northeast. This may be the result of some pumping, not yet identified, in that direction. In order to investigate the difference between the actual flow path and that predicted by the ground-water flow model, Du Pont has initiated the following activities to characterize the flow system in the vicinity of the proposed landfill[26]:

- Collection of additional water-level data;
- Installation of an additional well cluster (XZ7 M01B and X27 M01C) on the eastern side of Bouttown Creek to assess the gradient of the northeast flow component; and
- Compilation of additional information concerning off-site pumping sources so this information may be incorporated into the model.

After this information is collected and evaluated, the model will be further refined such that its predictive capabilities for the area may be expanded.

3.2.1.2 Ground-Water Quality

Contamination of ground water in the surficial aquifers in the area south of Henby Creek has been recognized for some time. The interceptor well system was developed to provide an efficient means of containing the contamination in the surficial deposits, not allowing it to move to greater depths and potentially into the P-R-M regional aquifer system. However, identification of contamination in some shallow Raritan (or E aquifer) wells is what initiated the hydrogeologic investigations of the early 1970's. Exhibit 3-27 provides water quality data for wells developed between the depths of 180 and 250 ft depths (shallow Raritan of LBG or the E zone of WCC) and wells developed at depths generally over 400 feet in the P-R-M system.

In the past, the NJDEP and EPA have identified several sources of contamination to the surficial deposits at the Chambers Works Plant (e.g. unlined basin and waste water ditch systems) and Du Pont has been responding to the problems by closing and/or replacing these systems. In addition, the capacity of the interceptor well system has been increased and it has been expanded to control the flow of ground water in the deposits immediately beneath the site. Well observation data have documented the zones of influence of these wells (cones of depression) as well as the decrease in industrial contamination. However, the design of the system requires continual refinement as additional information about the hydraulic properties of the subsurface materials is developed and as the activities in various parts of the plant change.

EXHIBIT 3-27

GROUND WATER QUALITY DATA FOR DEEP WELLS

AVERAGE 1985 ANALYTICAL RESULTS FOR KEY PARAMETERS IN WATER SAMPLES FROM SELECTED RARITAN WELLS[a]

Well	Depth (ft)	pH	Specific conductance (umhos/cm^2)	TDS	Chloride	Sulfate	Iron	DOC[(1)]	TOX[(2)]
ON PLANT - SHALLOW AQUIFER									
M-45C	186	6.5	1,437	839	295	135	86	18	0.6
M-92	197	7.0	453	255	55	*10	8.7	4	0.04
M-94	194	7.0	462	332	60	*5	10.0	5	0.1
WS-1	240	6.7	727	413	119	55	17	7	0.1
WS-2	247	6.6	724	404	105	13	6.0	4	0.16
CP-1	195	6.3	1,109	609	237	*10	21.0	5	0.04
CP-2	184	6.7	449	228	73	--	16.6	3	0.02
CP-6	185	6.7	153	*100	*10	*10	13.2	*2	*0.01
ON PLANT - DEEP AQUIFER									
M-45B	444	7.6	1,032	482	231	*10	0.09	4	0.02
M-91	466	8.9	1,077	565	245	*10	4.9	4	0.05
M-93[(3)]	490	7.9	1,095	820	254	*3	2.5	3	0.04
DW-8	356	7.5	513	285	73	*10	0.9	4	0.01
WS-3	461	6.7	727	350	126	*10	0.6	4	0.03
CP-7	429	7.9	211	*111	*10	*10	2.8	*6	0.01
OFF PLANT - PENNSVILLE TOWNSHIP WATER DEPARTMENT - SHALLOW AQUIFER									
1[2/]	246	6.3	410	250	59	--	--	1	*0.005
4[2/]	137	5.9	174	147	10	--	--	2	0.2
5[2/]	125	5.7	155	132	*10	--	--	1	0.01
OFF PLANT - ATLANTIC ELECTRIC COMPANY - SHALLOW AQUIFER									
2	184	6.4	534	331	87	*10	10.4	4	0.02
3	185	6.7	367	230	45	*10	3.4	3	*0.008
5	169	6.5	376	*190	54	*10	5.9	2	*0.008
6	188	6.3	714	385	140	*10	21.4	3	0.2
OFF PLANT - COURSES LANDING - SHALLOW AQUIFER									
3	458	7.6	269	143	*11	*10	3.2	3	*0.007

[a]From Leggette, Brashears and Graham, Consulting Groundwater Geologists, 1986, Information Required by USEPA Regarding 3005(j) 13 of HSWA.

EXHIBIT 3-27

GROUND WATER QUALITY DATA FOR DEEP WELLS

AVERAGE 1985 ANALYTICAL RESULTS FOR KEY PARAMETERS IN WATER SAMPLES FROM SELECTED RARITAN WELLS[a] (continued)

Well	Depth (ft)	pH	Specific conductance (umhos/cm^2)	TDS	Chloride	Sulfate	Iron	DOC(1)	TOX(2)
			OFF PLANT - COURSES LANDING - DEEP AQUIFER						
1	549	7.7	391	217	22	*10	0.18	3	*0.009
2	637	7.5	279	159	*10	*10	0.6	4	*0.006
			OFF PLANT - PENNS GROVE WATER SUPPLY COMPANY - DEEP AQUIFER						
Layne No. 1[2/]	350	6.7	950	541	217	--	--	3	*0.005

* Denotes less than.
(1) DOC - Dissolved Organic Carbon
(2) TOX - Total Organic Halogen
(3) This well is completed in an upper horizon of the Shallow Raritan Aquifer.
(4) One sample taken in 1985.

a Leggette, Brashears & Graham, Consulting Groundwater Geologists, 1986, Information Required by USEPA Regarding 3005(j) 13 of HSWA.

For the proposed landfill and incinerator complexes, Du Pont has installed several wells and developed a quarterly and annual sampling schedule (see Exhibit 3-28). These wells will be used first to establish the levels of background contamination and then later, during the operational phase of the units to determine if releases have occurred.

Exhibits 3-29 and 3-30 show the location of these wells with respect to the proposed incinerator and landfill complexes. In the case of the incinerator complex, a few of these wells (M60 and M61) have been operating as monitoring wells for the adjacent basin complex. In order to properly assess the effectiveness of contamination control features (e.g. leachate collection and detection systems) or engineered barriers (e.g. landfill liners) at either the proposed landfill or incinerator, it is necessary to establish baseline water quality in these areas so deviations from these baseline conditions may be detected in the future. To establish which waste constituents may affect ground-water quality, the WWTP sludge and incinerator ash that will be handled by the facilities were characterized by Du Pont (see Exhibit 3-31). From this information, as well as information concerning the type of drummed waste the incinerator will handle, ground water quality indicator parameters were selected for both the landfill and the incinerator. Detection of these parameters or changes in background values would provide the first indication that engineered and natural barriers had failed. Exhibit 3-32 provides the list of the ground-water quality parameters proposed for the incinerator and landfill.

As stated previously, prior to the operation of the unit, it is necessary to establish the monitoring system, sampling schedule, and to establish baseline conditions through sampling. Because the incinerator complex is near compliance monitoring wells for the basin complex, a good deal of baseline data are available for this area. Exhibit 3-33 lists the indicator parameters selected for these compliance monitoring wells. Exhibit 3-34 provides some monitoring data presently available for these wells and Exhibit 3-35 provides monitoring data for Appendix VIII and Appendix IX constituents from another nearby well. A summary of ground water quality data for wells M-61 (J16-M01B), M-60 (K15-M01B), and M-48 (K15-M01B) is displayed in Exhibit 3-36.

With the exception of a water sample collected from well M15-M01B near the incinerator complex, ICF split 6 soil and 5 water samples with Du Pont from the proposed secure landfill area to provide independent verification of Du Pont's analyses and quality assurance of analytical data. ICF found that Du Pont's lab has active quality control and review procedures. However, it was found that the lab may have a methylene chloride contamination problem. Significant concentrations of priority pollutants were not found in the samples; however, the number of samples does not represent a statistically significant number. In addition, matrix effects, not a laboratory problem, caused problems with recovery of the acid fraction of the semivolatiles. Therefore, data for all acid compounds may be unusable.

EXHIBIT 3-28

WATER SAMPLING SCHEDULE FOR PROPOSED INCINERATOR AND SECURE LANDFILL

Well	Quarterly	Annual
Proposed Secure Landfill		
P29-M01B	X	X
P29-M01C	X	
Q30-M01B	X	X
Q30-M01C	X	
R26-M01B	X	X
R28-M02B	X	X
R28-M01C	X	
R31-M01B	X	X
R31-M01C	X	
S27-M02B	X	X
S27-M02C	X	
S32-M02B	X	X
S32-M02C	X	
S32-M01B	X	X
S32-M01C	X	
T28-M01B	X	X
T28-M01C	X	
T29-M01B	X	X
T29-M01C	X	
T31-M01B	X	X
T31-M01C	X	
Proposed Incinerator		
M15-M01B	X	X
M15-M01C (IW-1d)	X	
L15-M01B (IW-2s)	X	X
L15-M01C (IW-2d)	X	
K17-M01B (IW-3s)	X	X
K17-M01C (IW-3d)	X	
L16-M01B (IW-4)	X	X
M15-M02B (IW-5)	X	X
H17-M01B (IW-6s)		
H17-M01C (IW-6d)		
J17-M01B (IW-7)		
H16-M01B (IW-8)		
L19-M01B		
L19-M01C		
J16-M01B (M-61)	X	X
K15-M01B (M-60)	X	X

EXHIBIT 3-29

INCINERATOR COMPLEX WELLS

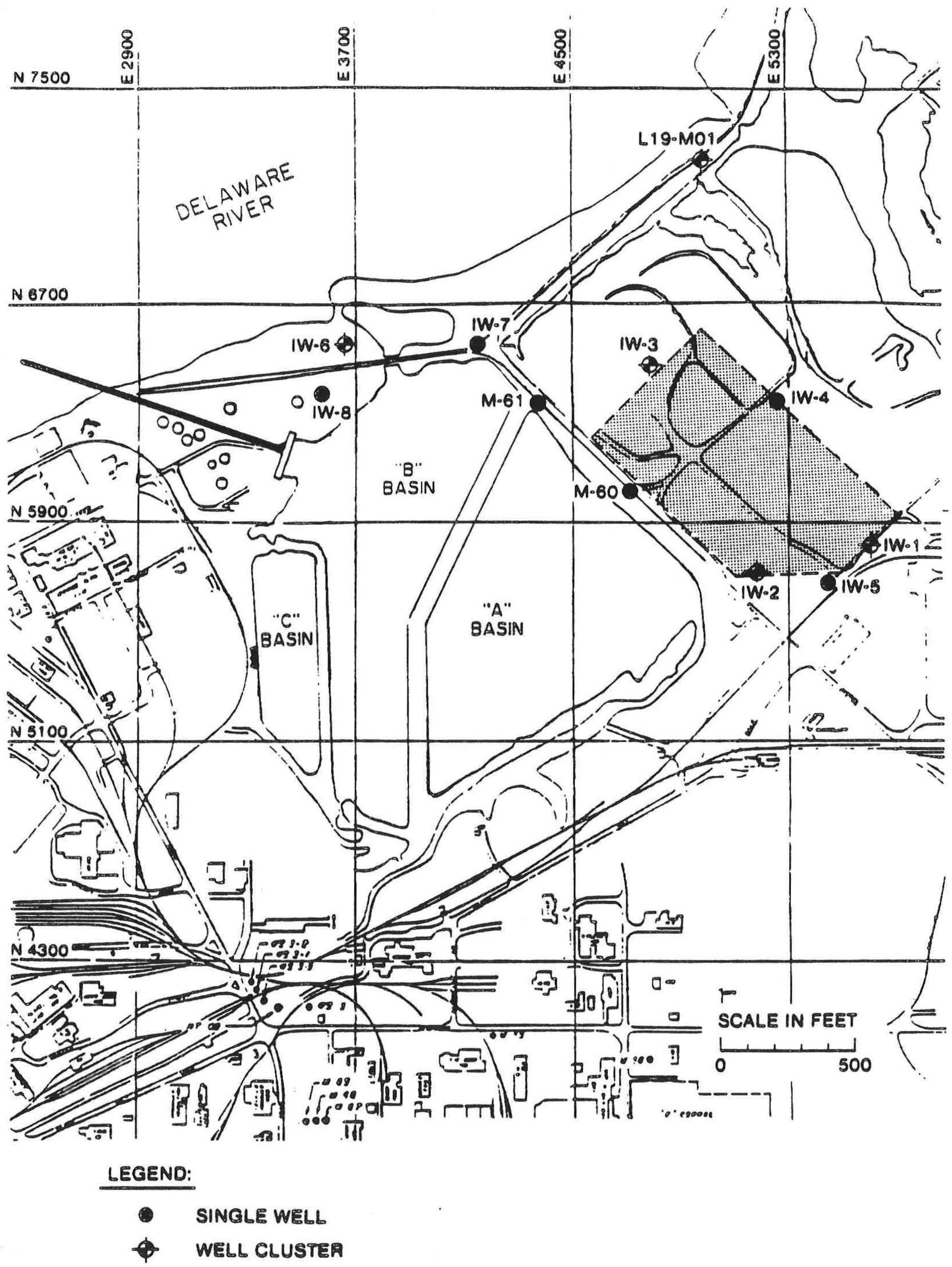
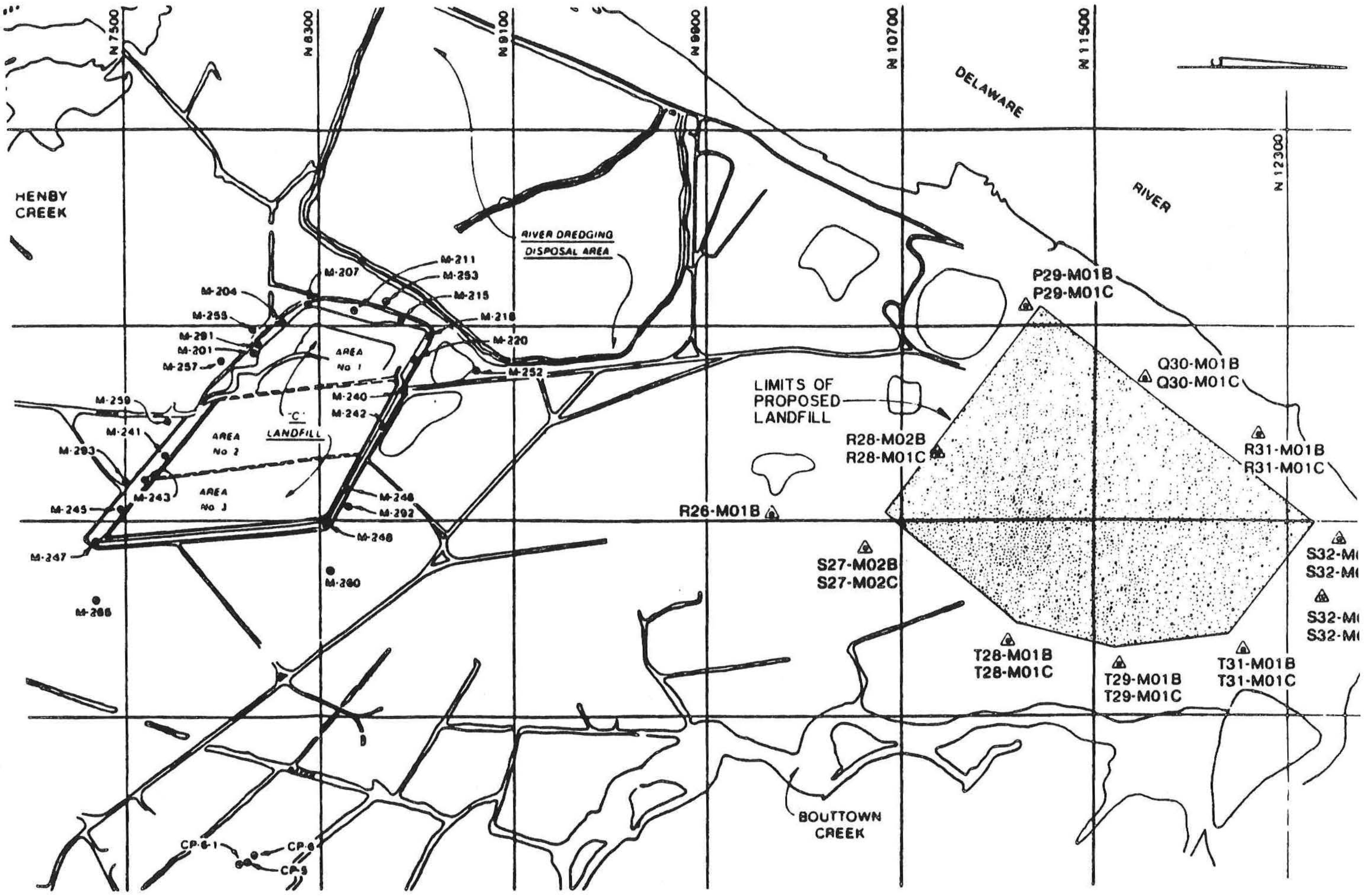


EXHIBIT 3-30[a]

LANDFILL COMPLEX WELLS



KEY:

WELL CLUSTERS

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[a]Woodward-Clyde Consultants, 1989b, Volume VII, Hydrogeologic Conditions, Hazardous Waste Incinerator and Secure Landfill, E.I. Du Pont de Nemours and Company, Inc., Chambers Works, Deepwater, New Jersey. Project Number: 88C2054 February 7, 1989.

EXHIBIT 3-31

SLUDGE AND BOTTOM ASH CHARACTERISTICS

	Concentration	Properties
Sludge		
Water, wt	50 to 65 %	
Calcium, Magnesium Hydroxides and Carbonates, wt	15 to 20 %	
Silicates, wt	12 to 17 %	
Oil and Grease, wt	5 to 8 %	
Trace metals (primarily Al)	3 to 5 %	
Silver	2.5 ppm	
Arsenic	1.0 ppm	
Barium	5.0 ppm	
Cadmium	0.4 ppm	
Mercury	0.003 ppm	
Nickel	190 ppm	
Lead	1.0 ppm	
Selenium	0.5 ppm	
Zinc	1020 ppm	
Sulfides	trace	
Phenolics	trace	
Bulk Density		78 lb/ft^3
BTU/lb		3000
Color		Brown to Black
pH		10-12
Reactive		No
Toxic		No
Pyrophoric		No
Radioactive		No
Schock Sensitive		No
Explosive		No
Bottom Ash		
Aluminum	20 to 40 %	
Silicon	20 to 40 %	
Calcium	5 to 20 %	
Iron	1 to 20 %	
Carbon	1 to 3 %	
Lead	500 ppm	
Phosphorus	500 ppm	
Sodium	1000 ppm	
Vanadium	500 ppm	
Chromium	5000 ppm	
Nickel	5000 ppm	
Manganese	1000 ppm	
Titanium	5000 ppm	
Cadmium	500 ppm	
Copper	5000 ppm	
Potassium	1000 ppm	
pH		8 to 12 s.u.
Dry Density		70 to 105 ft^3

EXHIBIT 3-32[a]

GROUNDWATER QUALITY PARAMETERS

	Landfill Quarterly		Annually[b]	Incinerator Quarterly	Annually
Volatile Orgs. by GC/MS[c]			X +15[d]	X	X +15
Acid Extr. Orgs. by GC/MS[e]					X +10
Base/Neut. Extr. Orgs. by GC/MS[f]			X +15	X	X +15
Aluminum	X		X	X	X
Arsenic	X			X	X
Barium	X			X	
Cadmium	X			X	X
Chromium	X			X	X
Lead	X			X	X
Mercury	X			X	X
Selenium	X			X	X
Total Cyanide			X		
Iron	X*			X	
Manganese	X		X	X	X
Copper				X	
Zinc	X			X	X
Sodium	X		X	X	X
Flouride	X			X	
Nitrate	X			X	X
Ammonia	X			X	X
Sulfate	X			X	X
Chloride	X*			X	
Total Phenols	X*			X	
Calcium			X	X	
Nickel				X	X
Manganese	X		X	X	
Lindane	X			X	
Methoxychlor	X		X		
Toxaphene	X		X		
Endrin	X		X		
2,4 D	X		X		
2,4,5-TP Silvex	X		X		
Radium	X		X		
Gross Alpha	X	X	X	X	
Gross Beta	X	X	X	X	
Potassium			X		
Vanadium				X	
Coliform Bacteria	X		X		
Hardness	X*				
pH	X*		X**		
Total Organic Carbon (TOC)	X*		X**		
Total Organic Halogen (TOX)	X*		X**		
Total Dissolved Solids (TDS)	X*		X**		
Specific Conductance	X*		X**		
Total Kjeldahl Nitrogen			X**		

* Monitoring well P27-M01B would have four replicate samples of each of these parameters collected at each sampling event.
** Monitoring wells J16-M01B, K15-M01B, and K17-M01B would have four replicate samples of each of these parameters collected at each sampling event.

[a] Woodward-Clyde Consultants, 1989b, Volume VII, Hydrogeologic Conditions, Hazardous Waste Incinerator and Secure Landfill, E.I. Du Pont de Nemours and Company, Inc., Chambers Works, Deepwater, New Jersey. Project Number: 88C2054 February 7, 1989.

[b] These samples are taken annually in addition to the quarterly samples.

[c] USEPA Priority Pollutant List Volatile Organics by GC/MS.

[d] Plus (+) 15 and plus (+) 10 refer to the tentative identification of unknowns by Methods 624/625 GC/MS to identify substances with peak areas greater than 10% of the nearest internal standard being searched based on a 50 ppb internal standard concentration.

[e] USEPA Priority Pollutant List Acid Extractable Organics by GC/MS.

[f] USEPA Priority Pollutant List Base Neutral Extractable Organics by GC/MS.

EXHIBIT 3-33[a]

COMPLIANCE MONITORING WELLS FOR
BASIN AREA

Acid Extr. Orgs. by GC/MS[b]
Base/Neut.
Extr. Orgs. by GC/MS[c]

Aluminum
Arsenic
Chromium
Lead
Mercury
Total Cyanide
Iron
Manganese
Zinc
Sodium
Sulfate
Chloride
Total Phenols
Nickel
Nitrogen Nitrate
Manganese
Gross Alpha
Gross Beta
Potassium
Vanadium
pH
Total Organic Carbon (TOC)
Total Organic Halogen (TOX)
Total Dissolved Solids (TDS)
Volatile Organic Scan[d]

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[a] Woodward-Clyde Consultants, 1989b, Volume VII, Hydrogeologic Conditions, Hazardous Waste Incinerator and Secure Landfill, E.I. Du Pont de Nemours and Company, Inc., Chambers Works, Deepwater, New Jersey. Project Number: 88C2054 February 7, 1989.

[b] USEPA Priority Pollutant List Acid Extractable Organics by GC/MS plus a 10 peak library search.

[c] USEPA Priority Pollutant List Base Neutral Extractable Organics by GC/MS plus a 15 peak library search.

[d] USEPA Priority Pollutant List volatile fracion by GC/MS plus a 5 peak library search.

EXHIBIT 3-34

BASELINE GROUND WATER QUALITY DATA FOR BASIN WELLS NEAR THE PROPOSED INCINERATOR COMPLEX

Well No: M-53
Location: N 5421, E 2605

Compounds	EPA Standards	Nov. & Dec. 1981	Jan. & Feb. 1982	April & May 1982	July & August 1982
Arsenic (mg/1)	0.05	0.08	0.04	0.008	0.03
Barium (mg/1)	1.0	0.11	0.02	0.06	0.01
Cadmium (mg/1)	0.01	0.02	0.004	0.008	0.003
Chromium (mg/1)	0.05	0.10	0.02	0.01	<0.01
Fluoride (mg/1)	1.4-2.4	16	135	36	58
Lead (mg/1)	0.05	0.57	0.05	0.12	0.002
Mercury (mg/1)	0.002	0.0008	0.0002	<0.0001	<0.0001
Nitrate (mg/1)	10	0.01	0.01	0.01	0.04
Selenium (mg/1)	0.01	*	0.01	0.01	*
Silver (mg/1)	0.05	<0.01	<0.001	0.001	<0.001
Endrin (mg/1)	0.0002	ND	ND	ND	ND
Lindane (mg/1)	0.004	ND	ND	ND	ND
Methoxychlor (mg/1)	0.1	ND	ND	ND	ND
Toxaphene (mg/1)	0.005	ND	ND	ND	ND
2,4D (mg/1)	0.1	ND	ND	ND	ND
2,4,5-TP (silvex) (mg/1)	0.01	ND	ND	ND	ND
Radium (pC/1)	5	<1	1.3	<1	1
Gross Alpha (pC/1)	15	<40	11	<5	<2
Gross Beta (pC/1)	50	170	46	20	36
Coliform Bacteria	1	0	0	0	20
pH	-	0	0	0	20
Specific Conductance (μmhos cm^2)	-	2,850	2,645	2,360	2,760
Total Organic Carbon (mg/L)	-	176	101	66	73
Total Organic Halogen (mg/L)	-	4.18	3.19	1.58	2.61

Well No: M-60
Location: N 5900, E 4795

Compounds	EPA Standards	Nov. & Dec. 1981	Jan. & Feb. 1982	April & May 1982	July & August 1982
Arsenic (mg/1)	0.05	0.04	<0.001	0.002	*
Barium (mg/1)	1.0	0.17	0.21	0.18	0.10
Cadmium (mg/1)	0.01	0.0008	0.008	0.006	0.009
Chromium (mg/1)	0.05	0.007	0.01	0.01	0.01
Fluoride (mg/1)	1.4-2.4	0.2	0.9	0.9	0.6
Lead (mg/1)	0.05	0.14	0.23	0.06	0.06
Mercury (mg/1)	0.002	<0.0001	0.0003	<0.0001	<0.0001
Nitrate (mg/1)	10	<0.01	<0.01	0.16	0.10
Selenium (mg/1)	0.01	0.04	<0.001	0.002	*
Silver (mg/1)	0.05	0.01	<0.001	<0.001	<0.001
Endrin (mg/1)	0.0002	ND	ND	ND	ND
Lindane (mg/1)	0.004	ND	ND	ND	ND
Methoxychlor (mg/1)	0.1	ND	ND	ND	ND
Toxaphene (mg/1)	0.005	ND	ND	ND	ND
2,4D (mg/1)	0.1	ND	ND	ND	ND
2,4,5-TP (silvex) (mg/1)	0.01	ND	ND	ND	ND
Radium (pC/1)	5	<1	1	<1	<1
Gross Alpha (pC/1)	15	<100	<1	<10	<10
Gross Beta (pC/1)	50	<80	27	39	37
Coliform Bacteria	1	1	0	6	0
pH	-	6.2	11.7	6.0	6.1
Specific Conductance (μmhos cm^2)	-	7,900	8,860	8,240	7,590
Total Organic Carbon (mg/L)	-	135	127	105	126
Total Organic Halogen (mg/L)	-	11	8.7	8.8	12

Well No: M-61
Location: N 6290, E 4440

Compounds	EPA Standards	Nov. & Dec. 1981	Jan. & Feb. 1982	April & May 1982	July & August 1982
Arsenic (mg/1)	0.05	0.02	0.030.	0.004	0.02
Barium (mg/1)	1.0	0.18	0.10	0.25	0.22
Cadmium (mg/1)	0.01	<0.0005	0.004	<0.001	0.004
Chromium (mg/1)	0.05	0.003	0.01	0.01	<0.01
Fluoride (mg/1)	1.4-2.4	0.3	0.4	0.7	0.5
Lead (mg/1)	0.05	<0.001	0.08	<0.001	0.05
Mercury (mg/1)	0.002	<0.0001	0.0002	<0.0001	<0.0001
Nitrate (mg/1)	10	<0.01	<0.01	0.01	0.03
Selenium (mg/1)	0.01	0.02	*	0.04	*

EXHIBIT 3-34

BASELINE GROUND WATER QUALITY DATA FOR BASIN WELLS NEAR THE PROPOSED INCINERATOR COMPLEX (continued)

Compounds	EPA Standards	Nov. & Dec. 1981	Jan. & Feb. 1982	April & May 1982	July & August 1982
Silver (mg/1)	0.05	<0.01	<0.001	<0.001	<0.001
Endrin (mg/1)	0.0002	ND	ND	ND	ND
Lindane (mg/1)	0.004	ND	ND	ND	ND
Methoxychlor (mg/1)	0.1	ND	ND	ND	ND
Toxaphene (mg/1)	0.005	ND	ND	ND	ND
2,4D (mg/1)	0.1	ND	ND	ND	ND
2,4,5-TP (silvex) (mg/1)	0.01	ND	ND	ND	ND
Radium (pC/1)	5	2	<1	<1	<1
Gross Alpha (pC/1)	15	<30	<5	<7	<8
Gross Beta (pC/1)	50	39	23	30	30
Coliform Bacteria	1	0	0	0	0
pH	-	6.2	6.2	6.3	6.1
Specific Conductance (^{u}mhos cm^{2})	-	4,160	5,080	3,250	4,090
Total Organic Carbon (mg/L)	-	50	58	59	51
Total Organic Halogen (mg/L)	-	3.5	1.06	2.1	2.7

Well No: M-59
Location: N 4830,E 5180

Compounds	EPA Standards	Nov. & Dec. 1981	Jan. & Feb. 1982	April & May 1982	July & August 1982
Arsenic (mg/1)	0.05	0.04	0.02	<0.001	*
Barium (mg/1)	1.0	0.26	0.20	0.36	0.10
Cadmium (mg/1)	0.01	<0.0006	0.009	0.007	0.009
Chromium (mg/1)	0.05	0.004	0.02	0.01	0.01
Fluoride (mg/1)	1.4-2.4	13	1.5	1.1	0.6
Lead (mg/1)	0.05	0.10	0.10	0.07	0.06
Mercury (mg/1)	0.002	<0.0001	<0.0002	<0.0001	<0.0001
Nitrate (mg/1)	10	5.2	<0.01	0.04	0.10
Selenium (mg/1)	0.01	0.009	0.004	0.007	*
Silver (mg/1)	0.05	<0.01	<0.001	<0.001	<0.001
Endrin (mg/1)	0.0002	ND	ND	ND	ND
Lindane (mg/1)	0.004	ND	ND	ND	ND
Methoxychlor (mg/1)	0.1	ND	ND	ND	ND
Toxaphene (mg/1)	0.005	ND	ND	ND	ND
2,4D (mg/1)	0.1	ND	ND	ND	ND
2,4,5-TP (silvex) (mg/1)	0.01	ND	ND	ND	ND
Radium (pC/1)	5	<1	<1	1.2	<1
Gross Alpha (pC/1)	15	<80	<5	<10	<10
Gross Beta (pC/1)	50	<80	14	36	37
Coliform Bacteria	1	0	0	0	1
pH	-	10.0	11.5	11.5	11.9
Specific Conductance (^{u}mhos cm^{2})	-	4,570	8,790	6,410	7,180
Total Organic Carbon (mg/L)	-	137	46	87	119
Total Organic Halogen (mg/L)	-	29	3.4	15	18

Well No: M-48
Location: N 5618,E 5073

Compounds	EPA Standards	Nov. & Dec. 1981	Jan. & Feb. 1982	April & May 1982	July & August 1982
Arsenic (mg/1)	0.05	0.09	0.13	0.017	*
Barium (mg/1)	1.0	0.16	0.16	0.08	0.07
Cadmium (mg/1)	0.01	0.0005	0.012	0.005	0.01
Chromium (mg/1)	0.05	0.006	0.04	<0.01	0.015
Fluoride (mg/1)	1.4-2.4	20	23	8.3	15
Lead (mg/1)	0.05	0.52	0.06	0.66	0.24
Mercury (mg/1)	0.002	<0.0001	<0.0001	<0.0001	<0.0001
Nitrate (mg/1)	10	<0.01	<0.01	9.1	0.37
Selenium (mg/1)	0.01	0.07	0.15	0.001	*
Silver (mg/1)	0.05	<0.01	<0.001	<0.001	<0.001
Endrin (mg/1)	0.0002	ND	ND	ND	ND
Lindane (mg/1)	0.004	ND	ND	ND	ND
Methoxychlor (mg/1)	0.1	ND	ND	ND	ND
Toxaphene (mg/1)	0.005	ND	ND	ND	ND
2,4D (mg/1)	0.1	0.0007	0.0002	ND	0.0005
2,4,5-TP (silvex) (mg/1)	0.01	0.001	0.003	0.0005	0.0007
Radium (pC/1)	5	1	1.5	<1	1.3
Gross Alpha (pC/1)	15	<100	<2	<8	<20
Gross Beta (pC/1)	50	<80	67	36	24
Coliform Bacteria	1	0	0	0	0

EXHIBIT 3-34[a]

BASELINE GROUND WATER QUALITY DATA FOR BASIN WELLS
NEAR THE PROPOSED INCINERATOR COMPLEX
(continued)

Compounds	EPA Standards	Nov. & Dec. 1981	Jan. & Feb. 1982	April & May 1982	July & August 1982
pH	-	5.4	5.6	5.0	4.6
Specific Conductance (umhos cm2)	-	11,800	16,700	7,040	9,380
Total Organic Carbon (mg/L)	-	80	117	73	69
Total Organic Halogen (mg/L)	-	6.4	7.6	8.8	8.1
Well No: M-14					
Location: N 4701, E 4590					
Arsenic (mg/1)	0.05	<0.005	0.006	<0.001	<0.001
Barium (mg/1)	1.0	0.08	0.18	0.15	0.13
Cadmium (mg/1)	0.01	0.006	0.007	<0.001	0.008
Chromium (mg/1)	0.05	0.007	0.02	<0.01	0.01
Fluoride (mg/1)	1.4-2.4	1.4	1.5	1.8	1.4
Lead (mg/1)	0.05	0.02	0.06	<0.008	0.004
Mercury (mg/1)	0.002	<0.0001	0.0002	<0.0001	<0.001
Nitrate (mg/1)	10	<0.01	<0.01	0.01	0.01
Selenium (mg/1)	0.01	*	*	0.001	*
Silver (mg/1)	0.05	<0.01	<0.001	<0.001	<0.001
Endrin (mg/1)	0.0002	ND	ND	ND	ND
Lindane (mg/1)	0.004	ND	ND	ND	ND
Methoxychlor (mg/1)	0.1	ND	ND	ND	ND
Toxaphene (mg/1)	0.005	ND	ND	ND	ND
2,4D (mg/1)	0.1	ND	ND	ND	ND
2,4,5-TP (silvex) (mg/1)	0.01	ND	ND	ND	ND
Radium (pC/1)	5	25	<1	<1	<1
Gross Alpha (pC/1)	15	<40	<2	<3	<2
Gross Beta (pC/1)	50	<70	9.5	6	6.8
Coliform Bacteria	1	0	0	1	0
pH	-	6.8	5.0	6.7	6.6
Specific Conductance (umhos cm2)	-	425	715	455	450
Total Organic Carbon (mg/L)	-	11	7.2	6.8	13
Total Organic Halogen (mg/L)	-	0.35	0.059	0.33	0.37

[a]Woodward-Clyde Consultants, 1989b, Volume VII, Hydrogeologic Conditions, Hazardous Waste Incinerator and Secure Landfill, E.I. Du Pont de Nemours and Company, Inc., Chambers Works, Deepwater, New Jersey. Project Number: 88C2054 February 7, 1989.

EXHIBIT 3-35[a]

GROUNDWATER QUALITY IN THE VICINITY OF M-47

Compound	Standard	Appendix VIII 1985	Appendix IX 1986	Appendix IX 1987
Benzene (ug/l)		316	4.4	4.4
Chlorobenzene (ug/l)		1340	51.3	79.7
Toluene (ug/l)		98.8	6.07	8.64
2-Chlorophenol (ug/l)		3.62	7.54	12.1
1,2-Dichlorobenzene (ug/l)		1580	27.8	46.4
1,3-Dichlorobenzene (ug/l)		6.10	1.9	1.9
1,4-Dichlorobenzene (ug/l)		23.2	4.4	4.4
2,4-Dinitrotoluene (ug/l)		2580	11.0	12.0
2,6-Dinitrotoluene (ug/l)		783	1.9	1.9
Nitrobenzene (ug/l)		599	8.39	50.2
Arsenic (ug/l)	50 (ug/l)	10	10	10
Copper (ug/l)	1000 (u/l)	50	29	22
Lead (ug/l)	50 (ug/l)	40	5.0	5.0
Zinc (ug/l)	5000 (ug/l)	20	34	28
Total Cyanide (ug/l)	200 (ug/l)	26	25	25
Aluminum (ug/l)		90	190	NL
Aniline (ug/l)		98.3	10	10
Barium (ug/l)	1000 (ug/l)	67	54	55
Calcium (ug/l)		38800	39900	NL
Iron (ug/l)	300 (ug/l)	45600	11000	NL
Potassium (ug/l)		6900	6500	NL
Sodium (ug/l)	50000 (ug/l)	115000	126000	NL
Stronitum (ug/l)		190	NL	NL
M-Dinitrobenzene (ug/l)		2380	10	20
O-Toluidine (ug/l)		414	NL	10
P-Chloraniline (ug/l)		513	10	516
Manganese (ug/l)	50 (ug/l)	NL	1500	NL
Magnesium (ug/l)		NL	20400	NL
Pyridine (ug/l)		NL	397	100
Chloroform (ug/l)		16	1.6	19.1
Acetone (ug/l)		NL	10	17.7
O-Cresol (ug/l)		NL	36.6	32.9
Naphthalene (ug/l)		1.6	1.6	5.82

Note: NL - Not Listed
* - Standards based on N.J.A.C. 7:9-6.6 requirements for Class GW2 groundwater

[a] Woodward-Clyde Consultants, 1989b, Volume VII, Hydrogeologic Conditions, Hazardous Waste Incinerator and Secure Landfill, E.I. Du Pont de Nemours and Company, Inc., Chambers Works, Deepwater, New Jersey. Project Number: 88C2054 February 7, 1989.

EXHIBIT 3-36

SUMMARY OF GROUNDWATER QUALITY DATA
PROPOSED INCINERATOR COMPLEX

Parameter	Old Well Number 1	New Well Number 2	Low (mg/L)	High (mg/L)	Mean (mg/L)
Total Dissolved Solids	M61	J16-M01B	349	3170	1477
	M60	K15-M01B	2114	5210	3932
	M48	K15-M01B	1653	6940	3985
Chloride	M61	J16-M01B	86	1020	567
	M60	K15-M01B	733	2648	1665
	M48	-	592	3540	1495
Iron	M61	J16-M01B	8	60	37
	M60	K15-M01B	148	545	275
	M48	-	53	116	79
pH	M61	J16-M01B	6.0	7.9	6.5
	M60	K15-M01B	5.8	6.9	6.3
	M48	-	3.4	5.2	4.5
Total Organic Cabron	M61	J16-M01B	7	38	19
	M60	K15-M01B	47	150	124
	M48	-	78	91	81
Dissolved Organic Carbon	M61	J16-M01B	6	108	29
	M60	K15-M01B	42	147	117
	M48	-	26	117	62
Total Organic Halides	M61	J16-M01B	0.07	9.6	1.5
	M60	K15-M01B	6.1	18.5	11.7
	M48	-	3.7	10.7	6.5
Sodium	M61	J16-M01B	3.6	461	210
	M60	K15-M01B	7.1	1170	641
	M48	-	9.8	1890	947
Total Phenolics	M61	J16-M01B	10	45	29
	M60	K15-M01B	21	330	149
	M48	-	606	737	
Manganese	M61	J16-M01B	0.7	10.3	2.5
	M60	K15-M01B	7.6	15.6	11.5
	M48	-	1.2	2.0	1.7

Note: 1 Original Well Number
2 New name of well consistent with Du Pont's reorganization of the subsurface condition data.

3.2.2 Surface Water Uses and Quality

Exhibit 3-37 displays the surface water drainage in the vicinity of the Chambers Works. A portion of the area of the Chambers Works Property drains directly toward the Delaware River while the remainder drains into either Henby or Bouttown Creeks, which are wetlands of the Delaware River Estuary. Bouttown Creek flows into Helms Bay immediately north of Carneys Point, the location of the proposed landfill unit. Henby Creek flows into the Delaware at a point immediately north of the proposed incinerator unit. To the east of Chambers Works a short distance is the Salem River Drainage. Approximately one mile east of Deepwater, the Salem Canal diverts water from the Salem River across the water-shed divide to a discharge point on the Delaware River near the south boundary of the Chambers Works Property. Water from the Salem Canal is currently treated and used to supply potable water for Chambers Works.

Because of the tidal intrusion and mixing of seawater with river water in the Delaware River Estuary, this source is not suitable for potable use. The effect of mixing is evident from seven years of water quality data from a monitoring station at the Delaware Memorial Bridge, indicating that the specific conductance of the water may range from 100 to over 11,000 micromhos/cm (at 25°C). Because of the generally poor quality of Delaware Estuary water and the lack of other large surface water supplies, the main source of potable water in Salem County is ground water.

3.2.2.1 Surface-Water Quality

The Delaware River Basin Commission (DRBC)[27] divides the Delaware River Basin into six different zones; 1) the non-tidal Delaware River, 2) the Upper Delaware Estuary, 3) and 4) the Middle Delaware Estuary, 5) the Lower Delaware Estuary, and 6) the Delaware Bay. Exhibit 3-38 presents a summary of the key water quality parameters assessed by the DRBC on boat runs during 1984 and 1985 at New Castle (immediately south of Chambers Works) and Cherry Island (to the north of Chambers Works). Although water quality standards are often violated in the zones upstream which include Trenton and Philadelphia, the standards are generally met in Zone 5. Contaminant levels decline to some degree in this part of the system due to mixing and dilution with seawater. The standards for all the parameters listed were met during the 1984 -1985 monitoring period, except for phenol. At locations below Wilmington, the mean concentration for phenols for all samples exceeded the standard.

Du Pont presently discharges 40 million gallons of treated wastewater to the Delaware Estuary in accordance with Du Pont's New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Surface Water (DSW) permit issued pursuant to N.J.A.C. 7:14A-1 et seq. The wastewater comes from production operations at Chambers Works, wastewater trucked to the site from other industrial concerns, leachate collected from the landfills, and interceptor well water.

EXHIBIT 3-37

SURFACE WATER BODIES
CHAMBERS WORKS AREA

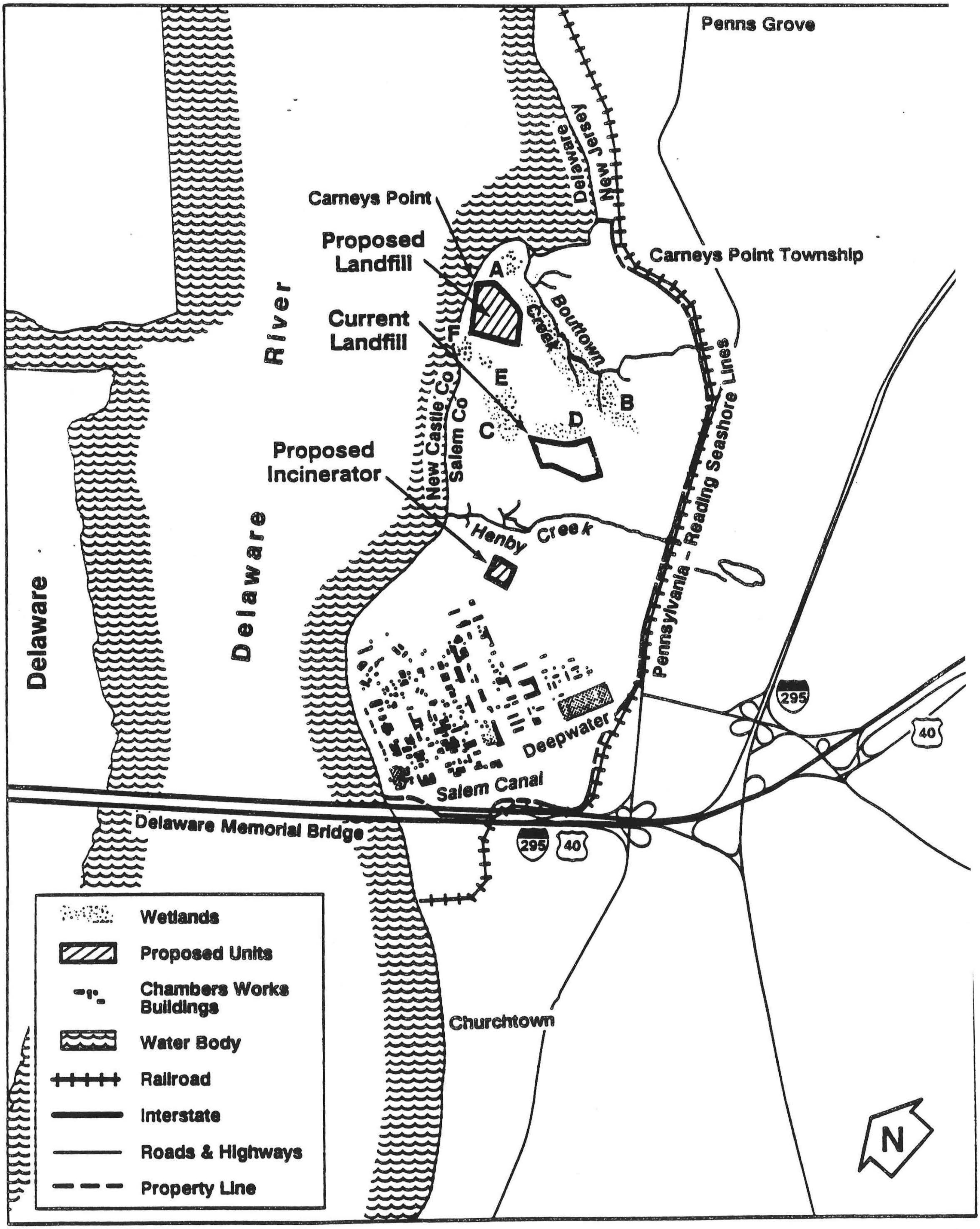

EXHIBIT 3-38[a]

SUMMARY OF 1984 AND 1985 WATER QUALITY
ZONE 5

Parameter		Cherry Is. RM 71	New Castle RM66
Dissolved Oxygen (mg/1)	Ave	6.3	6.6
	Max	10.6	9.6
	Min	2.8	3.0
	#	34	35
Fecal Coliform (#/100ml)	Ave*	142	87
	Max	1000	2000
	Min	<10	<10
	#	35	34
Total Phosphorus (mg/1)	Ave	0.17	0.15
	Max	0.39	0.33
	Min	0.08	0.06
	#	35	35
Nitrate nitrogen (mg/1)	Ave	2.0	2.0
	Max	3.2	3.1
	Min	0.4	0.3
	#	35	35
Ammonia Nitrogen (mg/1)	Ave	0.31	0.3
	Max	1.30	1.3
	Min	<0.10	<0.10
	X	35	35
pH	Ave	7.0	7.0
	Max	7.8	7.9
	Min	5.7	5.8
	#	33	33
Alkalinity	Ave	42	44
	Max	62	63
	Min	23	24
	#	35	35
Phenols	Ave	<0.007	0.013
	Max	0.023	0.091
	Min	<0.005	<0.005
	X	34	35
BOD_5	Ave	<2.4	<2.4
	Max	2.8	2.6
	Min	<2.4	<2.4
	X	34	34
Chlorophyll	Ave	7	7
	Max	15	14
	Min	0	0
	#	24	23

[a]Delaware River Basin Commission, 1986, Delaware River Water Quality Assessment: Delaware River Basin Commission, 53 p.

3.2.2.2 Tidal Influence of the Delaware River Estuary

Water-Level Monitoring. ICF conducted a water-level monitoring study over the period of a week (February 15 through February 22, 1989) in the area of the proposed secure landfill at wells R31-M01B & C, S32-M02B & C, and R28-M01B. This activity was coordinated with the water-leveling activities of WCC so that ICF could then compare two data sets. The wells instrumented by WCC for which data were provided to ICF included P29-M01B & C, Q30-M01B & C, T29-M01B & C. In addition, tidal monitoring data were collected for the Delaware Estuary at the south end of Chambers Works (near Munson Dam). This data set indicates:

- That the B and C zones respond to oscillating tides;
- The response of the B zone tends to be greater than the C aquifer. Tidal oscillation of the river during this period was between 5 and 6 feet while the response of the B zone was between 1 and 4 feet and the response of the C zone was between 0.4 and 2.5 feet (depending on location);
- Flow in the B zone is toward the Delaware Estuary for this area but flow in the C zone was not determined (a well development problem was encountered during the survey).

The differing response of the two zones may indicate differences in the degree of hydraulic connection between the two zones and the Delaware Estuary, or it may be simply a function of the differing depth of the zones.

3.2.3 **Floodplain/Flood Hazard Area Delineation**

This section discusses the procedures used to analyze and delineate flood plains and the results of analyses conducted for the Chambers Works region. The relevant factors to consider in an environmental impact statement for facilities located on a tidally-influenced river floodplain are also noted.

3.2.3.1 Flood Frequency-Elevation Studies

The proposed secure landfill and incinerator units are within the 100 year flood plain[28] that has been determined by the Federal Emergency Management Agency (FEMA). FEMA has conducted flood insurance studies for the townships of Pennsville and Carneys Point, New Jersey. These studies involve hydrologic and hydraulic analyses to determine flood hazard data relevant to flood plain management and flood insurance premium rates. The studies assess the characteristics of flood events of a magnitude which are expected to be equalled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (commonly termed the 10-, 50-, 100-, and 500-year floods, respectively).

FEMA's hydrologic analysis to determine flood frequency-elevation relationships involved an examination of discharge-frequency data at specific points along the Salem River. These data were then transposed to ungaged points downstream (including its confluence with the Delaware River). Tidal elevations were then examined for the Delaware River based on measurements taken at Philadelphia, PA, Lewes, DE, and Reedy Point, DE dating back to 1900. In the hydraulic analysis, FEMA examined the cross-section profile and shoreline characteristics of the Salem and Delaware Rivers, including the channel roughness factor for the channel and overbank areas. FEMA then compiled a "Summary of Elevations" based on the determined frequency-elevation data. At the upstream corporate limits of Pennsville, the Delaware River flood elevations are listed as follows (based on NGVD datum):

10-year	7.3 ft
50-year	8.4 ft
100-year	9.2 ft
500-year	13.8 ft

WCC's "100-Year Flood Event Wave Climate Evaluation"[29] was based on FEMA's study and specifies that the proposed landfill and incinerator will be designed to withstand floodwaters up to 9 feet[1] which is likely to occur once (on the average) every 100 years.

3.2.3.2 Other Factors Affecting Flood Potential

The location of the Chambers Works Property along the tidally-influenced lower section of the Delaware River makes it susceptible to floods due to riverine as well as coastal processes. Meteorologic data, including descriptions of storm frequency, intensity, wind speed and direction, and precipitation rates, must therefore be considered with regard to river discharge as well as tidal fluctuations and ocean storm surges in order to determine potential flood frequencies and elevations. Therefore, the actual likelihood of flooding of a given magnitude is a function of the likelihood of the occurrence of extreme events associated with several factors. Although individual extreme events, such as river flooding or storm surges may be related to a single meteorological phenomenon such as a hurricane, they may be operating independently. The likelihood of the most extreme floods is, therefore, a function of the likelihood of independent causes for flooding occurring simultaneously.

Varying amounts of historical data are available describing the characteristics of past storm events in the Chambers Works area and the resultant hydrologic affects. Exhibits 3-39 through Exhibit 3-41 present summary tables of historical data for extreme precipitation, winds and tides. These summary tables were developed from extended historical records for precipitation, wind, and tides. It is apparent that a worst-case flooding scenario would result from a combination of extreme climatic, riverine, and marine events. For example, if a hurricane were to strike the area during a time of peak river discharge and spring high tide, with winds coming from either the Southwest (longest fetch for proposed incinerator site) or the Northwest (longest fetch for proposed landfill

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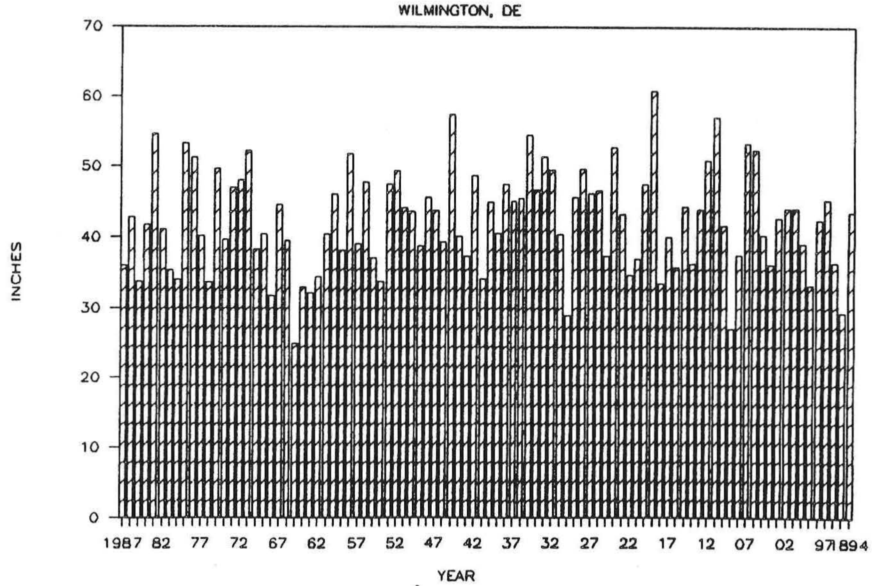
1 FEMA provides a value of 9 feet on their flood insurance maps rather than 9.2 feet.

EXHIBIT 3-39

SUMMARY OF PRECIPITATION DATA FOR CHAMBERS WORKS FACILITY

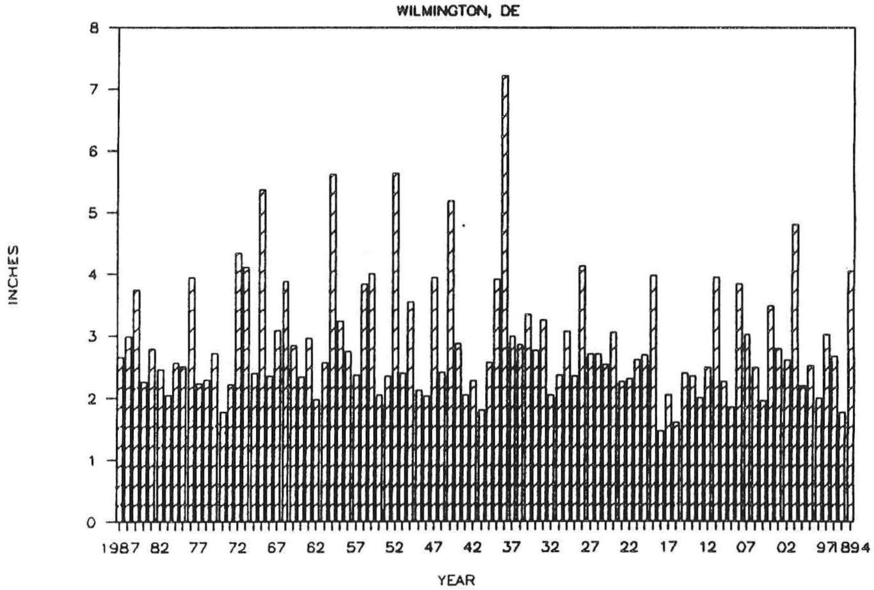
YEARLY TOTAL PRECIPITATION

WILMINGTON, DE



GREATEST 24 HOUR PRECIPITATION

WILMINGTON, DE



YEAR	PRECIPITATION TOTAL (in.)	Greatest 24 hours (in.)	Date
1987	35.98	2.66	7/5-6
1986	42.87	3	6/11-12
1985	33.73	3.75	9/26-27
1984	41.72	2.25	5/29-30
1983	54.7	2.79	9/21-22
1982	41.07	2.45	6/12-13
1981	35.28	2.05	8/8
1980	33.92	2.56	10/25-26
1979	53.31	2.51	8/2-3
1978	51.28	3.94	7/2-3
1977	40.13	2.22	3/22
1976	33.59	2.29	5/1
1975	49.61	2.71	7/12-13
1974	39.61	1.77	10/15-16
1973	47.05	2.21	6/29
1972	48.13	4.35	6/21-22
1971	52.24	4.11	8/27-28
1970	38.31	2.39	4/14-15
1969	40.38	5.37	9/2-3
1968	31.75	2.35	5/28-29
1967	44.65	3.08	8/9-10
1966	39.51	3.88	10/18-19
1965	24.9 .	2.84	7/11
1964	32.82	2.33	7/8
1963	32.1	2.96	11/6-7
1962	34.41	1.96	9/27-28
1961	40.44	2.56	4/12-13
1960	46.03	5.62	9/11-12
1959	38.19	3.23	8/31
1958	51.87	2.75	3/19-20
1957	39.09	2.36	8/25-26
1956	47.85	3.83	11/1-2
1955	37.14	4	8/12-13
1954	33.72	2.05	8/20-21
1953	47.6	2.35	7/23
1952	49.38	5.63	7/10
1951	44.19	2.4	11/7
1950	43.61	3.54	11/25
1949	38.84	2.12	5/3
1948	45.69	2.03	12/30
1947	43.82	3.95	5/30
1946	39.31	2.41	7/22
1945	57.48	5.18	8/1
1944	40.18	2.87	8/2
1943	37.34	2.05	4/19
1942	48.79	2.28	8/12
1941	34.17	1.8	7/7
1940	44.99	2.56	4/8
1939	40.52	3.91	8/19
1938	47.54	7.22	6/26
1937	45.15	2.99	8/7
1936	45.48	2.86	1/2
1935	54.45	3.35	11/16
1934	46.67	2.76	9/7
1933	51.42	3.25	8/23
1932	49.54	2.05	10/17
1931	40.37	2.37	7/9
1930	28.84	3.07	9/13
1929	45.68	2.35	10/1
1928	49.74	4.12	7/13
1927	46.25	2.7	12/4
1926	46.63	2.7	7/15
1925	37.27	2.54	7/31
1924	52.73	3.05	7/22
1923	43.17	2.25	4/28*
1922	34.61	2.31	7/2
1921	36.89	2.6	8/7
1920	47.53	2.68	8/10
1919	60.89	3.98	19
1918	33.39	1.45	5/21
1917	39.94	2.04	10/24
1916	35.71	1.6	7/10
1915	44.35	2.4	2/2
1914	36.22	2.34	7/28
1913	43.83	2	4/27
1912	50.93	2.49	10/23
1911	57.05	3.95	31
1910	41.63	2.25	9/2
1909	26.94	1.84	2.2
1908	37.39	3.84	7/26
1907	53.31	3.02	11/7
1906	52.42	2.48	6/5
1905	40.33	1.95	12/21
1904	36.13	3.48	9/14
1903	42.7	2.79	7/18
1902	44.09	2.6	1/22
1901	44.01	4.8	8/19
1900	39.05	2.2	10/1
1899	33.16	2.52	8/2
1898	42.49	2	2/21
1897	45.21	3.02	7/27
1896	36.45	2.67	2/6
1895	29.26	1.77	4/9
1894	43.44	4.05	5/21

* 1987-1954 DATA FROM WILMINGTON AIRPORT
** 1953-1894 DATA FROM WILMINGTON MUNICIPAL BUILDING

EXHIBIT 3-40

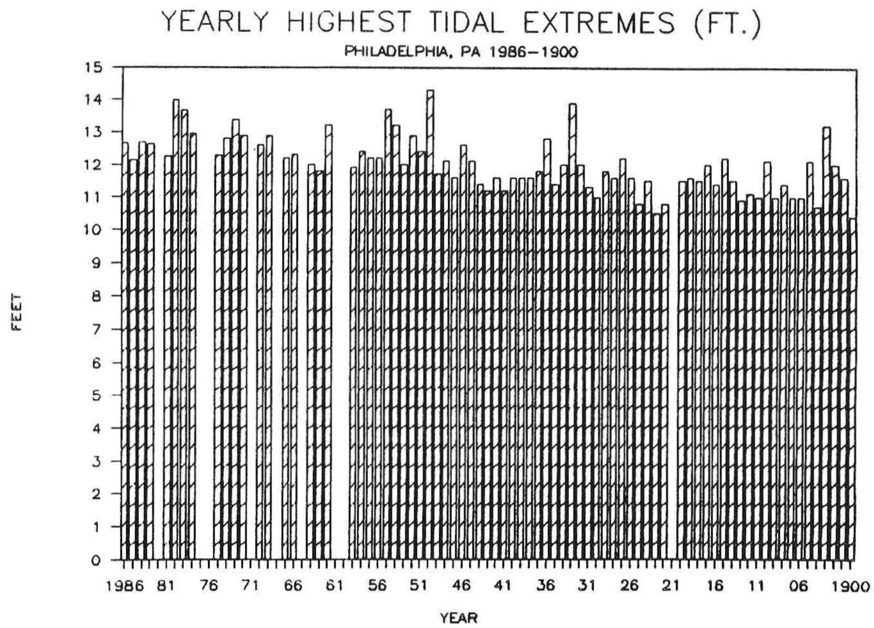
SUMMARY OF WIND DATA FOR CHAMBERS WORKS FACILITY

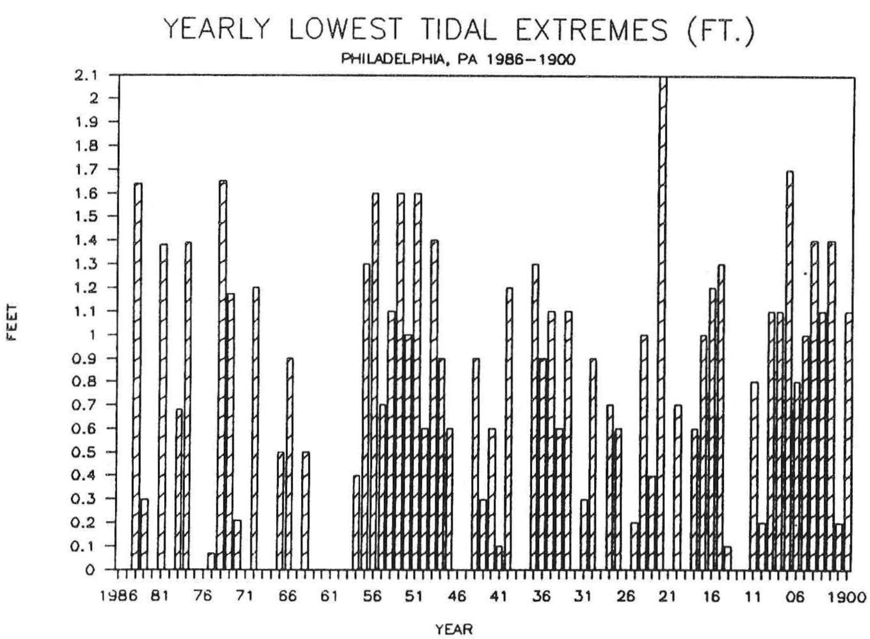
WILMINGTON AIRPORT 1950-1987

	RESULTANT		Avg.Spd	PEAK GUST		
Year	Direct.	Speed	Hourly	Speed	Direct.	Date
1987	313	2.1	8.7	66	NW	7/26
1986	303	2.4	9.2	52	NW	3/15
1985	296	2.5	9.3	64	NW	9/27
1984	300	2.2	8.6	71	NW	5/8
1983	300	3.4	10	39	310	8/22
1982	300	2.3	9.3	39	290	4/4
1981	290	3.6	9.9	35	320	2/25
1980	300	3.4	9.9	39	320	3/18
1979	290	2.2	9.2	35	310	8/2
1978	300	2.8	9.3	35	280	12/25
1977	280	3.6	9.6	40	310	1/28
1976	280	3.7	9.5	40	310	2/2
1975	290	2.3	9.1	39	310	4/3
1974	300	2.5	9.3	35	60	12/1
1973	300	2.1	9.4	42	300	11/1
1972	310	1.8	9.1	42	290	12/16
1971	300	2.5	9.3	46	350	8/28
1970	280	2	8.7	40	320	12/6
1969	280	2.6	9.9	39	270	1/1
1968	270	3	10	39	280	1/4
1967	290	2.2	8.9	42	240	2/16
1966	290	2.7	9.3	32	220	8/11
1965	270	2.9	N/A	44	200	2/25
1964	290	N/A	9.8	42	300	3/10
1963	WNW	N/A	8.4	48	W	7/29
1962	NW	N/A	9.8	44	WNW	12/31
1961	NW	N/A	9.8	43	ENE	4/13
1960	WNW	N/A	9	42	WNW	2/19
1959	WNW	N/A	8.9	N/A	N/A	N/A
1958	WNW	N/A	9.2	43	NE	1/14
1957	NW	N/A	9.8	46	WNW	1/23
1956	NW	N/A	9.6	46	WNW	2/25
1955	S	N/A	8.4	40	E	8/13
1954	NW	N/A	8.7	58	SSW	10/15
1953	NW	N/A	8.2	38	NW	11/7
1952	NW	N/A	8.2	43	SSE	3/11
1951	NW	N/A	8.1	35	SSE	12/20
1950	NW	N/A	7.7	46	SSE	11/25

EXHIBIT 3-41

SUMMARY OF TIDE DATA RELEVANT TO CHAMBERS WORKS FACILITY





YEARLY TIDAL EXTREMES PHILADELPHIA, PA 1986-1900

	OBSERVED TIDES			
	HIGHEST		LOWEST	
YEAR	Date	Feet	Date	Feet
1986	12/2	12.66	3/6	-0 28
1985	9/2	12.15	2/9	0.10
1984	4/6	12.67	1/21	1.64
1983	4/3	12.64	12/25	0.3
1982	10/10	12.04	4/7	0
1981	5/5	12.25	1/5	1.38
1980	10/25	13.98	12/25	-0.01
1979	2/26	13.68	2/6	0.68
1978	1/26	12.94	12/17	1 39
1977	***	***	***	***
1976	***	***	***	***
1975	10/20	12.28	4/4	0.07
1974	12/2	12.8	11/22	1.65
1973	6/30	13.39	2/17	1.17
1972	6/22	12.88	2/21	0.21
1971	***	***	***	***
1970	11/15	12.6	12/7	1.2
1969	7/29	12.9	2/10	0
1968	***	***	***	***
1967	9/28	12.2	2/25	0.5
1966	11/28	12.3	2/1*	0.9
1965	***	***	***	***
1964	3/12	12	12/18	0.5
1963	5/18	11.8	1/1	-1.5
1962	3/8	13.2	12/31	-3.0
1961	***	***	***	***
1960	***	***	***	***
1959	12/29	11.9	1/6	-0.3
1958	4/4	12.4	11/30	0.4
1957	6/29	12.2	1/24	1.3
1956	11/26	12.2	12/30	1.6
1955	8/13	13.7	3/28*	0.7
1954	10/15	13.2	1/28	1.1
1953	10/23	12	2/10	1.6
1952	3/11	12.9	3/17	1
1951	11/7	12.4	11/27*	1.6
1950	11/25	14.3	3/10	0.6
1949	4/6*	11.7	3/13*	1.4
1948	3/24	12.1	12/28	0.9
1947	11/1	11.6	2/11	0.6
1946	4/30	12.6	12/2	-1.0
1945	9/18	12.1	1/25	-1.4
1944	4/25	11.4	2/1	0.9
1943	5/22*	11.2	12/11	0.3
1942	3/3	11.6	2/22	0.6
1941	9/25	11.2	3/19	0.1
1940	12/29	11.6	2/15*	1.2
1939	8/19	11.6	1/26	-0.7
1938	7/23	11.6	2/20	-0.1
1937	4/27	11.8	2/3	1.3
1936	3/21	12.8	1/24	0.9
1935	7/10	11.4	1/4	1.1
1934	6/19	12	1/30	0.6
1933	8/24	13.9	12/12*	1.1
1932	11/10	12	3/8	-0.4
1931	4/12	11.3	12/8	0.3
1930	8/24	11	12/2	0.9
1929	10/22	11.8	3/8	-0.1
1928	7/7	11.6	1/21	0.7
1927	12/6	12.2	1/18	0.6
1926	11/18	11.6	1/29	0
1925	2/13	10.8	12/28	0.2
1924	1/16	11.5	1/27	1
1923	4/30*	10.5	2/15	0.4
1922	5/28	10.8	12/6	2.1
1921	***	***	***	***
1920	12/14	11.5	2/27	0.7
1919	11/8	11.6	3/29	-0.3
1918	4/11	11.5	3/11	0.6
1917	4/6	12	12/11	1
1916	6/17	11.4	2/28	1.2
1915	1/14	12.2	12/15	1.3
1914	3/30	11.5	1/13	0.1
1913	10/1*	10.9	12/9	-0.1
1912	2/22*	11.1	1/6	-0.1
1911	9/19*	11	12/29	0.8
1910	1/22	12.1	2/7	0.2
1909	2/24*	11	2/1	1.1
1908	2/1	11.4	2/2	1.1
1907	12/15	11	1/21*	1.7
1906	10/19	11	12/8	0.8
1905	1/7	12.1	12/1	1
1904	10/21	10.7	4/21	1.4
1903	10/11	13.2	1/13	1.1
1902	10/1	12	1/4*	1.4
1901	4/3	11.8	2/5	0.2
1900	11/7	10.4	11/16	1.1

site), severe flooding (possibly in excess of the 100-year elevation) could occur. The most extreme high tide for the 86 period of record at Philadelphia and the greatest precipitation over a period of 24 hrs, 7.22 inches (equal to the 100 year 24 hr storm[30]) were not associated with hurricane events.

Although FEMA has apparently determined that it is unlikely that all of these factors would occur simultaneously as described, it is unclear to what degree hurricanes effect the flood potential of the area. The effects of these hurricanes are largely dependent on the other factors described above.

Potential Hurricane (Cyclone) Threat. A total of 845 known North Atlantic tropical cyclones of at least tropical storm intensity (>39 mph winds) have occurred during the 101-year period between 1886 and 1986 for which data are available. This averages roughly 8.4 tropical storms per year, of which an average of 4.9 per year are hurricanes (>74 mph winds) (Neumann, et. al., 1987)[31]. Despite the potential for significant damage to be caused by storms merely of tropical storm intensity, little data are easily accessible depicting the absolute pathways and resultant destruction of these storms on the New Jersey coast near the Chambers Works Property.

Simpson and Lawrence (1971) estimate a probable hurricane occurrence of only 1 percent during any given year for the New Jersey coast. This estimate is based on the fact that over the last 100 years, only one hurricane (#4 in 1903) has directly struck the New Jersey coast. The probability of occurrence, however, may actually be higher based on the fact that as many as 58 hurricanes have struck the East Coast between South Carolina and Connecticut since 1886. Furthermore, with a typical diameter of 375 miles, hurricanes tracking just offshore or striking a nearby state may also cause significant damages to floodplain properties in New Jersey, such as at Chamber Works. A breakdown of these 58 identified hurricanes by intensity class is presented below.

CLASS	WIND SPEED	TOTAL NUMBER BETWEEN SOUTH CAROLINA AND CONNECTICUT
1	74-95	25
2	96-110	12
3	111-130	19
4	131-155	2
5	>155	0

Although meteorologic data, including descriptions of storm frequency, intensity, wind speed and direction, and precipitation rates, should be incorporated into any flood-frequency analysis, evidence of the flood elevations associated with the major floods of 1933, 1950, and 1962 (not exceeding 8.5 ft NVGD in the vicinity of Chambers Works) supports 9 feet (NGVD) as an appropriate planning elevation for the 100-year flood.

3.3 EXISTING AIR QUALITY

3.3.1 Meteorology and Climatology

The closest location near the Du Pont Chambers Works site for which complete meteorological data are collected is the Greater Wilmington Airport, located 8 miles west-southwest of the site. The following discussion is based on data from Wilmington Airport.

The Delaware River and Delaware Bay, located near the site, have a moderating influence on the climate of the area, leading to humid summers and relatively mild winters. The average monthly temperature in the area ranges from a high of 76.0°F in July to a low of 31.2°F in January. Recorded extremes of temperature range from 102°F, recorded in July, to 14°F below zero, recorded in January. The average length of the growing season in the area is about 200 days. The average date of the last freezing temperature in spring is around April 13, and the average date of the first freezing temperature in fall is around October 29.

Precipitation in the area is fairly uniformly distributed throughout the year, and averages 41.4 inches annually. The lowest recorded amount of annual precipitation was 24.90 inches, and the highest was 54.70 inches. The highest daily rainfall recorded was 6.24 inches. Snow may occur from October to April, with most of the snowfall occurring from December through March. The highest daily snowfall recorded was 16.5 inches. Most of the rain in the summer months comes from thunderstorms, and coastal storms are responsible for most of the rain throughout the remainder of the year. Atlantic hurricanes can cause heavy rains during the summer months, although winds rarely reach hurricane force in the area. Both heavy rains and high tides can cause flooding of the Delaware River and Delaware Bay.[32,33]

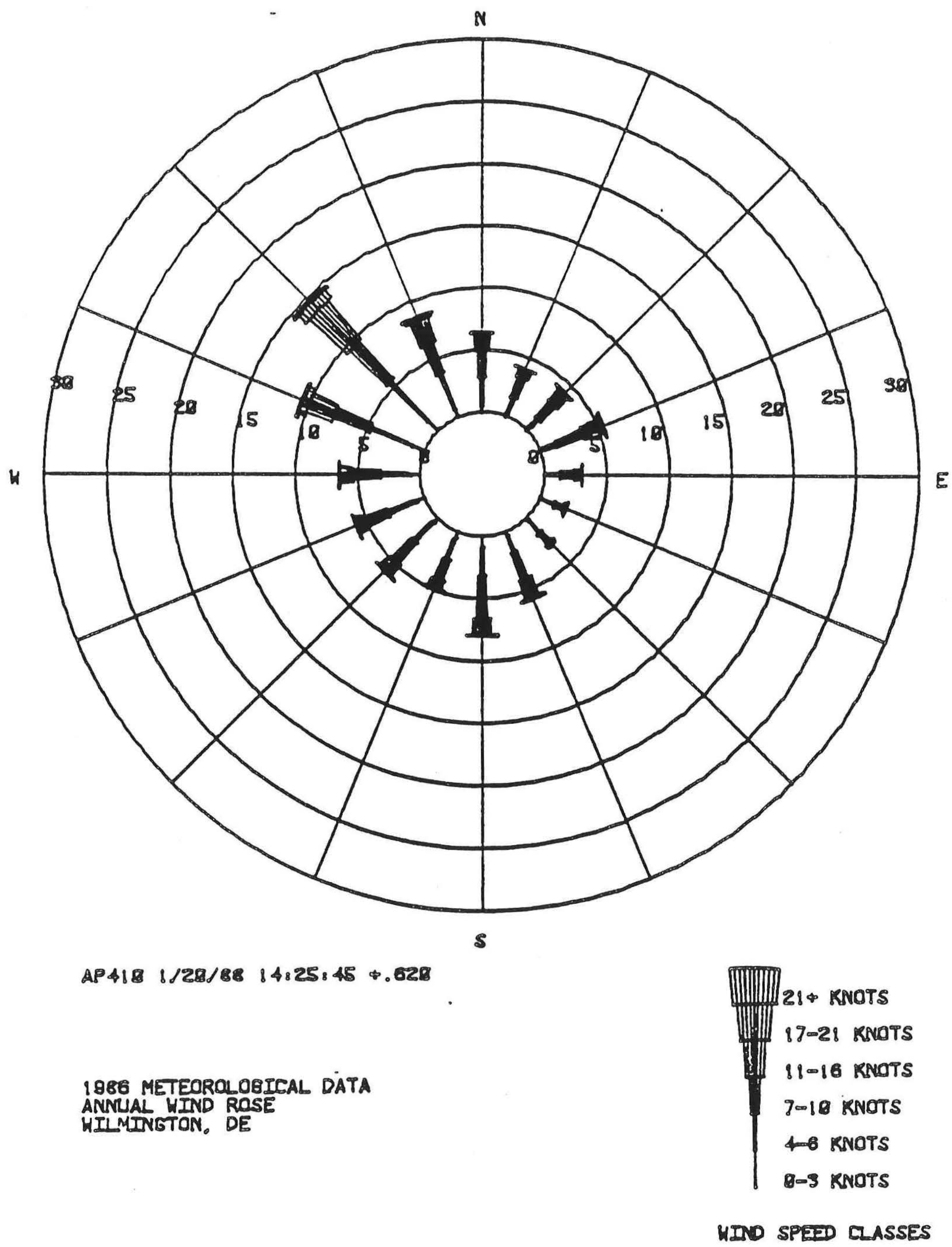
An annual wind rose for the Wilmington area is included in Exhibit 3-42.[34] Prevailing winds are from the south from May through September, and from the northwest and west-northwest during the remaining months. The wind is from the southwest quadrant approximately 44 percent of the time. The average wind speed is approximately 9.2 mph, with short term gusts up to about 50 mph. Winds blowing from the direction of the Delaware Bay or from Philadelphia, or from industrial areas along the Delaware River favor the formation of fog, which can occur at any time of the year.

3.3.2 Ambient Air Quality

3.3.2.1 Air Quality Reporting Regions and Monitoring Locations. Information in this section is taken primarily from the 1986 and 1987 New Jersey Air Quality Reports[35,36], the 1986 and 1987 Delaware Air Quality Summaries,[37,38] and the air permit application included in the RCRA Part B Permit Application for the proposed facility.[39]

EXHIBIT 3-42

ANNUAL WIND ROSE FOR THE WILMINGTON AREA



Source: RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Part 2 of 2.

The proposed incinerator will emit criteria pollutants (i.e., sulfur dioxide (SO_2), nitrogen oxides (NO_X), carbon monoxide (CO), inhalable particulate (PM-10), lead (Pb), and ozone (O_3) precursors (volatile organic substances) which are regulated by National and New Jersey Ambient Air Quality Standards (AAQS)) during normal operations. The States of New Jersey and Delaware monitor ambient concentrations of these pollutants from various locations. Ambient air quality monitoring locations in Salem County, New Jersey, New Castle County, Delaware, and the Delaware Bay and Southern Delaware Valley Regions of New Jersey, are listed in Exhibit 3-43. The location of each station with respect to Chambers Works is shown in Exhibit 3-44. The pollutants monitored at each location are described in Exhibit 3-45. The closest monitoring stations to Chambers Works are in Salem and New Castle Counties. Other monitoring stations are located between 25 and 50 km from Chambers Works. Ambient air quality data from the relatively remote monitoring stations are not necessarily representative of conditions in Salem County, but provide general information on ambient air quality in Southern New Jersey.

The State reports air quality through a numerical Pollutant Standards Index (PSI) for each monitored pollutant. The PSI is calculated based on the monitored concentration of each pollutant in each PSI Reporting Region during the previous 24-hour period. A PSI rating of 100 or greater indicates that the monitored pollutant had reached or exceeded the applicable ambient air quality standard. The PSI is further classified based upon its numerical value; 0-50 is classified as good, 51-100 as moderate, 101-200 as unhealthful, and above 200 as very unhealthful.

Salem County is located in the Delaware Bay Pollutant Standards Index Reporting Region, one of nine Regions classified by the State of New Jersey for the purposes of monitoring and reporting air quality. The Southern Delaware Valley and Southern Coastal Reporting Regions are adjacent to the Delaware Bay Region. Exhibit 3-43 shows the nine New Jersey State PSI Reporting Regions, and adjacent counties in Delaware.

The PSIs for criteria pollutants, with the exception of ozone, have been less than 100 (i.e., moderate or better) during 1986 and 1987. The PSI for ozone in the Delaware Bay PSI Reporting Region was moderate to good on 363 days in 1986, and unhealthful on 2 days. The PSI for ozone in the region was moderate to good on 351 days in 1987, and unhealthful on 7 days. Complete ozone monitoring data were not available for 7 days in 1987.

3.3.2.2 <u>Federal and State Attainment Status for Criteria Pollutants.</u> The air quality in the Delaware Bay Region is classified as better than National and New Jersey Ambient Air Quality Standards (AAQS) for total suspended particulate (TSP), sulfur dioxide (SO_2), carbon monoxide (CO), nitrogen oxides (NO_X), and lead (Pb). Ambient concentrations of ozone (O_3) in the Delaware Bay Reporting Region and in the entire State of New Jersey exceed both State and Federal ambient air quality standards. Ambient concentrations of ozone also exceed Federal standards in New Castle County (Wilmington), Delaware, which lies directly west of Salem County, New Jersey.[40] The region has not yet been classified with respect to the State and Federal inhalable particulate (PM-10) ambient air quality standard because data are not yet available.

EXHIBIT 3-43

NEW JERSEY STATE POLLUTANT STANDARDS INDEX REPORTING REGIONS

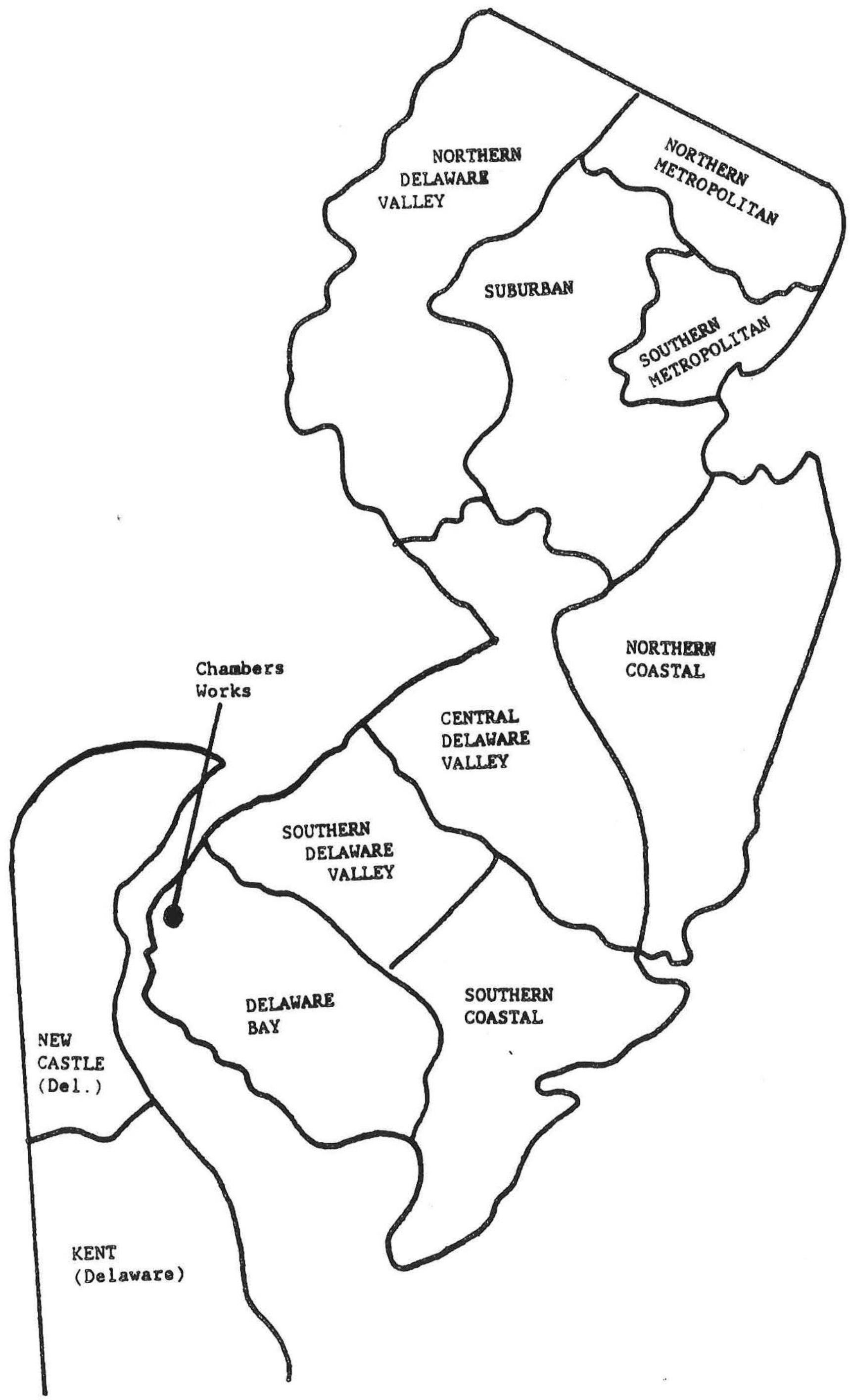
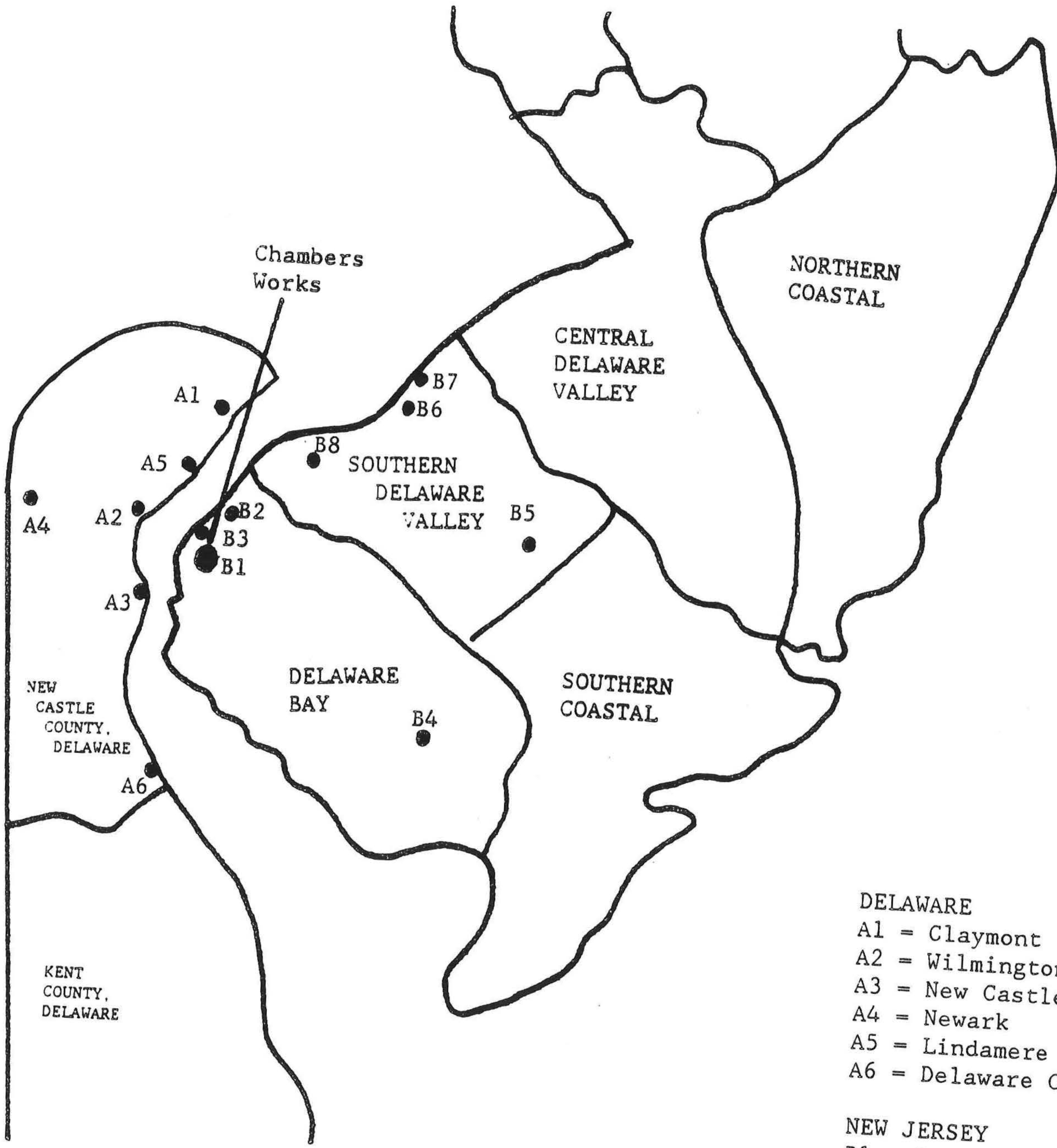


EXHIBIT 3-44

LOCATION OF EACH AMBIENT AIR QUALITY STATION



DELAWARE
A1 = Claymont
A2 = Wilmington
A3 = New Castle
A4 = Newark
A5 = Lindamere
A6 = Delaware City

NEW JERSEY
B1 = Deepwater
B2 = Pedricktown
B3 = Pennsgrove
B4 = Millville
B5 = Ancora S.H.
B6 = Camden
B7 = Pennsauken
B8 = Clarksboro

EXHIBIT 3-45

SUMMARY OF AMBIENT AIR QUALITY MONITORING STATIONS IN THE VICINITY OF DU PONT CHAMBERS WORKS - NEW JERSEY AND DELAWARE MONITORING STATIONS[a]

Station	County	PSI Region	Pollutants Monitored
NEW JERSEY:			
Deepwater 052	Salem	Delaware Bay	TSP, Pb, other metals
Pedricktown S57	Salem	Delaware Bay	TSP, Pb, other metals
Pennsgrove[b]	Salem	Delaware Bay	SO2
Millville	Cumberland	Delaware Bay	SO2, O3
Ancora S.H.	Camden	S. Del. Valley	SO2, O3, CO
Camden Lab 058	Camden	S. Del. Valley	SO2, O3, CO, NO2
Camden Lab ip02	Camden	S. Del. Valley	PM10, Pb
Camden Lab ip16	Camden	S. Del. Valley	PM10
Camden NO2	Camden	S. Del. Valley	TSP
Pennsauken 059	Camden	S. Del. Valley	TSP, PM10, metals
Clarksboro	Gloucester	S. Del. Valley	SO2, O3
DELAWARE:			
Claymont P-1	New Castle	New Castle	SO2, O3, CO, TSP, NO2
Wilmington P-2[c]	New Castle	New Castle	SO2, CO, TSP, PM10, NO2
Wilmington S-19	New Castle	New Castle	PM10
New Castle P-4	New Castle	New Castle	SO2, TSP
Newark UDE S-9	New Castle	New Castle	SO2
Newark Lums S-18	New Castle	New Castle	O3
Lindamere S-3	New Castle	New Castle	SO2, TSP, O3
Delaware City S-8	New Castle	New Castle	SO2, TSP

[a] New Jersey Department of Environmental Protection; 1987 Air Quality Report, NJDEP Division of Environmental Quality, July, 1988.

New Jersey Department of Environmental Protection; 1986 Air Quality Report, NJDEP Division of Environmental Quality, August, 1987.

[b] Monitoring at this location was discontinued at the end of 1985.

[c] Monitoring location does not meet EPA siting criteria for TSP monitoring stations.

3.3.2.3 Ambient Air Quality Data for Criteria Pollutants. Exhibit 3-46 summarizes available ambient air quality data for criteria pollutants at monitoring locations in New Jersey and Delaware in the vicinity of Chambers Works. However, it is assumed by EPA and NJDEP that ambient concentrations of all pollutants with the exception of ozone are well below applicable standards. Of the six criteria pollutants, only TSP is monitored in the immediate vicinity of Chambers Works. However, it is assumed by EPA and NJDEP that ambient concentrations of all criteria pollutants with the exception of ozone meet applicable standards in the vicinity of Chambers Works. Although ambient concentrations of ozone are not monitored in the immediate vicinity of Chambers Works, it is assumed by EPA and NJDEP that ambient concentrations exceed applicable standards, based on air quality monitoring data from other locations throughout New Jersey and Delaware. Ambient concentrations of carbon monoxide have exceeded the NAAQS in several urban areas in New Jersey, including Camden and Pennsgrove. High ambient concentrations of carbon monoxide in urban areas are generally attributed to mobile sources, and it is assumed by EPA and NJDEP that carbon monoxide concentrations in the vicinity of Chambers Works meet applicable standards.

EPA recently promulgated ambient air quality standards for PM-10 (the fraction of total particulate with a particle size of less than 10 microns) to replace the primary ambient air quality standards for TSP. Federal standards for ambient concentrations of PM-10 have been incorporated into the New Jersey Air Regulations, and will be incorporated into the revised New Jersey State Implementation Plan (SIP), which outlines air quality control strategies for the state.

It is expected by EPA that most areas in compliance with present ambient air quality standards for TSP will also be found to be in compliance with the new PM-10 standards. Salem County was not classified by EPA as an area expected to exceed the PM-10 standards. Data on ambient concentrations of PM-10 in Salem County and the Delaware Bay Reporting Region are not presently available. Data for the adjacent Southern Delaware Valley Reporting Region show the region to be in compliance with both the TSP and PM-10 standards. It is expected that PM-10 concentrations in the vicinity of Chambers Works meet applicable standards.

3.3.2.4 Ambient Air Quality Data for Non-Criteria Particulate Metals. Particulate emissions from the proposed incinerator are expected to contain metals. Exhibit 3-47 summarizes monitoring data for concentrations of particulate metals in the vicinity of Chambers Works. With the exception of lead, which is a criteria pollutant, ambient air quality standards have not been promulgated for metals. In 1987, EPA developed and released draft standards for emissions of metals from hazardous waste incinerators. The draft standards are based on EPA unit risk values (i.e., ambient air concentrations) and include standards for arsenic, beryllium, cadmium, chromium, barium, mercury, thallium, silver, vanadium, and zinc. The draft standards have not been published in the Federal Register, and are not expected to be promulgated until 1989. The draft metal emissions standards are further discussed in Section 4.2 on Air Quality Impacts and Section 4.4 on Public Health Assessment.

EXHIBIT 3-46

SUMMARY OF 1987 AMBIENT AIR QUALITY MONITORING DATA FOR CRITERIA POLLUTANTS IN THE VICINITY OF DU PONT CHAMBERS WORKS - NEW JERSEY MONITORING LOCATIONS

	Monitoring Location	Averaging Period	Ambient Standard (ppm) (primary)	(secondary)	Concentration (ppm)[a]
SO_2	Millville	Annual	0.03	0.02	0.007
		24-Hour	0.14	0.10	0.045/0.041
		3-Hour	None	0.5	0.064/0.061
	Ancora S.H.	Annual	0.03	0.02	0.006
		24-Hour	0.14	0.10	0.047/0.034
		3-Hour	None	0.5	0.074/0.066
	Camden Lab 058	Annual	0.03	0.02	0.013
		24-Hour	0.14	0.10	0.064/0.051
		3-Hour	None	0.5	0.101/0.083
	Clarksboro	Annual	0.03	0.02	0.009
		24-Hour	0.14	0.10	0.055/0.041
		3-Hour	None	0.5	0.074/0.069
	Pennsgrove[b]	Annual	0.03	0.02	0.011
		24-Hour	0.14	0.10	0.048
		3-Hour	None	0.5	0.094
NO_2	Camden Lab 058	Annual	0.05	0.05	0.028
CO	Ancora S.H.	1-Hour	35	35	5.2/4.1
		8-Hour	9	9	2.9/2.7
	Camden Lab 058	1-Hour	35	35	12.9/11.9
		8-Hour	9	9	9.0/6.7

[a] Annual averages are for calendar year. Highest and second highest values (highest/2nd highest) are shown for 24-hour, 8-hour, 3-hour, and 1-hour averages.

[b] Monitoring data is from 1985. 24-hour and 3-hour concentrations are second-highest values.

EXHIBIT 3-46

SUMMARY OF 1987 AMBIENT AIR QUALITY MONITORING DATA FOR CRITERIA POLLUTANTS IN THE VICINITY OF DU PONT CHAMBERS WORKS - NEW JERSEY MONITORING LOCATIONS (continued)

	Monitoring Location	Averaging Period	Ambient Standard (ppm) (primary)	(secondary)	Concentration (ppm)[a]
O_3	Millville	Max. 1-Hour	0.12	0.08	0.148/0.140 (7)[b]
	Ancora S.H.	Max. 1-Hour	0.12	0.08	0.169/0.165 (9)
	Camden Lab 058	Max. 1-Hour	0.12	0.08	0.211/0.177 (23)
	Clarksboro	Max. 1-Hour	0.12	0.08	0.173/0.166 (10)
TSP	Deepwater 062	Geo. Mean	75	60	46.8
		24-Hour	260	150	104/92
	Pedricktown S57	Geo. Mean	75	60	35.9
		24-Hour	260	150	99/83
	Camden N02	Geo. Mean	75	60	54.6
		24-Hour	260	150	127/111
	Pennsauken 059	Geo. Mean	75	60	48.3
		24-Hour	260	150	127/118
PM-10	Camden IP02	Arith. Mean	50[c]	50	30.9
		24-Hour	150	150	89/59
	Camden IP16	Arith. Mean	50	50	29.1
		24-Hour	150	150	85/57
	Pennsauken IP10	Arith. Mean	50	50	35.4
		24-Hour	150	150	106/92
Pb	Deepwater 062	Max. 3-Month	1.5	1.5	0.137
	Pedricktown S57	Max. 3-Month	1.5	1.5	0.097
	Camden Lab IP02	Max. 3-Month	None - PM-10 sample		0.089
	Pennsauken S71	Max. 3-Month	1.5	1.5	0.210

[a] Annual averages are for calendar year. Highest and second highest values (highest/2nd highest) are shown for 24-hour, 8-hour, 3-hour, and 1-hour averages.

[b] Number of days in 1987 that ozone concentration exceeded 0.12 ppm at monitoring location.

[c] Federal Standards only. New Jersey State Standards for PM-10 have not been promulgated.

EXHIBIT 3-46

SUMMARY OF 1987 AMBIENT AIR QUALITY MONITORING DATA FOR CRITERIA POLLUTANTS IN THE VICINITY OF DU PONT CHAMBERS WORKS - DELAWARE MONITORING LOCATIONS

	Monitoring Location	Averaging Period	Ambient Standard (ppm) (primary)	(secondary)	Concentration (ppm)[a]
SO_2	Claymont	Annual	0.03	0.02	0.010
		24-Hour	0.14	0.10	0.04/0.04
		3-Hour	None	0.5	Not Exceeded
	Wilmington	Annual	0.03	0.02	0.020
		24-Hour	0.14	0.10	0.05/0.05
		3-Hour	None	0.5	Not Exceeded
	New Castle	Annual	0.03	0.02	0.010
		24-Hour	0.14	0.10	0.03/0.03
		3-Hour	None	0.5	Not Exceeded
	Newark UDE	Annual	0.03	0.02	0.010
		24-Hour	0.14	0.10	0.03/0.03
		3-Hour	None	0.5	Not Exceeded
	Lindamere	Annual	0.03	0.02	0.010
		24-Hour	0.14	0.10	0.05/0.04
		3-Hour	None	0.5	Not Exceeded
	Delaware Cty	Annual	0.03	0.02	0.010
		24-Hour	0.14	0.10	0.04/0.04
		3-Hour	None	0.5	Not Exceeded
NO_2	Claymont	Annual	0.05	0.05	0.027
	Wilmington	Annual	0.05	0.05	0.029
CO	Claymont	1-Hour	35	35	5
		8-Hour	9	9	4
	Wilmington	1-Hour	35	35	11
		8-Hour	9	9	5
O_3[b]	Claymont	Max. 1-Hour	0.12	0.08	(0)[c]
	Lindamere	Max. 1-Hour	0.12	0.08	(0)
	Newark Lums	Max. 1-Hour	0.12	0.08	(0)

[a] Annual averages are for calendar year. Highest and second highest values (highest/2nd highest) are shown for 24-hour, 8-hour, 3-hour, and 1-hour averages.

[b] No violations of the ozone ambient air quality standard were recorded in 1986 or 1987. New Castle county is classified by EPA as non-attainment for ozone on the basis of violations recorded in 1985 and prior years.

[c] Number of days in 1987 that ozone concentration exceeded 0.12 ppm at monitoring location.

EXHIBIT 3-46

SUMMARY OF 1987 AMBIENT AIR QUALITY MONITORING DATA FOR CRITERIA POLLUTANTS IN THE VICINITY OF DU PONT CHAMBERS WORKS - DELAWARE MONITORING LOCATIONS (continued)

	Monitoring Location	Averaging Period	Ambient Standard (ppm) (primary)	Ambient Standard (ppm) (secondary)	Concentration (ppm)[a]
TSP	Claymont	Geo. Mean	75	60	38
		24-Hour	260	150	86/76
	Wilmington[b]	Geo. Mean	75	60	63
		24-Hour	260	150	153/129
	New Castle	Geo. Mean	75	60	40
		24-Hour	260	150	115/78
	Lindamere	Geo. Mean	75	60	44
		24-Hour	260	150	115/105
	Del. City	Geo. Mean	75	60	35
		24-Hour	260	150	115/96
PM-10	WilmingtonP	Arith. Mean	50[c]	50	35
		24-Hour	150	150	90/66
	WilmingtonS	Arith. Mean	50	50	34
		24-Hour	150	150	87/66

[a] Annual averages are for calendar year. Highest and second highest values (highest/2nd highest) are shown for 24-hour, 8-hour, 3-hour, and 1-hour averages.

[b] Monitoring location does not meet EPA siting criteria for TSP monitoring stations.

[c] Federal Standards only. Delaware State standards for PM-10 have not been promulgated.

EXHIBIT 3-47

SUMMARY OF 1987 AMBIENT AIR QUALITY MONITORING DATA FOR PARTICULATE METALS IN THE VICINITY OF DU PONT CHAMBERS WORKS - NEW JERSEY MONITORING LOCATIONS

Concentrations in ug/m3

	Pedricktown S57		Deepwater 062	
Pollutant[a]	Maximum Daily	Annual Average	Maximum Daily	Annual Average
Arsenic	ND	ND	ND	ND
Barium	ND	ND	ND	ND
Cadmium	0.006	0.002	0.005	0.001
Chromium	0.017	0.003	0.022	0.004
Copper	0.037	0.006	0.116	0.040
Iron	0.460	0.142	0.673	0.236
Magnesium	0.932	0.305	1.453	0.512
Manganese	0.187	0.014	0.798	0.036
Nickel	0.035	0.011	0.029	0.009
Potassium	ND	ND	ND	ND
Vanadium	ND	ND	ND	ND
Zinc	1.666	0.407	2.210	0.473

ND - Data not available

[a] Ambient air quality standards have not been established for these pollutants.

EXHIBIT 3-47 (continued)

SUMMARY OF AMBIENT AIR QUALITY MONITORING DATA FOR PARTICULATE METALS IN THE VICINITY OF DU PONT CHAMBERS WORKS - NEW JERSEY MONITORING STATIONS

Concentrations in ug/m3

	Pedricktown s57[a]		Deepwater 062[b]		
	Annual Average[c]		Annual Average		
Pollutant[d]	1986	1987	1986	1987	MDL
Arsenic	ND	ND	ND	ND	0.001
Barium	ND	ND	ND	ND	0.004
Cadmium	BMDL	0.002	BMDL	0.001	0.001
Chromium	BMDL	0.003	BMDL	0.004	0.001
Copper	0.012	0.006	0.086	0.040	0.002
Iron	0.217	0.142	0.230	0.236	0.004
Magnesium	0.301	0.305	0.452	0.512	0.001
Manganese	0.007	0.014	0.013	0.036	0.002
Nickel	BMDL	0.011	BMDL	0.009	0.009
Potassium	ND	ND	ND	ND	0.001
Vanadium	ND	ND	ND	ND	0.008
Zinc	0.453	0.407	0.381	0.473	0.002

ND - Data Not Available
MDL - Minimum Detection Limit
BMDL - Below Minimum Detection Limit

[a] Total Suspended Particulate (TSP) monitoring station

[b] Total Suspended Particulate (TSP) monitoring station

[c] Annual averages are based on quarterly means. In 1986, more than 25 percent of the samples for manganese at Pennsauken and at Camden Lab were less than the Minimum Detection Limit (MDL) in two quarters. One-half of the MDL was used in computing annual averages. Metals for which more than 25 percent of the samples were below the MDL in three or four quarters are reported as Below Minimum Detection Limit (BMDL).

[d] Ambient air quality standards have not been established for these pollutants.

EXHIBIT 3-47 (continued)

SUMMARY OF AMBIENT AIR QUALITY MONITORING DATA FOR PARTICULATE METALS IN THE VICINITY OF DU PONT CHAMBERS WORKS - NEW JERSEY MONITORING STATIONS

Concentrations in ug/m3

	Camden Lab IP02[a]		Pennsauken S71[b]		Pennsauken IP11[c]		
	Annual Average[d]		Annual Average		Annual Average		
Pollutant[e]	1986	1987	1986	1987	1986	1987	MDL
Arsenic	0.002	0.001	ND	ND	0.003	0.001	0.001
Barium	0.012	0.011	ND	ND	0.010	0.011	0.004
Cadmium	0.003	0.002	0.008	0.004	0.003	0.002	0.001
Chromium	ND	ND	BMDL	0.004	ND	ND	0.001
Copper	0.008	0.009	0.029	0.025	0.017	0.013	0.002
Iron	0.247	0.156	0.405	0.381	0.344	0.262	0.004
Magnesium	ND	ND	0.329	0.334	ND	ND	0.001
Manganese	0.012	0.007	0.017	0.016	0.017	0.012	0.002
Nickel	0.012	0.010	BMDL	0.014	0.012	0.010	0.009
Potassium	0.099	0.057	ND	ND	0.012	0.077	0.001
Vanadium	0.010	0.010	ND	ND	BMDL	0.010	0.008
Zinc	0.068	0.079	0.390	0.349	0.081	0.072	0.002

ND - Data Not Available
MDL - Minimum Detection Limit
BMDL - Below Minimum Detection Limit

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[a] Inhalable Particulate (PM-10) monitoring station

[b] Total Suspended Particulate (TSP) monitoring station

[c] Inhalable Particulate (PM-10) monitoring station

[d] Annual averages are based on quarterly means. In 1986, more than 25 percent of the samples for barium, cadmium, and copper at Pennsauken and barium, copper, and vanadium at Camden Lab were less than the Minimum Detection Limit (MDL) in one or two quarters. One-half of the MDL was used in computing annual averages. Metals for which more than 25 percent of the samples were below the MDL in three or four quarters are reported as Below Minimum Detection Limit (BMDL).

[e] Ambient air quality standards have not been established for these pollutants.

3.3.2.5 Ambient Air Quality Data for Other Non-Criteria Pollutants. No monitoring of ambient concentrations of non-criteria pollutants other than particulate metals is conducted in the vicinity of Chambers Works. NJDEP conducts monitoring for particulate organic matter (POM), acid precipitation, smoke shade, and visibility at locations remote from Chambers Works, including the Camden Lab, Pennsauken, Ancora S.H., and Millville monitoring stations. No State or Federal standards have been established for these pollutants. Some correlation exists between TSP concentrations and smoke shade, as measured in coefficient of haze (COHS) units[41], and ambient TSP concentration data can be used as a general indicator of the effects of the source on smoke shade, and to some extent on visibility. Acid precipitation is a result of emission and transport of sulfur and nitrogen oxides from stationary and mobile sources throughout the regional airshed. Addition of a single source such as a hazardous waste incinerator to the airshed is not expected to have a measurable effect on regional acid precipitation. Ambient concentrations of SO_2 and NO_x are a better indicator of the local effects of the proposed source.

Ambient concentrations of particulate organic matter are generally a result of fuel oil, coal, or municipal waste combustion. Benzo(a)pyrene, a suspected carcinogen, is a constituent of diesel exhaust and is also a pollutant of concern in assessment of municipal waste incinerators. The annual average concentrations of benzo(a)pyrene at the Camden Lab and Pennsauken stations in 1987 were 0.14 and 0.13 nanograms per cubic meter. The maximum recorded 24-hour average concentrations at the two locations were 0.81 and 1.18 nanograms per cubic meter. Particulate material collected at these locations contained between 18 and 26 percent extractable organic material.

3.4 ECOLOGY

3.4.1 Terrestrial Environment

The terrestrial environment of Chambers Works is a mixture of existing or former industrial areas and vegetated upland and wetland communities. Terrestrial wildlife habitat is limited primarily to Carneys Point, an approximately 130-acre area located north-northwest of the currently operating plant area. Carneys Point is bounded to the west and north by the Delaware River, to the east by Bouttown Creek, and to the south by Henby Creek. The entire area was formerly occupied by a munitions factory until the late 1960s. Since then, various demolition activities as a part of disassembly activities have left the wildlife habitat of Carneys Point relatively disturbed. Plant species diversity is limited, and the area is dominated by plants well adapted to cleared or disturbed land[42]. Exhibits 3-48 and 3-49 provide lists of the plant and animal species, respectively, known or expected to occur on Carneys Point. None of these species are endangered or threatened (see Section 3.4.3). A description of the plant and animal species comprising the upland and wetland communities of Carneys Point is presented below. Common species names are used in the following discussions; scientific names are presented along with common names in the exhibits.

EXHIBIT 3-48

PLANT SPECIES THAT OCCUR ON CARNEYS POINT
AT THE DU PONT CHAMBERS WORKS PLANT

Common Name	Scientific Name
Herbaceous and Shrub Species:	
Aster	*Aster* sp.
Milkweed	*Asclepias syriaca*
Thistle	*Cirsium discolor*
Fireweed	*Erechtities hieracifolia*
Switchgrass	*Panicum* sp.
Broom sedge	*Andropogan virginicus*
Common mullein	*Verbascum thapsus*
Bristly foxtail	*Setaria* spp.
Phragmites	*Phragmites communis*
Smartweed	*Polygonum hydropiper* or sp.
Panic grass	*Panicum* sp.
Wool-grass	*Scirpus cyperinus*
Sedge	*Carex crinita*
Nut sedge	*Cyperus esculentus*
Soft rush	*Juncus effusus*
Thoroughwort	*Eupatorium scrotinum*
Tree Species:	
Bigtooth aspen	*Populus grandidentata*
Cherry	*Prunus* sp.
Eastern cottonwood	*Populus deltoides*
Smooth sumac	*Rhus glabra*
Sweetgum	*Liquidambar styraciflua*
Sycamore	*Platanus occidentalis*
White birch	*Betula papyrifera*
White poplar	*Populus alba*

SOURCE: ENSR Consulting and Engineering, "Wetland Delineation Study for the Old Carneys Point Site," December 1988

EXHIBIT 3-49

WILDLIFE SPECIES KNOWN OR EXPECTED TO OCCUR ON CARNEYS POINT AT THE DU PONT CHAMBERS WORKS PLANT

Common Name	Scientific Name
Mammals:	
White-tailed deer	*Odocoileus virginianus*
Raccoon	*Procyon lotor*
Eastern cottontail	*Sylvilagus floridanus*
Woodchuck	*Marmota monax*
Opossum	*Didelphis marsupialis*
Muskrat	*Ondatra zibethicus*
Marsh rice rat	*Oryzomys palustris*
White-footed mouse	*Peromyscus leucopus*
Pine vole	*Microtus pinetorum*
Meadow vole	*Microtus pennsylvanicus*
Masked shrew	*Sorex cinereus*
Shorttail shrew	*Blarina brevicauda*
Eastern mole	*Scalopus aquaticus*
Star-nosed mole	*Condylura cristata*
Birds:	
American goldfinch	*Carduelis tristis*
Red-winged blackbird	*Agelaius phoeniceus*
Robin	*Turdus migratorius*
Eastern meadowlark	*Sturnella magna*
Cardinal	*Cardinalis cardinalis*
Common flicker	*Colaptes auratus*
Barn swallow	*Riparia riparia*
Pigeon	*Columba livia*
Mourning dove	*Zenaida macroura*
Turkey vulture	*Cathartes aura*
Red-tailed hawk	*Buteo jamaicensis*
American kestrel	*Falco sparverius*
Canada geese	*Branta canadensis*
Mallard	*Anas platyrhynchos*
Kingfisher	*Ceryle alcyon*
Common Egret	*Casmerodius albus*

EXHIBIT 3-49 (Continued)

WILDLIFE SPECIES KNOWN OR EXPECTED TO OCCUR ON CARNEYS POINT AT THE DU PONT CHAMBERS WORKS PLANT

Common Name	Scientific Name
Reptiles and Amphibians:	
Black racer	*Coluber constrictor*
Northern water snake	*Nerodia sipedon*
Painted turtle	*Chrysemys picta*
Mud turtle	*Kinosternon subrubrum*
Spotted turtle	*Clemmys guttata*
Stinkpot	*Sternotherus odoratus*
Snapping turtle	*Chelydra serpentina*
Bullfrog	*Rana catesbeiana*

3.4.1.1 Upland Communities. The upland habitat of Carneys Point is comprised of fields and wooded areas. Common plants of non-wooded areas include milkweed, thistle, goldenrod, broomsedge, common mullein, aster, thoroughwort, fireweed, switchgrass, bristly foxtail, phragmites, and other upland grasses. White poplar, white birch, cherry, sycamore, eastern cottonwood, and smooth sumac occur in the wooded areas. Much of the upland area, however, consists of monotypic stands of phragmites and poplar, as well as old road and foundation remains[43].

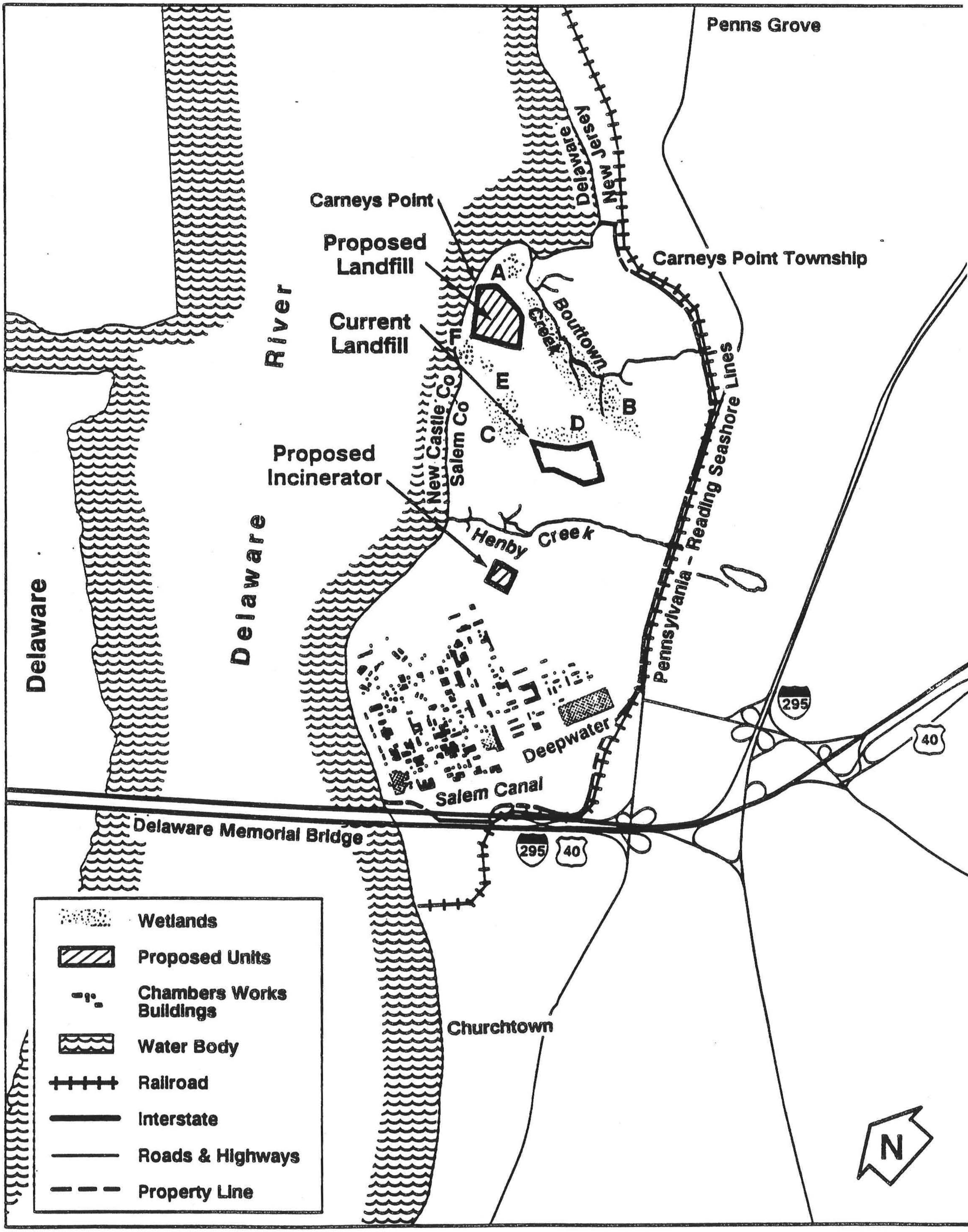
Surveys of the upland wildlife community have not been conducted. However, according to a representative of the U.S. Fish and Wildlife Service, habitat value of the area is not high,[44] and consequently, the wildlife population is probably somewhat limited in number and diversity. The area is known to support a substantial population of approximately 400 white-tailed deer. Other mammalian species possibly using the upland habitat of Carneys Point include raccoon, eastern cottontail, woodchuck, opossum, white-footed mouse, pine vole, masked shrew, shorttail shrew, and eastern mole. Bird species likely to use the upland areas include robin, American goldfinch, eastern meadowlark, cardinal, common flicker, barn swallow, pigeon, mourning dove, turkey vulture, red-tailed hawk, and American kestrel. A number of warblers and other passerine species also may occur in the upland areas. Reptile species include black racer and possibly other snake species. Amphibians may include toads and salamanders.

3.4.1.2 Wetland Communities. Six distinct wetland areas, totalling 29 acres, occur on Carneys Point[45]. Exhibit 3-50 shows the location of these wetlands (wetlands A - F) relative to the proposed landfill and incinerator locations. The dominant wetland of the area is the palustrine emergent wetland bordering Bouttown Creek (wetland B). This wetland comprises over half of the total wetland acreage of Carneys Point[46]. Five isolated emergent wetlands comprise the remaining wetland acreage of the area. According to the New Jersey Bureau of Wetlands[47], additional isolated wetlands, totalling less than a quarter of an acre, exist within the boundaries of the proposed landfill. Additional wetland acreage also may be associated with Henby Creek, although this area has not been surveyed.

Species composition of the six distinct wetland areas was determined during a wetlands investigation conducted by ENSR Consulting and Engineering in 1988. Dominant vegetation in the Bouttown Creek wetland includes smartweed, panic grass, phragmites, white poplar, and sweetgum. Wool-grass, sedge, nut sedge, phragmites, soft rush, panic grass, and switchgrass are the dominant species in wetland A, located at the northeastern tip of Carneys Point. Phragmites with a transitional borders of sweetgum or bigtooth aspen comprise the vegetative communities of wetlands C and E, located near the western border of Carneys Point. Sweetgum and eastern cottonwood are the dominant species in wetland D, adjacent to the existing landfill. No vegetation was observed in wetland F, located near the southwestern corner of the proposed landfill. Species composition has not been documented for the smaller, isolated wetlands within the proposed landfill boundary or for any wetlands possibly occurring along Henby Creek.

EXHIBIT 3-50

LOCATION OF WETLANDS (A - F)



The wetlands of Carneys Point have been classified by the New Jersey Bureau of Wetlands to be of intermediate resource value[48]. Under the New Jersey Freshwater Wetlands Protection Act (NJSA 13:9B), a wetland is of intermediate resource value if it does not have exceptional or ordinary resource value. Wetlands of exceptional resource value are those that discharge into FW-1 waters or FW-2 trout production waters, or that are present or documented habitat for threatened or endangered species (identified pursuant to the Endangered and Non-Game Species Conservation Act, P.L. 1973, c. 309[C.23:2A et. seq.]). Wetlands of ordinary resource value are isolated wetlands, man-made drainage ditches, swales, or detention facilities.

According to the New Jersey Freshwater Wetlands Protection Act (NJSA 13:9B), because the wetlands are of intermediate value, a buffer zone (transition area) of between 25 and 50 feet is required between wetlands and the landfill. However, parts of the landfill are within 25 feet of wetlands, and therefore, Du Pont will have to obtain a transition area waiver for the proposed landfill site. Such a waiver can be obtained because Du Pont can demonstrate that the average distance between the landfill and wetlands is between 25 and 50 feet. Du Pont plans to submit a wetlands transition area averaging plan for NJDEP after the RCRA Part B Permit Application has been submitted. A transition area averaging plan would expand a portion of the transition area at one part of the site to compensate, on a square footage basis, for reduction or partial elimination of the transition area at another part of the site.

Wetlands are typically productive ecological systems that provide valuable habitat for wildlife species. These areas often serve as breeding grounds for migratory waterfowl and other birds and also provide cover, forage, and nesting and rearing habitat for birds, mammals, reptiles, and amphibians. Wild mammal species likely to use the wetlands of Carneys Point include white-tailed deer, raccoon, masked shrew, star-nosed mole, meadow vole, muskrat, and marsh rice rat. A variety of birds likely use the area's wetlands. These include heron, egret, Canadian geese, mallard duck and other migratory waterfowl, kingfisher, red-winged blackbird, gulls, shorebirds, and warblers. Reptiles may include northern water snake, painted turtle, mud turtle, spotted turtle, stinkpot, and snapping turtle. Amphibians may include bullfrog and salamander.

3.4.2 <u>Aquatic Environment</u>

The aquatic environments of the Du Pont Chambers Works consist of the Delaware River, Henby Creek, Bouttown Creek, and the wetlands discussed above. The aquatic community of the Delaware River near Chambers Works has been studied extensively. Specific studies have not been conducted on the aquatic communities of the on-site creeks and wetlands. However, generalizations can be made based on the known characteristics of these waters. The aquatic species inhabiting the surface waters on or near Chambers Works are discussed below and are presented in Exhibit 3-51. Common species names are used in the following discussion; scientific names are presented along with common names in the exhibit.

EXHIBIT 3-51

AQUATIC SPECIES KNOWN OR EXPECTED TO OCCUR IN THE SURFACE WATERS ON AND NEAR THE DU PONT CHAMBERS WORKS PLANT

Common Name	Scientific Name
Invertebrate Species:	
Hooked mussel	Brachidontes recurvus
Sand shrimp	Crangon septemspinosus
Common prawn	Palemonetes vulgaris
Mud crab	Rhithropanopeus harrisi
American oyster	Crassotrea virginica
Blue crab	Callinectes sapidus
Fish Species:	
White perch	Morone americana
Bay anchovy	Anchoa mitchilli
Atlantic menhaden	Brevoortia tyrannus
Mummichog	Fundulus heteroclitus
Spot	Leiostomus xanthurus
Alewife	Alosa pseudoharengus
Silvery minnow	Hybognathus nuchalis
Gizzard shad	Dorosoma cepedianum
Blueback herring	Alosa aestivalis
Naked goby	Gobiosoma bosci
Black crappie	Pomoxis nigromaculatus
Pumpkinseed	Lepomis gibbosus
White catfish	Ictalurus catus
Brown bullhead	Ictalurus nebulosus
Carp	Cyprinus carpio
Striped bass	Morone saxatilis
Banded killifish	Fundulus majalis
Tidewater silverside	Menidia beryllina
Bluefish	Pomatomus saltatrix
Bluegill	Lepomis machrochirus
Yellow perch	Perca flavescens
American eel	Anguilla rostrata
Shortnose sturgeon	Acipenser brevirostrum
Mosquitofish	Gambusia affinis

3.4.2.1 Delaware River. The Delaware River near Chambers Works is estuarine. Aquatic life in these estuarine waters is abundant and diverse. Forty phytoplankton genera and 85 zooplankton taxa have been identified in the river near Chambers Works.[49] Invertebrate species possibly occurring near Chambers Works include hooked mussel, common prawn, sand shrimp, mud crab, blue crab, and American oyster. Fish of the area include white perch, bay anchovy, Atlantic menhaden, mummichog, spot, alewife, silvery minnow, gizzard shad, blueback herring, naked goby, black crappie, pumpkinseed, white catfish, brown bullhead, carp, striped bass, banded killifish, tidewater silverside, bluefish, bluegill, yellow perch, and American eel[50]. According to the New Jersey Division of Fish, Game and Wildlife, shortnose sturgeon also occur in this area of the Delaware River and as far north as Trenton, New Jersey[51].

3.4.2.2 On-Site Creeks and Wetlands. Specific studies have not been conducted on aquatic life in the on-site creeks and wetlands. Based on a general knowledge of these and similar habitats, it is likely that the invertebrate community is dominated by aquatic insects and bugs, with some crayfish and freshwater clams also possibly occurring. Fish are most likely limited to smaller species, including minnows, darters, shiners, and mosquitofish.

3.4.3 Endangered and Threatened Species

According to the New Jersey Natural Heritage Program, Division of Parks and Forestry, no rare, endangered, or threatened species occur on the Du Pont Chambers Works property[52]. However, several endangered or threatened species are known to permanently or seasonally inhabit areas near the plant. These species are discussed below. For some species, special habitat requirements which may render the species likely or unlikely to use the available habitat at the Chambers Works plant also are discussed.

- Bald eagles (Haliaeetus leucocephalus), a Federal and State endangered species, have been sighted in the area and are known to winter in an area approximately 0.5 miles southwest of Chambers Works.[53] No breeding activity is known to occur near Chambers Works. The nearest breeding activity is believed to be at Mannington Meadow, located approximately 8 miles south of Chambers Works near the town of Salem[54].

- Peregrine falcons (Falco peregrinus), a Federal and State endangered species, have been sighted on the Delaware Memorial Bridge[55] and apparently use the bridge as a nesting area[56]. In 1988, two pairs attempted to nest on the bridge, however, both pairs were unsuccessful.

- Shortnose sturgeon (Acipenser brevirostrum), a Federal and State endangered species, is known to use Delaware River near Chambers Works during migration[57].

- Pied-billed grebes (Podilymbus podiceps) have been sighted approximately 4.5 miles northeast of the project site[58]. Only the breeding population of pied-billed grebes is endangered in New Jersey. Pied-billed grebes prefer as breeding habitat freshwater marshes that are sparsely vegetated.

The wetlands of Bouttown Creek on Carneys Point provide this type of habitat to some degree. Therefore, although no grebes have been sighted at Chambers Works, this area may provide suitable grebe breeding habitat.

- Vesper sparrows (Pooecetes gramineus) have been sighted in areas between 3.5 and 5 miles southeast of Chambers Works and between 2.5 and 4 miles northeast of the plant[59]. Only the breeding population of vesper sparrow is endangered in New Jersey. Vesper sparrows prefer as breeding habitat grassy fields with adjacent hedgerows. The upland areas of Chambers Works do not provide this type of habitat, and therefore, the area is unlikely to provide suitable breeding habitat for this species.

- Savannah sparrow (Passerculus sandwichensis) have been sighted approximately 3.5 miles southeast of Chambers Works in Pilesgrove Township[60]. These birds are abundant migrants and a common wintering species in New Jersey. However, the breeding population of savannah sparrow is threatened in the State. The preferred breeding habitat of this species is short grass fields or short grass salt marshes. This type of habitat is generally lacking at Chambers Works, and therefore, savannah sparrows are unlikely to breed at the plant.

3.5 SOCIOECONOMIC CHARACTERISTICS

The Du Pont Chambers Works Plant is located in Pennsville and Carneys Point Townships in Salem County. These jurisdictions are important in characterizing the socioeconomic conditions around the plant. The socioeconomic study area, however, involves jurisdictions beyond those in which the facility is actually located. It includes jurisdictions most likely to be affected by the proposed action such as:

- Communities that incoming workers hired for the project are likely to live in;
- The area in which local project expenditures are likely to be made;
- Communities along routes used to transport hazardous wastes to Chambers Works; and
- Jurisdictions in which facility emissions will be disbursed.

Based on these criteria, the study area selected for characterization includes Salem County, New Jersey, and New Castle County, Delaware. In addition to these counties, several townships near the Du Pont Chambers Works facility have been included -- Penns Grove (2 miles from the site), Carneys Point (3 miles from the site), and Pennsville (4 miles from the site). These are the three communities in which the majority of Chambers Works employees currently live and where future employees are likely to live.

The area immediately surrounding the Chambers Works facility has a substantial population and employment base from which project demands can be met and within which incoming workers are likely to locate. Emissions from the incinerator will be distributed no further than a six-mile radius around the site (these two counties encompass that radius).

This section describes the socioeconomic environment in Salem and New Castle Counties and the incorporated areas identified above. This characterization describes population trends, economic conditions, community services, land use patterns and transportation systems. This characterization is provided in order to assess the changes likely to occur in the county and its communities as a result of the landfill and incinerator expansion (these changes are discussed in Section 4).

3.5.1 Demographics

Salem County, located along the last big bend in the Delaware River, in the southwest corner of the State is bordered by Gloucester and Cumberland Counties and the State of Delaware. The county has grown from 60,346 residents in 1970 to 65,400 residents in 1986. Salem County is comprised of 15 townships ranging in size from 1231 in Elsinboro to 13,690 in Pennsville.

New Castle County, Delaware, is west of Salem County across the Delaware River. New Castle contains approximately two-thirds of Delaware's population and has grown in size between 1970 and 1986 from 385,856 to 417,800. There are 13 incorporated places in the County ranging from about 70,000 people in the City of Wilmington to about 300 in the Village of Ardencroft.

Exhibit 3-52 illustrates the population trends occurring in these counties as well as in Penns Grove, Carneys Point, and Pennsville. Population data are also presented for 1980 and 1986 for Gloucester County, and other communities along the transportation routes leading to Chambers Works. Since it will be used only to assess transportation risks in Section 4, trend data are not presented for these jurisdictions. Both Salem and New Castle Counties have experienced population growth since 1970 of approximately 8 percent compared to state growth rates of 6 percent in New Jersey and 13 percent in Delaware. During this same timeframe, the population of Penns Grove declined by about 7 percent while Carneys Point and Pennsville grew by 22 percent and 3 percent, respectively.

Salem County is approximately 338 square miles and New Castle County is approximately 396 square miles in land area. Population densities for these counties in 1986 were 194 persons per square mile and 1056 persons per square mile, respectively.[61] The majority of the population in both counties is urban, ranging from 58 percent in Salem County to 93 percent in New Castle County.[62]

EXHIBIT 3-52

POPULATION TRENDS

Population Center	1970	1980	1986	1990	1995	2000
COUNTIES						
Salem County, NJ	60,346	64,676	65,400	67,500	69,400	71,000
Gloucester, NJ		199,917	210,647	220,100	234,500	249,100
New Castle Co, DE	385,856	398,115	417,800	436,080	463,000	482,910
TOWNSHIPS						
Penns Grove	5,727	5,760	5,300	5,255	N/A	5,255
Carneys Point Twp	7,016	8,396	8,530	8,698	N/A	9,058
Pennsville Twp	13,296	13,848	13,960	13,845	N/A	14,345
New Castle		4,907	4,960			
Wilmington		70,195	69,690			
Bellefonte		1,279	1,290			
Oldmans		1,847	1,881			
Pilesgrove		2,810	2,896			
Logan		3,078	3,550			
Woolwich		1,129	1,220			
South Harrison		1,486	1,745			
Harrison		3,585	3,860			
Swedesboro		2,031	2,082			
New Jersey	7,171,112	7,365,011	7,620,000	7,899,000	8,252,000	8,546,000
Delaware	548,104	594,338	633,000	666,000	702,000	734,000
United States	203,302,031	226,542,633	241,010,000	249,891,000	259,619,000	267,747,000

Sources:

1970 County, City, State, US: US Bureau of the Census, 1980 Census of Population, "Number of Inhabitants, United States Summary" (PC80-1-A1).

1980, 1986: US Bureau of the Census, Local Population Estimates, "1986 Population and 1985 Per Capita Income Estimates for Counties and Incorporated Places" Northeast and South Regions (Series P-26, Nos. 86-NE-SC and 86-S-SC).

NJ County Projections: NJ Department of Labor, Division of Planning and Research, Office of Demographic and Economic Analysis, "Population Projections for New Jersey and Counties: 1990 to 2020," Trenton, NJ, November 1985.

New Castle, DE Projections: Delaware Population Consortium, "Population Projections, 1987 Version," Dover, DE, January 1988. Obtained through Delaware Development Office, Dover, DE.

US, State Projections: US Bureau of the Census, "Current Population Reports" Series P-25 (Obtained from US Statistical Abstracts), 1987.

Draft Population Projections for the Years 1990, 2000, and 2010, Salem County Planning Board, October 4, 1988.

Official State Estimates, NJ Department of Labor, Division of Planning and Research, Office of Demographic and Economic Analysis, "Population Estimates for New Jersey July 1, 1987," Trenton, NJ, October 1988.

Exhibit 3-52 also shows population projections for Salem and New Castle Counties. They are projected to increase in size throughout the rest of this century as are the populations of New Jersey and Delaware. Penns Grove is expected to decrease in size by 1990 and stabilize at 5255 into the year 2000. Carneys Point and Pennsville are both projected to grow through the year 2000.

Of the total population in Salem County in 1980, 22 percent were school-age (between the ages of 5 and 17), and 12 percent were over the age of 65 (see Exhibit 3-53). In New Castle County, the school-age population comprised 21 percent of the population while 9 percent were over the age of 65. The county and township age distributions were similar to those of New Jersey, Delaware, and the nation. Pennsville Township was a notable exception, however, with nearly 28 percent of its population being school-aged. The gender distribution for the counties and townships are also illustrated in Exhibit 3-53.

3.5.2 Land Use

The Chambers Works Plant occupies a 1455-acre area in Pennsville and Carneys Point Townships. Chambers Works is located in the Penns Grove and Wilmington South quadrangles of the 7.5 minute USGS topographic series at geographic references 75° 30' longitude and 39° 37' latitude. Land use at the Chambers Works property consists of commercial structures, surface impoundments, other disturbed areas, and wetlands and ponds. The site is zoned "heavy industrial" and "general industrial." It is bisected from east to west by the Deepwater Canal.

Land immediately surrounding the Chambers Works plant is primarily residential, commercial, and industrial. Northeast of the site are Carneys Point and Penns Grove. Southwest of the site is Pennsville township. Salem County is predominantly rural with approximately 45 percent of total land area dedicated to agricultural uses. Salem County also contains over 50,000 acres of woodlands, which are primarily deciduous and are composed of mixed hardwoods. The southeastern portion of the County supports the only significant coniferous woodlands.[63] Terrain in the County is characteristically flat with slight local relief and isolated hills.

Salem County's surface water resources consist of a number of tributaries of the Delaware River. The County's freshwater resources are located on the upstream portion of these tributaries and provide irrigation, recreation, and domestic and industrial water supplies. The County includes almost 30,000 acres of tidal and freshwater wetlands which are an integral part of the Delaware River and Bay ecosystems. Salem County's wetlands have important ecological significance and provide habitat for a diversity of wildlife, especially during waterfowl migratory periods. Recreational areas in Salem County include two State parks--Fort Mott and Parvin--and three State Fish and Game Wildlife Management Areas--Greenwood Pond, Maskell's Mill Pond, and Mad Horse Creek--and a National Wildlife Refuge--Killcohook.[64]

EXHIBIT 3-53

1980 POPULATION CHARACTERISTICS

	Gender		Age: 5-17 yrs		Age: >65 yrs	
Population Center	% Female	% Male	Total	Percent	Total	Percent
Salem County, NJ	51.4	48.6	14,388	22.0	7,652	11.7
New Castle Co, DE	52.5	47.5	86,485	20,7	39,273	9.4
Penns Grove	53.1	46.9	1,195	20.7	564	9.8
Carneys Point Twp	51.5	48.5	1,925	22.9	949	11.3
Pennsville Twp	51.0	49.0	3,925	28.3	1,648	11.9
New Jersey	52.0	48.0	1,487,694	20.2	861,684	11.7
Delaware	51.8	48.2	124,811	21.0	59,434	10.0
United States	51.4	48.6	47,348,073	20.9	25,599,676	11.3

Sources: County Gender: US Dept of Commerce, Bureau of the Census "1983 County and City Data Book."

All other data: US Dept of Commerce, Bureau of the Census, "1980 Census of the Population, General Population Characteristics" PC80-1-81 (US), PC80-1-89 (DE), and PC80-1-B32 (NJ).

Exhibit 3-54 presents types of agricultural land use in Salem and New Castle Counties. Land dedicated to agricultural use has declined in both counties since 1978. In 1978, 40 percent of the land in New Castle County was dedicated to farms; by 1987, this figure declined to 37 percent. Similarly, 47 percent of the land in Salem County was dedicated to farms in 1978. This declined to 44 percent in 1982 (U.S. Census Bureau figures for 1987 are not yet available for Salem County). Agricultural land in Salem County is devoted primarily to soybeans, corn, snap beans, sudex, sudan sorghum mix, sudan grass, and peas.

The average per acre value of farm property in both counties increased between 1978 and 1982. The average per acre land values in New Castle County, however, were considerably higher than those in Salem County, as shown in Exhibit 3-54.

Exhibit 3-55 describes the market value of products sold. Both counties have experienced an increase in sales over the last decade. Crops made up the majority of agricultural sales in both counties. Grains and vegetables are the predominant cash crops, making up approximately 65 to 80 percent of total crop sales. Dairy products are the predominant source of sales in the livestock and poultry category.

3.5.3 Economic Activity

A distribution of employment by major industrial category for the counties are presented in Exhibit 3-56. The major employment sectors in Salem County in 1986 were manufacturing, services and retail trade which made up 73 percent of all jobs in the county. In terms of annual payroll, manufacturing (49 percent) and transportation/other public utilities (27 percent) were the largest categories. Major employment sectors in New Castle county were the same as those in Salem county. Annual payroll in New Castle county, however, was largely made up of manufacturing (41 percent), services (19 percent), and wholesale trade (9 percent).

In addition to Du Pont Chambers Works, another important employer in Salem County is the Public Service Electric and Gas Company which operates Salem I and II and Hope Creek I nuclear plants. These plants employed 6500 workers during the peak phase in 1985 and currently employ approximately 2200 workers. However, when construction on Hope Creek was completed at the end of 1986, the County experienced a net drop in construction employment in 1987 of 600 jobs. Salem County's recent experience with fluctuating employment levels related to new construction will be an important factor in their ability to manage growth associated with construction of new facilities at the Du Pont plant.

Unemployment rates for the counties have tended to be similar to the rates in their respective states as shown in Exhibit 3-57. In 1988, the unemployment rate in Salem County was 4.0 percent compared to the rate for New Jersey of 3.6. During this same period, New Castle county had a unemployment rate of 3.3 percent compared to the Delaware rate of 3.1 percent. Unemployment rates in Salem and New Castle Counties have declined during the 1980's, reflecting similar nationwide trends. Unemployment rates in the three townships have

EXHIBIT 3-54

AGRICULTURAL LAND USE TRENDS IN SALEM AND NEW CASTLE COUNTIES

Distribution	Salem County			New Castle County		
	1978	1982	1987	1978	1982	1987
Total Land Area*	216,320	216,320	216,320	253,440	253,440	253,440
Land in Farms	101,903	95,585	N/A	102,084	102,023	93,998
Average Farm Size	166	149	N/A	226	209	247
Total Cropland	82,001	79,207	N/A	87,209	84,120	78,162
Harvested Cropland	71,337	68,651	N/A	80,277	77,566	64,358
Cropland used for Pasture/Grazing	6,357	7,722	N/A	4,412	4,037	N/A
Other Cropland	4,127	2,834	N/A	2,520	2,517	N/A
Total Woodland	9,142	9,541	N/A	8,197	8,619	N/A
Other Land	10,760	7,837	N/A	6,678	9,284	N/A
Pastureland, all types	11,519	10,736	N/A	6,864	6,702	N/A
Land set aside in Federal farm programs	217	135	N/A	850	255	N/A
Value of Land & Buildings						
Average per farm ($)	249,695	248,966	N/A	501,507	528,150	670,476
Average per acre ($)	1,483	1,656	N/A	2,363	2,398	2,769

Source: US Department of Commerce, Bureau of the Census, 1982 Census of Agriculture, Geographic Area Series, vol 1, Part 8, Delaware State and County Data, and Part 30, New Jersey State and County Data; 1987 Census of Agriculture, Advance County Report, New Castle County, DE, September 1988.

* All units are acres unless otherwise noted.

N/A Not available.

EXHIBIT 3-55

MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD
(in thousands of dollars)

Sales	Salem County		New Castle County		
	1978	1982	1978	1982	1987
Total Sales	38,698	41,164	24,245	27,151	30,417
Average per farm	63.1	63.5	53.6	55.6	
Sales by Community					
Crops*	25,137	27,259	18,350	20,385	21,323
Livestock, poultry & their products**	13,561	13,905	5,895	6,766	9,094

* Grains and vegetables make up approximately 65 to 80% of crop sales.

** Dairy products made up 52 to 67 percent of this category in 1978, and 1982, respectively.

Source: US Department of Commerce, Bureau of the Census, 1982 Census of Agriculture, Geographic Area Series, vol 1, Part 8, Delaware State and County Data, and Part 30, New Jersey State and County Data; 1987 Census of Agriculture, Advance County Report, New Castle County, DE, September 1988.

EXHIBIT 3-56

1986 EMPLOYMENT AND PAYROLL BY INDUSTRIAL CATEGORY

Category	Salem County		New Castle County	
	Employees as of March 12	Annual Payroll ($1,000)	Employees as of March 12	Annual Payroll ($1,000)
Total	17,649	425,661	186,363	4,249,535
Agricultural services, forestry, and fisheries	(A)	(C)	735	8,983
Mining	- - -	- - -	44	1,609
Contract Construction	509	10,468	11,656	281,345
Manufacturing	6,489	207,265	45,956	1,721,704
Transportation and other public utilities	2,906	113,828	10,336	258,817
Wholesale trade	494	8,515	12,706	402,134
Retail trade	3,053	29,936	35,740	372,797
Finance, insurance, and real estate	589	9,394	17,174	374,567
Services	3,399	43,770	50,389	800,210
Unclassified establishments	(B)	(C)	1,627	27,369

(A) Employment-size class of 20 to 99 employees
(B) Employment-size class of 100 to 249 employees
(C) Figures withheld to avoid disclosing data for individual companies

Source: US Bureau of the Census, County Business Patterns, 1986, New Jersey and Delaware, US Government Printing Office, Washington, DC, 1988.

EXHIBIT 3-57

TRENDS IN UNEMPLOYMENT PERCENTAGE RATES

Population Center	1980	1985	1987	Aug 1988
Salem County, NJ	7.4	7.2	5.6	4.0
New Castle County, DE	7.5	5.2	2.8	3.3
Penn's Grove	18.5	13.0	10.3	N/A
Carneys Point Twp	6.2	5.9	4.6	N/A
Pennsville Twp	7.2	6.9	5.4	N/A
New Jersey	7.2	5.7	4.0	3.6
Delaware	7.7	5.3	3.2	3.1
United States	7.1	7.2	6.2	5.6

Sources:

State unemployment: US Department of Labor, Bureau of Labor Statistics, Office of Employment and Unemployment Statistics (Phone conversation).

National unemployment: US Department of Commerce, Bureau of Economic Analysis, Survey of Current Business, May 1981, September 1987, S 88.

US and State Labor Participation: US Bureau of Labor Statistics "Geographic Profile of Employment and Unemployment, 1985," (Found in US Bureau of the Census, "Statistical Abstract of the United States, 1987" (107th edition) Washington, DC, 1986.

NJ County and City unemployment: NJ DoL, Div of Policy and Planning, Office of Labor Market and Demographic Research, Bureau of Labor Force Statistics.

DE County unemployment: "Annual Average Labor Force Statistics," Delaware Development Office, Business Research Section, Dover, DE.

tended to be higher than either the state or national rates, particularly in Penns Grove.

Between 1984 and 1986, per capita personal income in Salem County increased from $12,588 to $14,276 (12 percent) and the County ranked 20th in the State. Salem County has consistently lagged behind the State of New Jersey in per capita income since 1979. Per capita income in New Jersey between 1984 and 1986 went from $16,455 to $18,879 (15 percent). New Castle County has historically maintained a higher per capita personal income than the State of Delaware as a whole.[65] Between 1984 and 1986 this trend continued with per capita income increasing from $15,100 to $17,180 (12 percent). Per capita income in Delaware increased from $13,666 in 1984 to $15,469 in 1986 (12 percent).[66]

3.5.4 Housing

The number of housing units in Salem and New Castle Counties, Penns Grove, Carneys Point and Pennsville townships in 1980 is presented in Exhibit 3-58. In Salem County, there were 24,165 total housing units in 1980. The number of housing units in Penns Grove, Carneys Point, and Pennsville was 2343, 3269, and 5244, respectively in 1980. The Salem County Planning Commission has indicated that there was substantial growth in the number of apartments in Salem County during the 1980's partially as a result of the employment growth associated with the nuclear power plant construction. When construction ended and the labor force was reduced, apartment vacancies increased. According to the Salem County Planning Commission, the County currently has surplus housing capacity, particularly in apartments. The current vacancy rates for Salem County and the townships, however, are not available. In addition to its year-round housing stock, Salem County has four trailer parks one in Penns Grove, two in Carneys Point, and one in Pennsville. There are also nine hotels/motels in Salem County; four are located in Carneys Point, two in Pennsville, one in Penns Grove, and two in the town of Salem.[67] In New Castle County, in 1987, there were 165,549 dwelling units in the County, which represents a 10 percent increase over the number of units in 1980.

3.5.5 Community Services

3.5.5.1 Emergency Services. This section is a summary description of the emergency services provided by Salem and New Castle Counties and the townships of Carneys Point, Pennsville, and Penns Grove. A more detailed description of equipment, facilities, and personnel training is provided in Appendix C. Du Pont's emergency services capability was presented in detail in Section 2. The County and townships have verbal agreements with Du Pont officials to provide emergency services to the plant, if necessary. This agreement is reciprocal, with Du Pont offering the support of their emergency response teams to nearby townships, if necessary.

The State of New Jersey, Salem County, and the County's 15 townships/boroughs each have emergency plans in place to deal with hazardous materials incidents.[68] Key areas addressed in these plans include emergency response

EXHIBIT 3-58

1980 HOUSING UNITS

	Total Housing Units	Owner Occupied Units	Number of Units w/o Complete Plumbing	Renter Occupied Units	Number of Units w/o Complete Plumbing
Salem County	24,165	16,078	143	6,252	136
New Castle County	148,563	93,695	280	45,249	895
Penns Grove	2,343	1,005	10	1,094	23
Carneys Point	3,269	2,149	8	828	11
Pennsville	5,244	3,853	15	982	5

Source: US Department of Commerce, Bureau of the Census, Census of Housing, 1980.

capabilities, public protection (i.e., evacuation or in-place protection), hospital care, and airborne monitoring. The Salem County Chapter of the American Red Cross has a Disaster Plan that addresses sheltering and mass care for evacuees and includes a listing of shelters in the county.[69]

When there is a Hazmat incident that has the potential of exceeding capacity of the county response forces, the New Jersey Department of Environmental Protection (NJDEP) is notified. The NJDEP will then notify other designated State agencies and dispatch the NJDEP Hazmat Team from West Trenton (approximately 55 miles from Deepwater). The team will provide technical assistance to Salem County emergency agencies and perform mitigation operations. Cleanup and disposal are handled by a private contractor.

Delaware and New Castle County also have emergency plans and evacuation plans in place. Evacuation plans are contained in the New Castle County Emergency Operations Plan, Wilmington Emergency Operations Plan, and Delaware Emergency Operations Plan. Sheltering of evacuees is coordinated by the Delaware Chapter of the American Red Cross under agreements with New Castle County and the public schools system. Evacuees are sheltered, fed, and cared for under provisions contained in Red Cross disaster plans and in the New Castle County Emergency Operations Plan.[70]

Hazardous materials incidents in New Castle County that have the potential to overwhelm local response forces are referred to the State Emergency Response Team (SERT). The SERT is composed of designated individuals from the Department of Natural Resources and Environmental Control; Department of Public Safety; Division of Emergency Planning and Operations; Department of Public Health; State Police; Delaware State Fire School; and local emergency management offices. Like the NJDEP team, the SERT is designated to provide technical assistance and perform mitigation operations. Cleanup and disposal are handled by a private contractor.

3.5.5.2 <u>Fire Department Capabilities.</u> Each of the 15 townships and boroughs in Salem County has a volunteer fire department. The fire departments closest to the Chambers Works site include Pennsville (one station in Pennsville, and one in Deepwater), Penns Grove, and Carneys Point. None of these fire departments have a hazardous materials response vehicle or a team specifically dedicated to hazardous materials emergencies; however, the firefighters receive fire suppression training and basic hazardous materials training. Response time of the 4 nearby fire departments to the Chambers Works incinerator and landfill would be approximately 5-10 minutes depending on availability of the volunteer members and road/weather conditions.[71]

Fire protection in New Castle County is provided by 21 volunteer fire departments and a fully-paid fire department in Wilmington. None of these departments have a hazardous materials team or response unit. The fire departments located closest to Chambers Works include Goodwill Volunteer Fire Department of New Castle and Holloway Terrace Volunteer Fire Department. Their response time to Chambers Works is approximately 8 to 12 minutes. Hazardous materials training courses are optional for firefighters and emergency medical services (EMS) personnel.[72]

3.5.5.3 Emergency Medical Services and Hospitals. Thirteen organizations in Salem County provide emergency medical services (i.e., ambulance and rescue). Nine are associated with fire departments and four are independent. The latter include three ambulance companies and one ambulance/rescue company. The ambulances in the county are primarily "basic life support" ambulances, meaning that their personnel are trained and equipped to provide basic life support services. The county requests "advanced life support" (paramedic) ambulances, when necessary, from the nearby counties of Gloucester, New Jersey, New Castle, and Chester, Pennsylvania. Ambulance response time to the Chambers Works Plant is approximately 5-10 minutes.[73]

When transport of seriously injured patients to trauma centers or burn centers becomes necessary, Salem County can call upon the State to provide medivac helicopter support. Depending upon their specific injuries, patients may be flown to several hospitals in New Jersey, Pennsylvania, or Delaware.[74]

The primary hospital for treating contaminated or injured patients is Salem County Hospital, which has specialized facilities and procedures for decontamination. There are several out-of-county hospitals that have been designated for treating seriously injured, burned, or contaminated patients. These include, with distance from Deepwater in parenthesis, the University of Pennsylvania Hospital in Philadelphia (approximately 23 miles), Saint Agnes Hospital in Philadelphia (approximately 23 miles), and Chester-Crozier Hospital in Chester, Pennsylvania (approximately 14.5 miles). In addition, there are trauma centers available: Cooper Medical Center in Camden (approximately 28.5 miles) and University Hospital in Newark (approximately 100 miles).[75] The primary hospital for treating contaminated patients in New Castle County is Wilmington Hospital located in the City of Wilmington. The hospital has complete decontamination facilities. The Medical Center of Delaware, with branches in Wilmington and Christiana, serves as poison control center in New Castle County.[76]

Emergency medical services in New Castle County are provided by several government-operated organizations and one private organization. Advanced life support (i.e., paramedic) is provided by the New Castle County Ambulance Service. The Ambulance Service operates five paramedic units and one Basic Life Support (BLS) ambulance. BLS in the County is provided primarily by the volunteer fire departments, while Wilmington is served by a private company under contract with the City.[77] When transport of seriously injured patients to trauma centers, burn centers, or poison control centers becomes necessary, New Castle County can call upon the State to provide medivac helicopter support. State Police medivac helicopters are located in Wilmington, Dover, and Georgetown. Depending upon their specific injuries, patients may be flown to several hospitals in Delaware, Pennsylvania, New Jersey, or Maryland.

3.5.5.4 Law Enforcement Capabilities. Law enforcement in Salem County is provided by municipal police departments and the State Police. Police officers' involvement in hazardous materials incidents includes evacuation assistance, traffic and crowd control, and security of evacuated areas. Police officers receive basic hazardous materials training in the areas of materials identification and hazard awareness. Law enforcement agencies that protect the areas closest to the Chambers Works plant include the police departments of Pennsville, Penns Grove, and Carneys Point and the State Police from the Woodstown station. Minimum staffing levels, per shift, for these four agencies are as follows:

- Pennsville - 6 officers;
- Penns Grove - 3 officers;
- Carneys Point - 4 officers; and
- NJ State Police - 8 officers (Woodstown station).[78]

Law enforcement in New Castle County is provided by the New Castle County Police Department, City of Wilmington Police Department, State Police, and a few small municipal police departments (e.g., Newark and Newport). In addition, the Delaware River & Bay Authority Police Department provides law enforcement services for the Delaware Memorial Bridge. The New Castle County Police Department has 221 officers, with approximately 35 officers on patrol per shift.[79]

3.5.5.5 Emergency Environmental Monitoring. In New Jersey, emergency monitoring of airborne and waterborne contaminants from accidental releases of hazardous wastes is conducted by the State. The Department of Environmental Protection is responsible for air and water sampling and assessing the impact of contaminants. The Department of Health provides atmospheric assessment and assistance on health problems associated with chemical exposure. Salem County itself has no hazardous waste monitoring capabilities.

In Delaware, emergency monitoring of airborne contaminants from accidental releases of hazardous wastes is also conducted by the State. Specifically, the responsibility is that of the Department of Natural Resources & Environmental Control, Air & Waste Management Division, Air Resources Section, Air Surveillance Branch. The Air Surveillance Branch (ASB) utilizes a response van that contains air sampling and analysis equipment, a computer, and EPA-Level B personal protective gear. The van is equipped with a HEPA filter and an air supply/ventilation system that creates positive pressure within the completely sealed van. This allows personnel to operate within the van while the van is parked directly inside an area affected by hazardous airborne contaminants. The van is also equipped with a manifold that draws-in ambient air directly into on-board analyzers. The ASB personnel can then conduct a gas chromatography mass spectroscopy analysis to determine types of hazardous contaminants and their concentrations. The ASB also has portable monitoring and sampling devices that can be utilized if needed. The ASB personnel manning the van are members of the State Emergency Response Team.[80]

ASB also operates, as part of their ongoing air toxics program, three permanent air monitors in the Wilmington area. The monitors are activated twice per week for a 24-hour period each time. Although the monitors are in-place for the purpose of monitoring specific contaminants on a continuous basis, they may also produce beneficial data during emergency releases of hazardous wastes.[81]

3.5.5.6 Utilities and Wastewater Treatment Services. Atlantic Electric is the utility that supplies electricity to all of Salem County, including Penns Grove, Pennsville, and Carneys Point. Penns Grove and Pennsville both have secondary wastewater treatment facilities, while Carneys Point has primary treatment and a secondary system under construction. Carneys Point has a ban on new hookups for large users such as motels, apartments, and commercial units until the new system is completed in late 1989. Pennsville has excess capacity in its system currently and Carneys Point will have excess capacity when the new facility is complete.[82]

3.5.6 Local Government Revenues and Expenditures

Revenues for Salem County during 1981-82 and 1985-86 increased by about 10 percent from $23 million to $25 million respectively. Revenues in New Castle County increased by 38 percent during this same period (from $88 million to $121 million). Expenditures in Salem County increased by about 10 percent, from $22 million to $24 million, and were principally for education, highways and welfare. Expenditures in New Castle County increased by 23 percent, from $93 million to $105 million, with the largest expenditures aside from debt interest for sewerage and sanitation, police protection and natural resources.[83] Revenues in 1986 for Pennsville, Carneys Point and Penns Grove were $7.7 million, $2.5 million, and $0.7 million respectively. Carneys Point received $186,000 in 1986 from the Hazardous Waste Facility Tax paid by Du Pont. According to the 1987 Carneys Point municipal budget, these funds were allocated to police and fire protection, and first-aid services. Du Pont paid $960,078 in 1987 and $1,203,785 in 1988.

3.5.7 Public Attitudes Toward Project

The majority of residents living in Salem county are not aligned with any citizen or environmental group. There are, however, several organized groups that have expressed concerns over the proposed hazardous waste incinerator. These groups can be primarily characterized as local citizens' organizations and environmental activists. In addition, at least one new environmental group has been organized in direct response to Du Pont's proposed incinerator.

Local citizens' groups have held meetings and used various local media as a platform for their views. Some of the more vocal groups include the newly organized group, Salem Counties Against Toxins (SCAT); the Chemical Workers Association (CWA); and the Carneys Point Township Advisory Committee on Hazardous Waste Incineration. Environmental activist groups such as Greenpeace, which maintains national as well as local membership, have also expressed interest in the proposed incinerator.

Most concerns expressed by the local citizens' groups focus on the potential negative health effects incinerator emissions could have on nearby communities. These groups state they have not, in their opinion, received sufficient information concerning incinerator emissions, air pollution controls, and incinerator venting to the atmosphere. County residents have also expressed concern over the increased transportation of hazardous wastes to the proposed incinerator. Residents of Carneys Point and surrounding municipalities are concerned that an increased number of vehicles transporting hazardous waste to the proposed incinerator will increase the likelihood for transportation-related accidents and hazardous waste spills. The potential for ground-water contamination resulting from this type of accident was also cited as a concern. Another concern includes the potential impact incinerator emissions may have upon area wildlife, in particular, nesting birds.

Some residents question Du Pont's ability to operate and maintain the proposed incinerator properly, referring to the 1987 New Jersey Department of Environmental Protection citing of Chambers Works for improper analysis of acceptable waste being burned in its current facility. Residents have also indicated the ground-water contamination which occurred at Du Pont's Chambers Works as a concern, including faulty construction and operation of Landfill "C." In addition, environmental groups have also criticized Chambers Works past record of reporting environmental problems. They cite Du Pont's handling of a past ground-water contamination problem at the Chambers Works facility as an example of the company's unwillingness to disclose necessary information to the public.

Residents' attitudes regarding the proposed incinerator generally reflect the findings of a 1987 Newark Star Ledger/Rutgers University Eagleton Institute Poll, which surveyed New Jersey residents concerning their attitudes regarding environmental issues. This state-wide poll revealed that a majority of New Jersey residents do not oppose the construction of a new hazardous waste incineration facility in the state, however, sentiment reverses significantly as the proposed location of such a facility becomes closer to their own community. Residents of Salem County are aware of, and acknowledge, the state-wide problem of hazardous waste disposal but feel their county should not be called upon to assume the responsibility of becoming a location for a hazardous waste incinerator that could potentially accept hazardous wastes from other areas as well as from outside interests (i.e., non-Du Pont generators). Conversely, many Salem County residents and organizations have publicly stated their support for the proposed hazardous waste units and consider the company extremely capable of operating a hazardous waste incinerator.

3.6 HISTORICAL AND ARCHEOLOGICAL RESOURCES

Archeological, cultural, and historical resources are defined as prehistoric and historic districts, sites, structures, and other evidence of human use that are considered to be important to a culture or subculture or a community for scientific, traditional, religious, or other reasons. Within Chambers Works, there are no buildings, structures, districts, sites or objects listed on or eligible for listing on the State or National Register of Historic Places. There are no cultural resources listed on or eligible for listing on the State and National Registers within the adjacent townships of Penns Grove, Pennsville, and Carneys Point.[84] The Salem County Historical Society has no listing of any sites of historical interest within Chambers Works either.[85] While there has been no comprehensive cultural survey of the site, it is highly unlikely that any resources would be found at the proposed incinerator or landfill sites given their previous uses (described in Sections 2.1 and 2.2).

3.7 AESTHETIC QUALITY OF THE AREA

The landscape in the area surrounding Du Pont Chambers Works exhibits considerable visual variety. Relatively flat landforms containing agricultural crops, forested areas, and urban areas are predominant. Much of the land in Salem County, particularly in the western part of the county, consists of wetlands. The Delaware River borders the plant on the west. Along U.S. 130, which borders the Du Pont Chambers Works plant on the east, an aesthetic barrier of forestland separates motorists from the plant. With the exception of a few stacks that can be seen in back of the LINDE Gas Products plant, this barrier obscures the view of the Du Pont facilities from the eastern border during all seasons. The Chambers Works plant can be seen easily from the Delaware Memorial Bridge.

3.8 ACOUSTIC ENVIRONMENT[86]

Primary noise sources near Chambers Works are truck traffic on State Route 130, truck and automobile traffic on Interstate 95, and noise emanating from traffic passing over the Delaware Memorial Bridge. Secondary noise sources are the Chambers Works plant and noise of local activities such as trucks moving in the park at Harrison and Jackson Streets, noise associated with play at the park, and local traffic passing through the area such as that at Division and J Streets in Carneys Point.

3.8.1 Measuring Noise

In order to characterize existing noise levels, a 24-hour test was conducted to allow production of a statistically valid sample of the immediate noise which may have a range of greater than 60 decibels (dB) between a maximum and minimum level. The time varying nature of the noise precludes using short duration samples. This is particularly true in areas that are dominated by traffic noise. Statistical data are used to analyze an acoustical environment because sound levels can vary over a considerable range since many sources contribute to sound measured at a location. Transient ambient sources often raise sound levels 20 decibels or more above background sound levels. The following descriptors are most often used to assess data of this type:

> L_{90} - The sound level exceeded 90 percent of the time during a given measurement period. L_{90} is usually referred to as background sound level.
>
> L_{50} - This is the median level exceeded 50 percent of the time during a measurement period.

L_{10} - This is the sound level exceeded 10 percent of the time during a measurement period. L_{10} is a measure of the contribution of intrusive sound sources.

L_{eq} - The equivalent continuous noise level that would exist if all the noise in the measurement period were averaged over that time period.

L_{min} (L_{max}) - The minimum (maximum) (slow or fast averaged) noise level during the measuring period.

A glossary of technical terms used to measure and describe noise is presented in Appendix B.

From these measurements two types of noise plots can be produced. One is a time-history in which the minute-by-minute noise levels are plotted over the 24-hour period. The second is an hourly sound level statistical plot in which the maximum and minimum levels, the equivalent continuous level (L_{eq}) and the statistical levels exceeded 10 percent (L_{10}), 33 percent (L_{33}), 50 percent (L_{50}), and 90 percent of the time (L_{90}) are displayed for each one-hour period.

For this assessment, a Larson-Davis type 700 Environmental Noise Monitor set for A-weighing, SLOW response, which measures the noise every 125 milliseconds and produces a one minute average from the preceding 480 samples, was used. These one minute averages, which are the A-weighted sound level time-histories at each of the monitoring locations, are illustrated in Exhibits 3-59, 3-60, and 3-61. The sampled data, which were accumulated eight times per second, are used to generate the hourly statistics. Therefore, the hourly statistics may show a greater range of sound levels than do the time-histories.

The Larson-Davis monitors were calibrated prior to and after testing using a Bruel and Kjaer model number 4230 sound level calibrator serial number 542241, which was calibrated by Bruel and Kjaer. This calibration is traceable to the National Bureau Standards.

3.8.2 Assessing Ambient Noise Levels

Three locations were chosen for monitoring by virtue of their proximity to the proposed facility. One location was at the park at the corner of Harrison and Jackson Streets in Deepwater, 2600 ft from the proposed facility; another location was near the residences at the roadside on Route 130 North opposite the first entrance north of the Plant Street entrance (2200 ft from the facility). The third site for which data are presented is at Division and J Streets (8600 ft from the facility) in Carneys Point. Ambient noise levels at this location will be discussed first.

Average 24-hour noise levels at Division and J Streets indicated an L_{eq} of 57 dB. Inspection of Exhibit 3-59, the 24-hour time-history at this location, shows that the noise levels between the hours of 1230 and 2100 are highly variable with the levels ranging from 80 dB to approximately 38 dB. This variability is typical of traffic noise on a suburban street. The activity

EXHIBIT 3-59

DIVISION AND J STREETS 24 HOUR TIME-HISTORY
A-WEIGHTED SOUND LEVEL VS. TIME

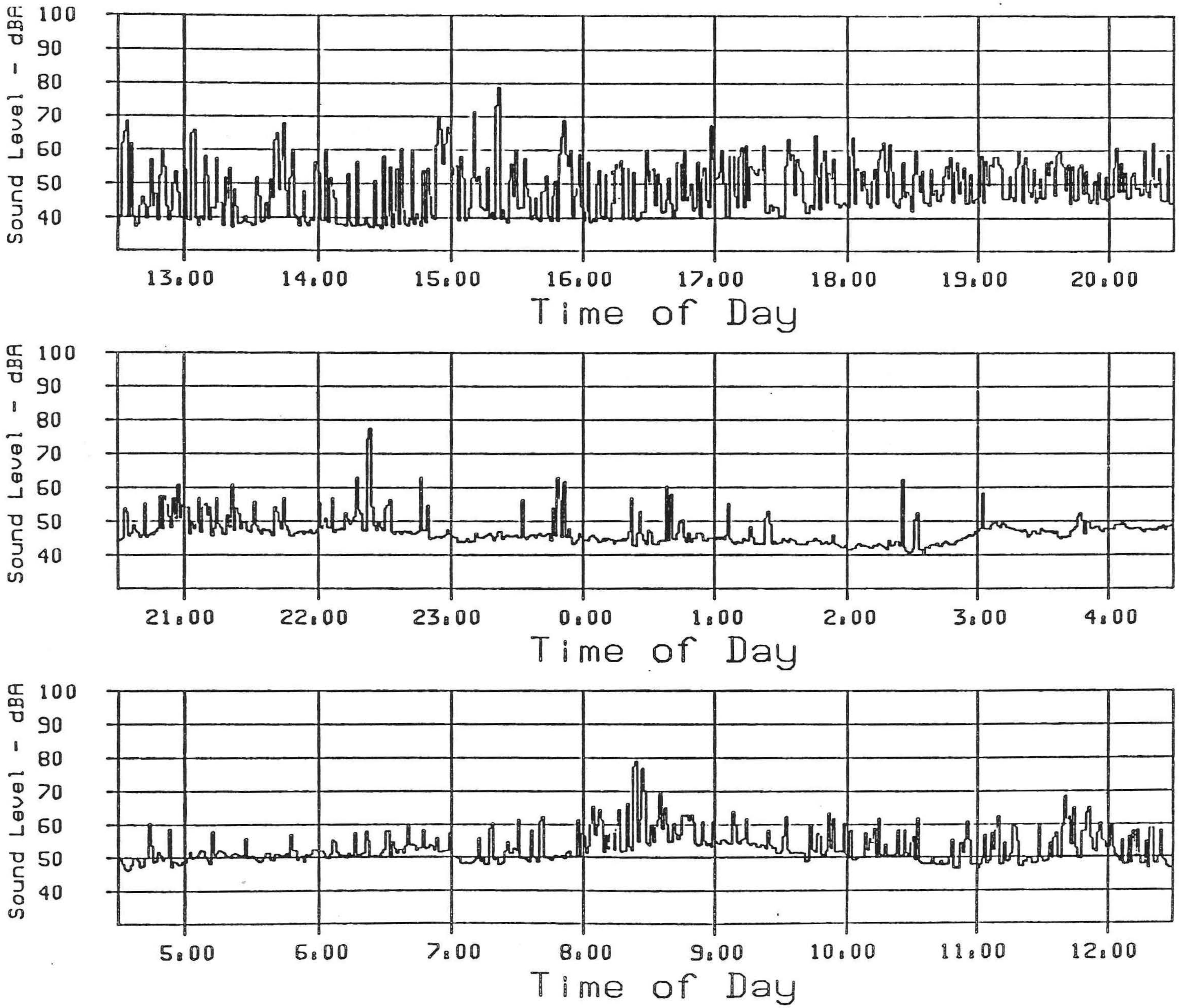


EXHIBIT 3-60

ROUTE 130 NORTHBOUND 24 HOUR TIME-HISTORY
A-WEIGHTED SOUND LEVEL VS. TIME

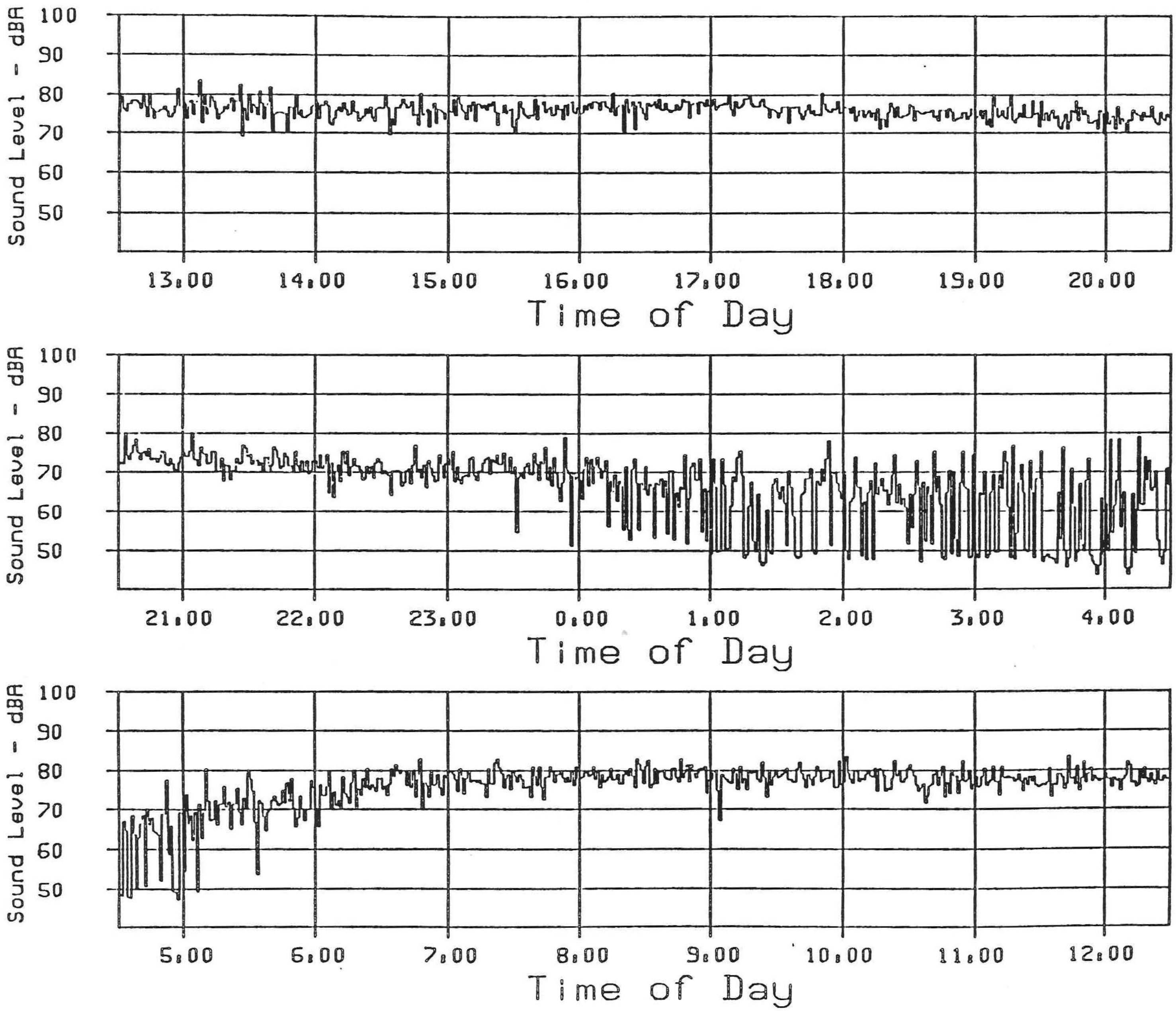
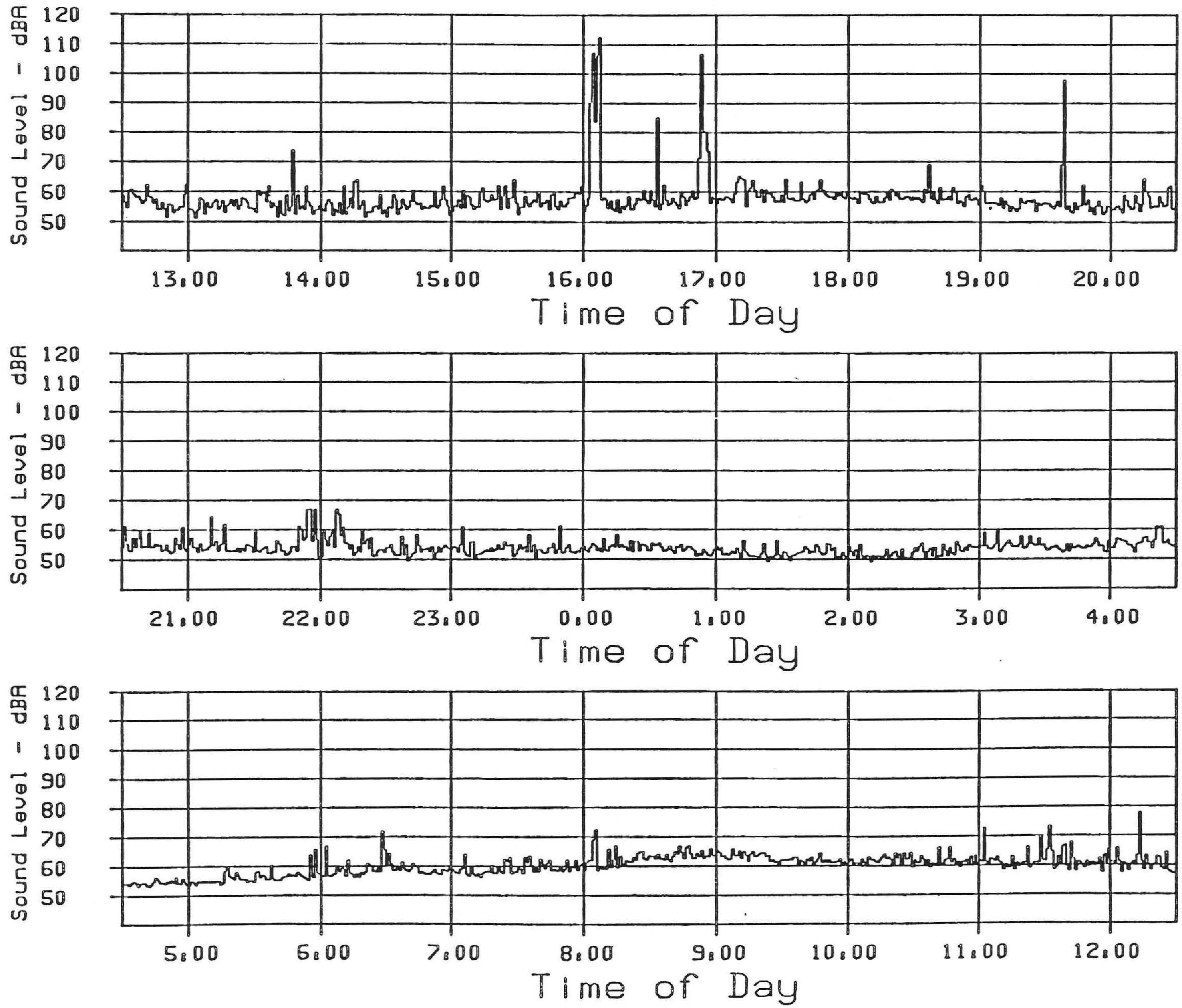


EXHIBIT 3-61

HARRISON AND JACKSON STREET CORNER, DEEPWATER 24 HOUR TIME-HISTORY
A-WEIGHTED SOUND LEVEL VS. TIME



decreases at approximately 2200 hours with only occasional vehicle passbys, between the hours of 2200 and 0700 the following day. At 0700 there is an increase in the number of vehicle passbys, and the activity at 1100 hours approximates the activity seen the previous day. The background level, as indicated by the trend of the lowest noise levels, decreases beginning at about 2200 hours until reaching a minimum at about 0230, at which point the noise level begins to increase and shows a strong jump between the hours of 0800 and 0900 corresponding to morning traffic. The hourly sound level statistics at this location, shown in Exhibit 3-62, reflect the trend seen in the time-history. The equivalent 24-hour sound level at this location is 57 dB(A) with a day/night sound level (L_{dn}) of 60 dB(A). The L_{dn} is used by the Department of Housing and Urban Development for assessing land suitability, and this falls within the acceptable range for residential use.

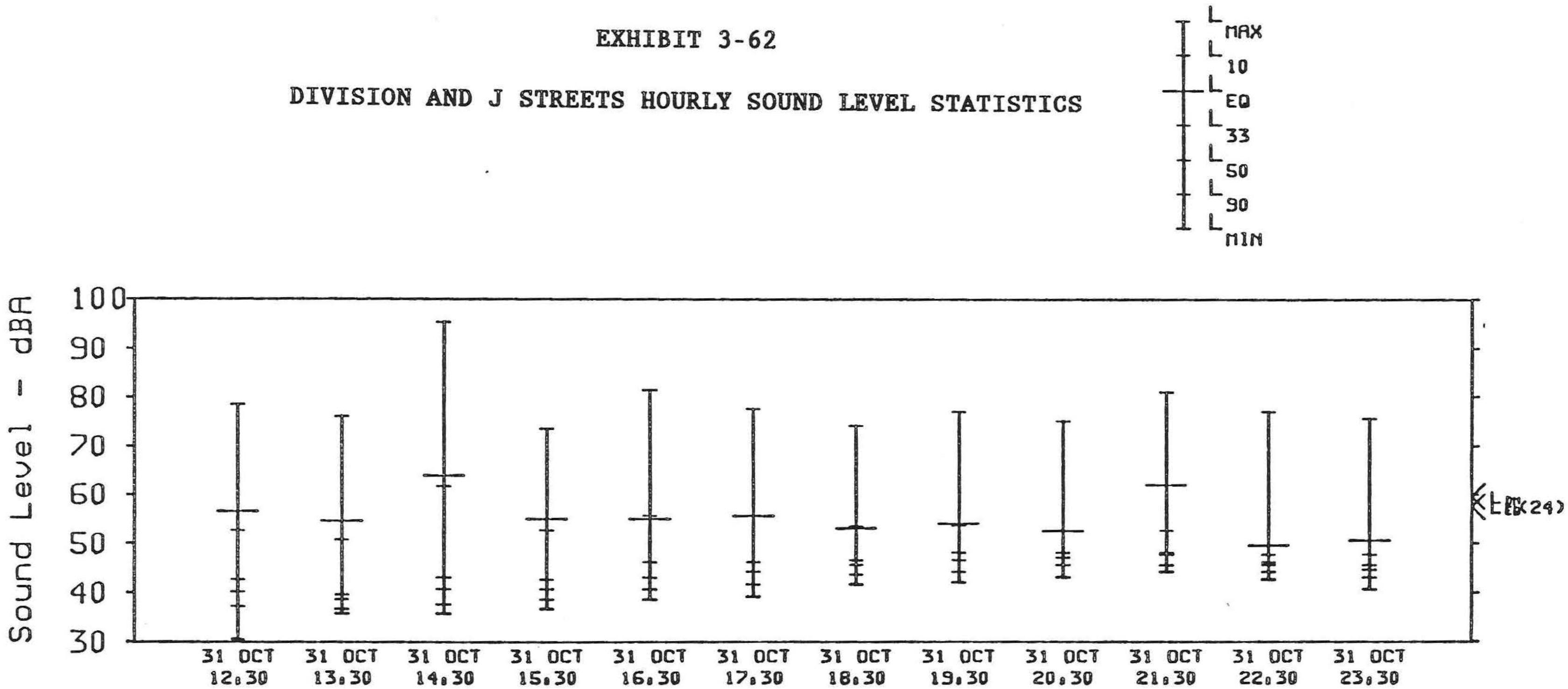
Exhibit 3-60 is the noise time-history measured at the roadside of Route 130 northbound. These data show a high background level of noise between 75 and 80 dB up until approximately 2000 hours on 31 October. Between the hours of 2000 and 2300 the noise level drops by approximately 5 dB to 70 dB. After midnight the noise drops precipitously until the background noise level is approximately 50 dB. The contributions of noise from individual vehicles become more predominant in the time-history, and the variability of the noise increases between 0030 and 0500 hours due to a reduction in the background noise level. After 0500, traffic increases on Route 130, and the constant background noise increases to previous levels and the variability decreases for the remainder of the time-history. As indicated by the hourly sound level statistics, Exhibit 3-63, there is wide variability in the minimum and maximum sound levels and the L_{eq} decreases from approximately 78 dB at 1230 to approximately 68 dB at 0130 on 1 November after which time the L_{eq} and L_{90} increase. The equivalent continuous 24-hour noise level at this location is 76 dB(A) and the L_{dn} is 80 dB(A).

Noise levels at the corner of Harrison and Jackson Streets, Deepwater, are shown in Exhibit 3-61. With the exception of anomalous points at approximately 1605 hours, 1650 hours and 1935 hours, the noise levels are consistently between 50 and approximately 70 dB, with the majority of levels being between 55 and 60 dB. Several trucks were observed parked in the vicinity of the monitor when the monitor was placed. It is anticipated that these few high (125 dB) level noises, as shown in the hourly sound level statistics, Exhibit 3-64, are from a source close to the monitor.

The logic for this assumption is as follows. If the source were distant from the monitor and located at Chambers Works, the decrease of sound with distance will be similar for this monitor and for the monitor on Route 130. Therefore, even though the background noise level on Route 130 is higher than at this location, the sound will still be measurable at that monitor. Since this is not the case, it is reasonable to conclude that these excursions represent an infrequent activity (i.e., motorcycle without a muffler) within the park that afternoon. When the 24-hour equivalent continuous levels and the day/night levels are recomputed using the equivalent sound levels in the hourly intervals preceding and following the intervals in which there occurred these wide excursions, L_{eq} equals 59 dB and L_{dn} equals 78 dB. To have no measurable effect on the L_{eq}, the operations must produce an L_{eq} of less than 66 dB over the period.

EXHIBIT 3-62

DIVISION AND J STREETS HOURLY SOUND LEVEL STATISTICS



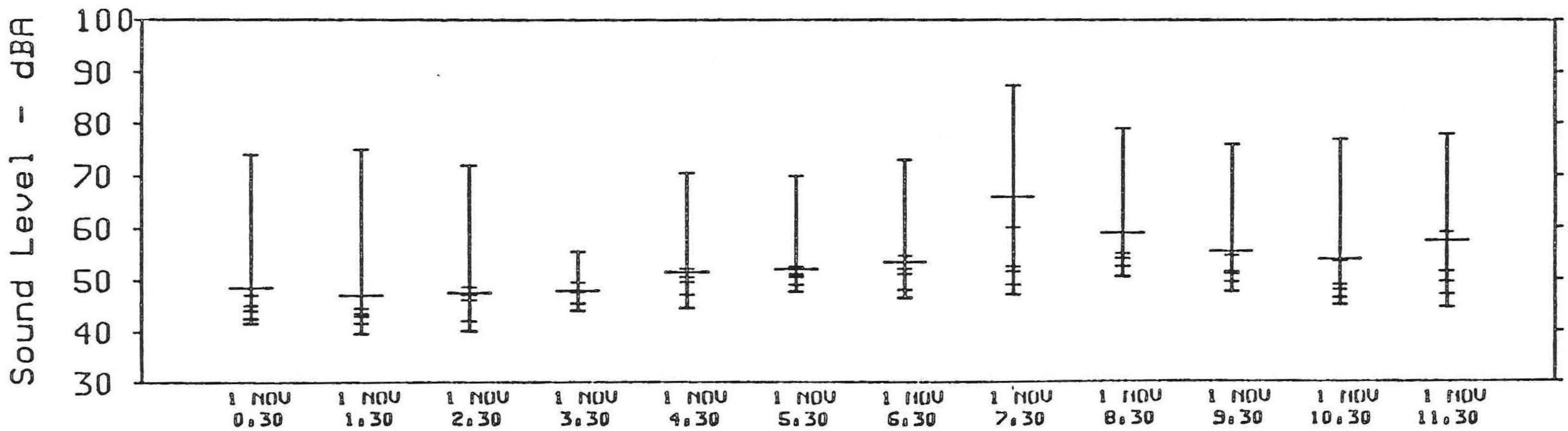
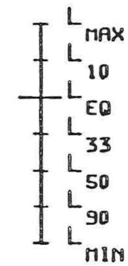
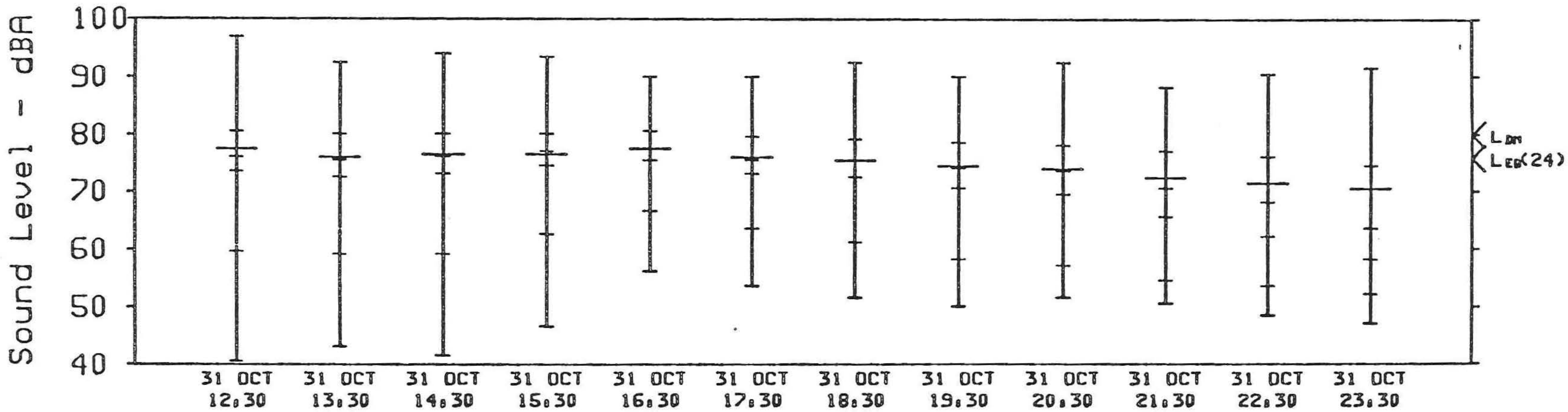


EXHIBIT 3-63

ROUTE 130 NORTHBOUND HOURLY SOUND LEVEL STATISTICS





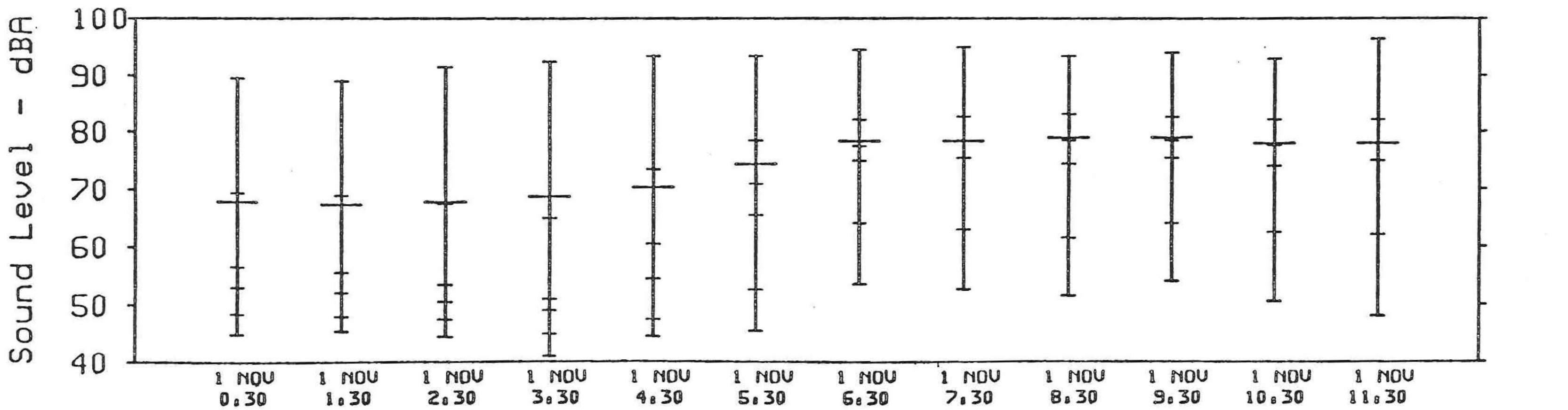
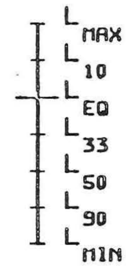
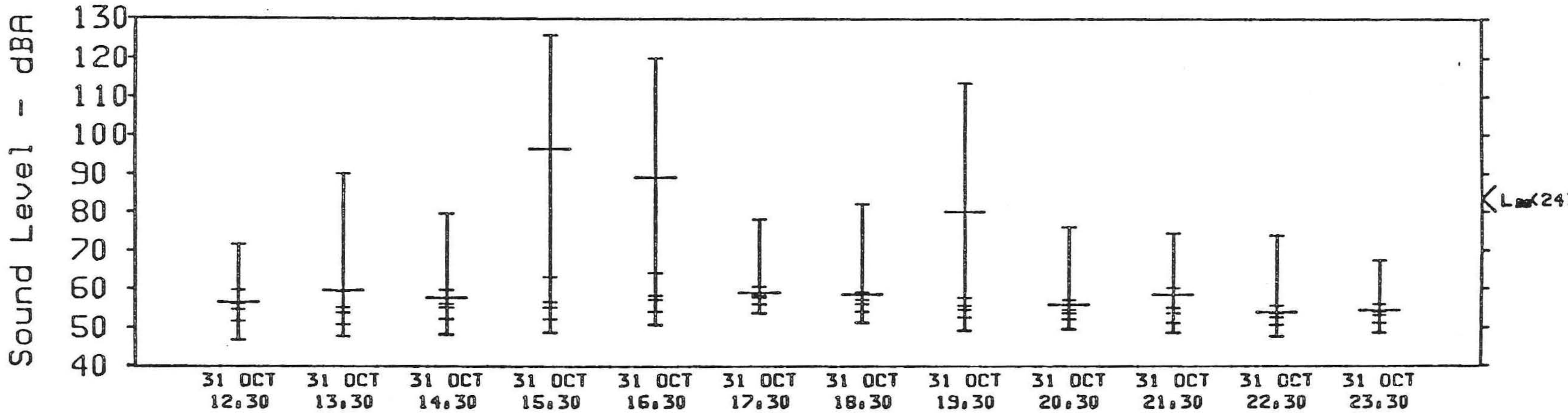
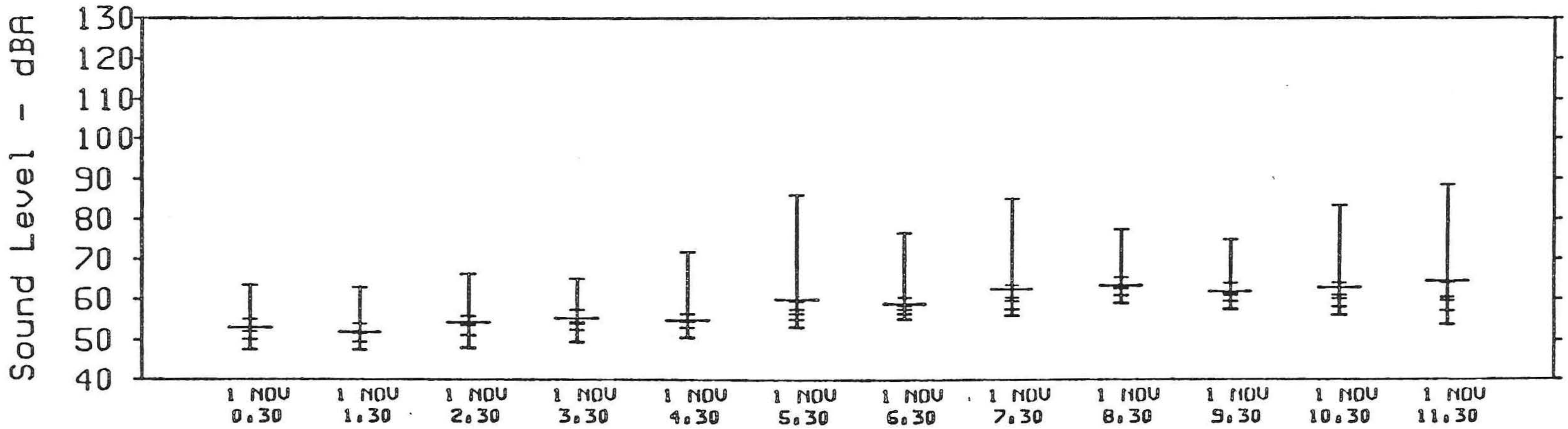


EXHIBIT 3-64

HARRISON AND JACKSON STREET CORNER, DEEPWATER HOURLY SOUND LEVEL STATISTICS







In summary, the noise levels measured at the three sites are suburban environments dominated by high volume interstate and local highway noise.

NOTES

1. In the remainder of this section and subsequent sections, the surficial deposits and their associated aquifers will be referred to as the Pleistocene deposits/aquifers and the lower Cretaceous sediments will be referred to as the PRM deposits/aquifers.

2. Owens, J.P. and Minard, J.P., "Upper Cenozoic Sediments of the Lower Delaware Valley and the Northern Delmarva Peninsula, New Jersey, Pennsylvania, Delaware, and Maryland," U.S. Geological Survey Professional Paper 1067-D, 1979, 47 p.

3. Ibid.

4. Newell, W.L., Wyckoff, J.S., and J.P. Owens, "Southeast Friends of the Pleistocene, 2nd annual field conference," Cenozoic geology and geomorphology of southern New Jersey Coastal Plain, November 11-13, 1988: USGS Open File Report 89-159, 1989.

5. Rosenau, J.C., Lang, S.M., Hilton, G.S., and J.G. Rooney, "Geology and Groundwater Resources of Salem County, New Jersey," State of New Jersey Department of Conservation and Economic Development, Division of Water Supply, Special Report 33, 1969.

6. Ibid.

7. Vowinkel, E.F. and Foster, W.K., "Hydrogeologic Conditions of the Coastal Plain of New Jersey," U.S. Geological Survey Open-File Report 81-405, 1981.

8. Rosenau, J.C., Lang, S.M., Hilton, G.S., and J.G. Rooney, "Geology and Groundwater Resources of Salem County, New Jersey," State of New Jersey Department of Conservation and Economic Development, Division of Water Supply, Special Report 33, 1969.

9. Ibid.

10. Owens, J.P. and Minard, J.P., "Upper Cenozoic Sediments of the Lower Delaware Valley and the Northern Delmarva Peninsula, New Jersey, Pennsylvania, Delaware, and Maryland," U.S. Geological Survey Professional Paper 1067-D, 1979, 47 p.

11. Lewis, H.C., "The Trenton gravel and its relation to the antiquity of man," Acad. Nat. Sci. Philadelphia Proc., 1880, p 296-309.

12. This term applies to deposits created distal to the limits of glaciers. Pertains to features of glacial origin beyond the limits of the glacial ice, such as streams, lakes, and loess.

13. Section 4.2.1.2 provides a description of a numerical ground water flow model that Du Pont is developing for the Chambers Works Facility. The model is discussed in this section since it is particularly useful as a predictive tool to determine the potential impacts to ground water, releases from the proposed incinerator and landfill may have and because it will be used for the design and implementation of corrective action strategies, including the most efficient operation of the interceptor well system (discussed in Section 3.2 and 4.2).

14. Gill, H.E., and Farlekas, G.M., "Geohydrologic Maps of the Potomac-Raritan-Magothy Aquifer System in the New Jersey Coastal Plain," U.S. Geological Survey Hydrologic Investigations Atlas HA-557, 1976.

15. Powley, V.R., "Soil Survey of Salem County, New Jersey," U.S. Department of Agriculture, Soil Conservation Service, 1969.

16. Vowinkel, E.F., and Foster, W.K., "Hydrogeologic Conditions in the Coastal Plain of New Jersey," U.S. Geological Survey Open-File Report 81-405, 39 p.

17. Vowinkel, E.F. and Foster, W.K., "Hydrogeologic Conditions of the Coastal Plain of New Jersey," U.S. Geological Survey Open-File Report 81-405, 1981.

18. Delaware River Basin Commission, "Special Groundwater Study," Basinwide Report and Executive Summary, Delaware River Basin Commission, 1982.

19. Woodward-Clyde Consultants, "Draft In-house Documentation of the Chambers Works Groundwater Flow Model, 1988," E.I. Du Pont de Nemours & Company, Deepwater, NJ. Project Number: 88C2307-1 February 16, 1989b.

20. Fusillo, T.V. and Voronin, L.M., "Water-Quality Data for the Potomac-Raritan-Magothy Aquifer System, Trenton to Pennsville, New Jersey, 1980," U.S. Geological Survey Open-File Report 81-814, 1981.

21. Schaefer, F.L., "Distribution of Chloride Concentrations in the Principal Aquifers of the New Jersey Coastal Plain 1977-81," U.S. Geological Survey, Water-Resources Investigations Report 83-4061, 1983.

22. Gill, H.E., and Farlekas, G.M., "Geohydrologic Maps of the Potomac-Raritan-Magothy Aquifer System in the New Jersey Coastal Plain," U.S. Geological Survey Hydrologic Investigations Atlas HA-557, 1976.

23. Luzier, J.E., "Digital-simulation and Projection of Head Changes in the Potomac-Raritan-Magothy Aquifer System, Coastal Plain, New Jersey," U.S. Geological Survey Water-Resources Investigations 80-11, 1980, 72 p.

24. Leggette, Brashears, & Graham, Inc., Information Required by USEPA Regarding Section 3005(i) 13 of HWSA, 1986a.

25. Woodward-Clyde Consultants, "Draft In-house Documentation of the Chambers Works Groundwater Flow Model, 1988," E.I. Du Pont de Nemours & Company, Deepwater, NJ. Project Number: 88C2307-1 February 16, 1989b.

26. Ibid.

27. Delaware River Basin Commission, "Delaware River Water Quality Assessment," Delaware River Basin Commission, 1986, 53 p.

28. Flood Insurance Rate Map, Township of Carneys Point, New Jersey, Salem County, Community Panel Number: 340424 0005B, June 1982.

29. Woodward-Clyde Consultants, "100-year Flood Event, Wave Climate Evaluation," E.I. Du Pont de Nemours & Company, Deepwater, NJ, August 16, 1988.

    Superseded by:

    Woodward-Clyde Consultants, "Responses to Interrogatories Associated with the Proposed Secure Landfill, E.I. Du Pont de Nemours & Company, Deepwater, NJ, Project Number 86C2128-3 January 30, 1989.

30. Rainfall Frequency Atlas of the United States, for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years: prepared by David M. Hershfield: Technical Paper No. 40 US Dept. of Commerce.

31. Neumann, C.J., Jarvinen, B.R., and A.C. Pike, "Tropical Cyclones of the North Atlantic Ocean, 1871-1986," National Climatic Data Center, 1988.

32. Ruffner, James and Bair, Frank, "The Weather Almanac," Gale Research Company, Detroit Michigan, 1983.

33. U.S. Department of Commerce, "Climatic Atlas of the United States," USDOC Environmental Science Services Administration, Environmental Data Service, reprinted by National Oceanic and Atmospheric Administration, 1983.

34. RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

35. New Jersey Department of Environmental Protection, 1987 Air Quality Report, NJDEP Division of Environmental Quality, July, 1988.

36. New Jersey Department of Environmental Protection, 1986 Air Quality Report, NJDEP Division of Environmental Quality, August, 1987.

37. Delaware Department of Natural Resources and Environmental Control, Monthly Air Quality Data Summary, Delaware DNREC, Division of Air and Waste Management December, 1987.

38. Delaware Department of Natural Resources and Environmental Control, Monthly Air Quality Data Summary, Delaware DNREC, Division of Air and Waste Management December, 1986.

39. RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

40. Delaware Department of Natural Resources and Environmental Control, Monthly Air Quality Data Summary, Delaware DNREC, Division of Air and Waste Management December, 1987.

41. New Jersey Department of Environmental Protection, 1987 Air Quality Report, July 1988, p 19.

42. ENSR Consulting and Engineering, "Wetland Delineation Study for the Old Carneys Point Site," December 1988, p. 3-1.

43. Ibid, p. 3-8.

44. Ibid, p. 3-8.

45. Ibid, p. 3-9.

46. Ibid, p. 3-17.

47. Telephone conversation with Mr. Lew Cattuna, NJ Bureau of Wetlands, December 28, 1988.

48. Telephone conversation with Mr. Lew Cattuna, NJ Bureau of Wetlands, January 3, 1989.

49. R.F. Molzahn, "An Ecological Study of the Delaware River in the Vicinity of the Edge Moor Power Station," February 1975, p. 52-71.

50. Du Pont, "Impingement and Entertainment Report Chambers Works Chemical Plant."

51. Telephone conversation with Ms. Janice Thomas, NJ Division of Fish, Game and Wildlife, December 31, 1988.

52. Personal correspondence with the NJ Natural Heritage Program, February, 1988, as cited in: ENSR Consulting and Engineering, "Wetlands Delineation Study for the Old Carneys Point Site," December 1988.

53. Personal correspondence with the NJ Natural Heritage Program, February, 1988, as cited in: ENSR Consulting and Engineering, "Wetlands Delineation Study for the Old Carneys Point Site," Appendix C, December 1988.

54. Telephone conversation with Ms. Cathy Clark, NJ Division of Fish, Game and Wildlife, December 30, 1988.

55. Personal correspondence with the NJ Natural Heritage Program, February, 1988, as cited in: ENSR Consulting and Engineering, "Wetlands Delineation Study for the Old Carneys Point Site," Appendix C, December 1988.

56. Telephone conversation with Ms. Janice Thomas, NJ Division of Fish, Game, and Wildlife, December 30, 1988.

57. Ibid.

58. Personal correspondence with the NJ Natural Heritage Program, February, 1988, as cited in: ENSR Consulting and Engineering, "Wetlands Delineation Study for the Old Carneys Point Site," Appendix C, December 1988.

59. Ibid.

60. Ibid.

61. U.S. Department of Commerce, Bureau of the Census, "Census of Population and Housing," 1988 Computer printout of County Land Areas; U.S. Department of Commerce, Bureau of the Census, 1983 County and City Data Book.

62. U.S. Department of Commerce, Bureau of the Census, "1980 Census of Population, Characteristics of the Population, Number of Inhabitants, United States Summary," PC80-1-A1.

63. Salem County Census Trends 1970-1980, Salem County Planning Commission.

64. The County of Salem," A Plan For Comprehensive Development," October 17, 1972; Penns Grove Zoning Map; Carneys Point Zoning Map, December, 1978; Pennsville Township Revised Zoning Map, December, 1974.

65. New Castle County Department of Planning, "Comprehensive Plan, Background Report, New Castle County, Delaware," December, 1986. U.S. Bureau of the Census, "1986 Population and 1985 Per Capita Income Estimates for Counties and Incorporated Places," March 1988.

66. U.S. Department of Commerce, Bureau of Economic Analysis, "Survey of Current Business," Volume 66, number 4, April 1988.

67. Interview with Charlie Munyon, Salem County Planning Commission, December, 1988.

68. Telephone Conversation with Carl Wentzell, Deputy Coordinator, Salem County Office of Emergency Management, December 15, 1988.

69. Salem County Chapter of the American Red Cross, Disaster Plan, February, 1985.

70. Telephone Conversation with Valerie Tallman, Director of Emergency Services, Delaware Chapter of the American Red Cross, December 29, 1988.

71. Telephone conversation with Carl Wentzell, December 16, 1988.

72. Telephone Conversation with Grover Ingle, President, New Castle County Fire Chiefs Association, December 19, 1988. Also, Telephone conversation with Joseph L. Murabito, Training Administrator, Delaware State Fire School, December 28, 1988.

73. Telephone conversation with Carl Wentzell, December 16, 1988.

74. Telephone conversation with Bob Hanson, New Jersey State Police, December 20, 1988.

75. Telephone conversations with Carl Wentzell and Bob Hansen.

76. Telephone conversation with Edward Barlow.

77. Telephone Conversation with Edward Barlow, Chief, New Castle County Ambulance Service, December 28, 1988. Also, Telephone conversation with Ted Doyle, Battalion Chief, Wilmington Fire Department, December 16, 1988.

78. Telephone conversation with Carl Wentzell.

79. Telephone conversation with Captain Yackoski, New Castle County Police Department, December 28, 1988.

80. Telephone conversation with Joseph J. Kliment, Program Manager, Air Surveillance Branch of the Delaware Department of Natural Resources & Environmental Control, December 28, 1988, regarding emergency monitoring of airborne contaminants.

81. Ibid.

82. Telephone conversations with Township Clerks in Pennsville, Penns Grove, and Carneys Point, January 9, 1989.

83. 1982 Census of Governments, Finances of County Government, vol. 4 #3, September 1984. 1986 Salem County Budget; U.S. Department of Commerce, Bureau of the Census, County Government Finances in 1985-86, February 1988.

84. Letter from Nancy L. Zerbe, Administrator, State of New Jersey, Department of Environmental Protection, Division of Parks and Forestry, Office of New Jersey Heritage to Mr. Andy Muir, December 19, 1988.

85. Telephone conversation with Jonathon Gell, Archaeologist, State of New Jersey, Department of Environmental Protection, Division of Parks and Forestry, Office of New Jersey Heritage, January 4, 1989. Also, Telephone Conversation with Dr. Harlan Buzby, Salem County Historical Society, December 14, 1988.

86. Source: Twenty Four Hour Noise Survey at Du Pont Chambers Works, Ostergaard Associates, December 1988.

Section 4

SECTION 4

ENVIRONMENTAL IMPACT ANALYSIS

This section presents impacts that may result from the construction and operation of the proposed hazardous waste incinerator and landfill. Potential impacts on the physical, biological, and socioeconomic environment, which was described in Section 3, are discussed, as well as potential impacts on public health and worker health and safety. The section also discusses how the proposed expansion projects adhere to the New Jersey siting criteria for new major commercial hazardous waste facilities.

4.1 WATER QUALITY AND USES

4.1.1 Surface Water

No adverse impacts to surface-water quality and surface-water uses are expected from the construction and routine operation of either the proposed incinerator or landfill units. It is assumed that construction activities will adhere to required construction techniques, and therefore, will not create erosion and increase sediment loading to area drainageways and the Delaware River. In addition, neither unit will have a wastewater discharge to a surface-water body. The incinerator complex has been designed to prevent stormwater run-on and runoff and to contain all spills through the use of spill containment curbs. Wastewater generated by the incinerator's air pollution control system (i.e., the only wastewater), all rain that falls onto the complex, and any liquid spill material will be conveyed to the Chambers Works wastewater treatment plant (WWTP; refer to Sections 2.1.2, 2.3.1 and 2.3.2). Expected quantities will represent an extremely small percentage of the 40 million gallons treated and discharged each day from the WWTP. Contaminants in the incinerator stack emissions may reach area surface waters by direct deposition, but contaminant concentrations are expected to be very low and are not expected to affect water quality adversely (refer to Section 4.3.2.2).

Discharges from landfilling activities also will be controlled, including leachate generated by stormwater infiltrating through the wastes (during landfilling) and wash-water runoff from the truck wash station. Both of these wastes will be collected and pumped to the WWTP for processing (refer to Section 2.3.3). Quantities also will represent only an extremely small percentage of the flows processed daily at the WWTP. Run-on will be prevented by the perimeter containment dike. The quality of area surface waters could be affected by exfiltration of contaminated ground water. Ground water could become contaminated if the landfill liner were to leak and if the leachate collection and detection systems did not collect all the leachate. Surface water could then become contaminated if the proposed interceptor wells could not collect all of the contaminated ground water. Refer to Section 4.1.2 for a discussion of potential ground-water contamination.

Floodwaters should not impact either unit, although both units will be located within the 100-year coastal floodplain (refer to Section 3.2.3). The incinerator's waste storage building will be constructed on fill material that will be raised to the 100-year flood event elevation (i.e., to 12.3 ft. CWD, which is equal to the 100-year flood event elevation). The landfill will include a perimeter clay containment/starter dike that will have a minimum top elevation at 17 ft. CWD, which is 4.7 ft. above the 100-year flood event elevation. The dike also will include rip-rap protection that will have a top elevation at 14.5 ft. CWD, which is 2.0 ft. above the 100-year flood event elevation. Therefore, floodwaters are not expected to wash away wastes in the landfill or waste drums from the incinerator's waste storage area, which would result in contamination of surface waters.

ICF Technology also evaluated the long-term stability of the containment dike. The evaluation included a study of Woodward-Clyde Consultants' (WCC) landfill design and stability analysis and Du Pont's proposed landfilling procedures. Based on the evaluation, it was determined that the strengths of the compacted construction materials and waste materials would be more than sufficient to assure long-term stability. In addition, rigorous construction specifications and inspection schedules (i.e., during construction, operation, and post-closure periods) have been proposed to assure that the landfill will be built as designed and that integrity problems will be detected before there can be any release of contaminants to the environment and resultant impacts.

4.1.2 Ground Water

The proposed incinerator complex and landfill have been designed to protect ground water, and therefore, no adverse impacts to ground water are anticipated. The incinerator complex will consist of an impermeable concrete pad surrounded by curbing to contain liquid spills. Spills will not be able to percolate to ground water. Very small amounts of particulate contaminants from stack emissions will be deposited onto the ground, but concentrations of these contaminants are considered insignificant and would not be expected to percolate down to the P-R-M aquifer system in any concentrations that would pose a health risk (refer to Section 4.4).

The landfill design includes various control features to prevent the release of hazardous waste constituents to the subsurface environment. These features include a complex liner system, a leachate collection system, and a leak detection system (refer to Section 2.2.2). The landfill also includes a ground-water monitoring system to detect contaminant releases from the structure should any of the controls fail, and a well system to intercept any contaminated ground water. Leachate and any intercepted ground water will be pumped to the Chambers Works WWTP for processing.

The ground-water interceptor well system has not yet been designed, and therefore, its effectiveness can not be evaluated. The system design, including well location(s), pumping depth(s) and pumping rate(s), will be based on a hydrogeologic model being developed by WCC (refer to Appendix D for model details). The model is currently developed to simulate ground-water movement (e.g., flow rate and direction) based on hydrogeologic conditions at Chambers Works south of the proposed landfill area. To develop an effective interceptor well system for the new landfill, hydrogeologic information on the landfill site has to be assembled and entered into the model. Such information includes characteristics of subsurface deposits obtained from visual observation of excavated cores and hydraulic testing around existing wells (i.e., slug tests), which has already been collected (refer to Sections 3.1 and 3.2). Downhole geophysical logging of wells would provide additional information to supplement data from cores, slug tests, and ICF's surface geophysical testing. The WCC hydrogeologic model should then be validated (e.g., via pump testing). Such testing would involve pumping and water-level monitoring at wells installed in both the surficial and P-R-M systems.

ICF Technology also evaluated the geotechnical aspects of the landfill design to determine if the liner system and leachate collection and detection systems would be able to withstand the anticipated maximum waste load. The evaluation included a study of WCC's design features, their analysis of potential settlement, physical properties of proposed materials, and proposed construction/installation procedures. Based on this geotechnical evaluation, it was determined that there would be minimal settlement of foundation soils and waste materials, and therefore, the liners would not experience any elongation which could be detrimental to their integrity. Total settlement calculated for base of the landfill ranges from 16 inches maximum at the center to 1.5 inches minimum at the perimeter. Maximum differential settlement occurs across an east-west section and is 0.17 feet per 260 feet. Also, the slope of the leachate collection and detection systems would be altered by an insignificant amount (i.e., from 2% to 1.75%). In addition, all relic foundations associated with the nitrocellulose manufacturing plant would be excavated down to two feet below grade to further ensure minimal differential settlement. The proposed liners and PVC piping associated with the leachate collection and detection systems also have sufficient strength to bear the anticipated load.

4.2 AIR QUALITY

This section of the EHIS summarizes the air quality impacts from operation of the proposed incinerator/landfill and associated waste storage and handling systems. A technical discussion of compliance of the incinerator and waste storage and handling system operations with State and Federal ambient air quality and emission standards is included in Section 4.2.1. Regulatory compliance issues are summarized in Section 2.1.5.

A description and evaluation of air quality modeling conducted by ENSR is included, along with a description of additional modeling conducted by ICF Technology. The air quality analysis for the incinerator and waste storage and handling systems is based on the results of modeling conducted by ENSR and ICF Technology. Compliance of the air pollution control systems of the proposed incinerator and waste storage and handling system with State and Federal control technology requirements is discussed and a summary of air quality impacts is provided.

4.2.1 Regulatory Analysis

The incinerator is required to comply with provisions of the Clean Air Act, including the National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) regulations. It must also comply with New Jersey's Ambient Air Quality Standards (NJAAQS). Du Pont must demonstrate that construction and operation of the incinerator will not result in any violation of an ambient air quality standard. Also, since Chambers Works is an existing major air pollution source as defined under the PSD regulations, the incremental increases in ambient air concentrations of regulated air pollutants emitted by the incinerator must be less than the allowable PSD increments. In addition, the PSD regulations require Du Pont to demonstrate that the air pollution control technology applied to the incinerator represents Best Available Control Technology (BACT).

The NAAQS/NJAAQS are standards designed to protect sensitive population groups. The primary air quality standards are intended to protect the health of sensitive population groups such as the young, elderly, and those with respiratory ailments. These standards are specifically applicable for five of the criteria pollutants: sulfur dioxide (SO_2), particulate matter (PM-10), nitrogen oxides (NO_x), carbon monoxide (CO) and lead (Pb), as shown in Exhibit 4-1. In addition, secondary air quality standards exist for SO_2 and particulate matter. For SO_2, these secondary standards are intended to protect the general welfare of the public in terms of secondary impacts from effects on vegetation, soils, structures, etc. For particulates, the secondary standards are intended as guides for achieving the primary standards in addition to protecting the general public welfare. The specific secondary standards for SO_2 and particulates are given within parentheses in Exhibit 4-1.

There are no specific standards for SO_2 and NO_x emissions from hazardous waste incinerators. However, NJDEP requires that hazardous waste incinerator emission control systems demonstrate recent advances in the art of air pollution control. Emissions from the proposed incinerator and the ability of the control system to meet the state's requirements for BACT are discussed in the following sections. Specific emission limitations for various constituents are discussed in Section 2.1.5 (only for PM-10 and HCl/HF). Regulations pertaining to the design and operation of both the incinerator and the waste storage and handling areas are also summarized in Section 2.1.5.

Du Pont is not required under State or Federal regulations to perform an analysis of the effects of volatile organic substances (VOS) emissions from the proposed incinerator and waste storage and handling systems on ambient concentrations of ozone. In the draft air permit application, ENSR estimated the total emissions of ozone precursors (VOS) to be 10.2 tons per year. This is less than the regulatory threshold of 40 tons per year at which analysis of the impacts of VOS emissions on ambient ozone concentrations is required under the State air regulations.

EXHIBIT 4-1

STATE AND FEDERAL REGULATORY STANDARDS FOR CRITERIA POLLUTANTS

POLLUTANT	AVERAGING PERIOD	NAAQS/NJAAQS[a] ($\mu g/m^3$)	EPA DEFINED SIGNIFICANT LIMITS: PSD LIMIT ($\mu g/m^3$)	EPA DEFINED SIGNIFICANT LIMITS: MONITORING[b] ($\mu g/m^3$)	EPA DEFINED SIGNIFICANT LIMITS: IMPACT[c] ($\mu g/m^3$)
SO_2	3-hour	1300	512	-	25
	24-hour	365(260)	91	13	5
	Annual	80(60)	20	-	1
PM-10	24-hour	260(150)	37	10	5
	Annual	75(60)	19	-	1
NO_x	1-hour	475[d]	-	-	
	Annual	100	25[e]	14	1
CO	1-hour	40,000	-	-	2000
	8-hour	10,000	-	575	500
Pb	3-month	1.5	-	0.1	-

[a] National and New Jersey Ambient Air Quality Standards (numbers in parentheses are secondary standards).

[b] Modeled concentration at which ambient air quality monitoring is required.

[c] De minimis impact level.

[d] May soon be proposed as a New Jersey 1-hour ambient standard.

[e] NO_2 Class II increment.

Currently EPA is publishing draft regulations for carbon monoxide concentration in the exhaust gas of hazardous waste incinerators. Under the draft regulations, incinerators will be required to limit emissions of carbon monoxide to 100 ppm or less, corrected to 7% O_2, as a one hour average. Several alternative approaches for site-specific and technology-based variances, which involve determining the concentration of specific hydrocarbons in the exhaust gas, are being considered by EPA at this time, including a limiting exhaust concentration of total hydrocarbons (as propane) of 20 ppm.

EPA is developing standards for emissions of certain metals from hazardous waste incinerators, and has released information concerning these standards in a document entitled Draft Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerators, June 9, 1988. Metals proposed to be regulated under the draft standards are antimony, arsenic, barium, beryllium*, cadmium, chromium, lead**, mercury*, silver, and thallium. EPA proposed the draft metal emission standards for hazardous waste incinerators in August 1988, and expects to promulgate them at a later date after receiving public comments. EPA has directed its regional offices to begin implementation of these standards by incorporating them in permits for hazardous waste incinerators that currently are in the permitting process. In addition, New Jersey has imposed permit conditions limiting the feed rates of vanadium and nickel to a permitted hazardous waste incinerator.[1]

4.2.2 Description and Evaluation of Air Quality Modeling Methodology

This section discusses the dispersion models for both stack and fugitive emissions, the input parameters used in the modeling, an analysis of the good engineering practice (GEP) stack height, and the particle deposition calculations.

4.2.2.1 Selected Dispersion Models

Stack Emissions. To model the dispersion of the emissions from the stack of the incinerator, ENSR has employed two EPA approved models:

1. Industrial Source Complex (ISC); and
2. VALLEY

The EPA ISC dispersion model is accepted for modeling the dispersion of emissions from point sources such as an incinerator stack which are located in simple terrain (receptor elevations at or below stack height). In addition, ISC also models the dispersion of emissions from area and line sources. This model can be used to analyze dispersion of pollutants in both urban and rural

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* This metal is presently regulated under the Clean Air Act as a hazardous air pollutant.

** This metal is presently regulated under the Clean Air Act as a criteria pollutant.

environments, and short term as well as long term concentrations can be estimated. ISCST is a version of the model which is used for short term concentrations. ISCLT is another version which is used for estimating long term concentrations. In addition, the model can be used to examine concentrations at specific receptor points. For screening purposes, the program can also generate a grid of receptors.

The VALLEY model is an EPA approved model used primarily for estimating the upper limits of 24-hour average pollutant concentrations due to isolated sources in rural, complex terrain (receptor elevations are above stack height). VALLEY models the dispersion of pollutants discharged from point and area sources. Dispersion of pollutants can be modeled in rural environments only. The model can accept user-specified receptors as well as generate a grid of receptors.

Both of these models are suitable for modeling the dispersion of the pollutants from the proposed incinerator stack. These models are approved by the EPA and have been in use for over ten years. They have been updated several times to correct and improve technical features and to make the models more appropriate for specific applications. EPA considers the short term and long term versions of ISC to be suitable for application in studies such as stack design studies, combustion source permit applications, new source review, prevention of significant deterioration, etc. To date, VALLEY represents a state-of-the-art model (among the models available in the public domain) for estimating concentrations of pollutants at receptors located in complex terrain.

Fugitive Emissions. ENSR has quantified fugitive emissions of volatile organic substances (VOS) which are emitted as a result of various waste handling operations such as tank unloading, container sampling, dedrumming, leakage from valves and flanges, etc. A screening analysis of dispersion of fugitive VOS emissions from waste storage and handling operations has been performed by ICF Technology. This analysis is discussed in Section 4.2.3.

4.2.2.2 Evaluation of Model Input Parameters

Stack Emissions. To model the dispersion of emissions from the incinerator stack, basic data are required as shown below:

1. Physical stack height;
2. Stack inside diameter;
3. Exhaust flow rate;
4. Exhaust temperature; and
5. Pollutant discharge rate.

These data are determined by the design and operation of the system. In addition, data pertaining to local meteorology, specific receptor locations, and nature of land use (rural or urban), need to be provided as model inputs. EPA has established specific guidelines on determining these input parameters. ENSR has modeled the dispersion of pollutants generated during two levels of operation, one at full design load, and the other at 60% of the design load.

In this modeling study, ENSR has followed the EPA guidelines of using the meteorological data for the five most recent consecutive years available (1982 through 1986). These data consist of five one-year sequences of hourly average observations of local surface wind speed, wind direction, atmospheric stability, and regional boundary layer mixing height. These data were taken from observations at the Greater Wilmington Airport which is an ideal location since it is located only 12 kilometers away from Chambers Works. In addition, the airport is located in terrain similar to the Chambers Works area.

The EPA recommended procedure for determining the area land use was also followed in concluding that Chambers Works is located in a predominantly rural area. The urban/rural classification is important because it determines the dispersion coefficients that are employed by the model. Two procedures, based on land use or population density, may be used to determine whether an area is urban or rural. The procedure based on land use is considered more definitive, and ENSR has followed this procedure in determining that the facility is located in a rural area. The EPA guidelines suggest that the land area within three kilometers be classified into various industrial, residential, commercial, and natural use categories. If heavy industrial, moderate-light industrial, commercial, and compact residential land-use types comprise more than 50% of this area, then an urban designation should be used for dispersion modeling. Otherwise a rural designation should be used, as was determined for the incinerator facility.

In this modeling study, ground level concentrations were modeled at 1259 receptors. Concentrations were modeled at various points on a grid of receptors generated by the model program, as well as other specifically selected receptors. Of the receptors considered in the analysis, 30 locations represented sensitive receptors. These consisted of areas such as national wildlife refuges, locations where NJDEP air quality monitors are placed, schools, and hospitals. Another 36 receptors were located at the plant boundary. In addition, as requested by NJDEP, a receptor was also located at the Delaware Memorial Bridge which is located approximately 2 km southwest of the facility.

GEP Stack Height Analysis. The New Jersey Department of Environmental Protection requires that Good Engineering Practice (GEP) stack height be incorporated into the design of hazardous waste incinerators. This analysis is required to insure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies, or wakes which may be created by the source itself, nearby structures, or nearby terrain obstacles. The maximum acceptable stack height for use in modeling a particular incinerator is determined by comparing the proposed height to the height and width of all nearby structures.

EPA has defined that the GEP stack height is 65 meters in the absence of any nearby structures. If any nearby structures are present, then the GEP stack height would be the greater of:

1. 65 meters; or

2. The height determined by the equation:

$$H_{GEP} = H_B + 1.5 \min(H_B, W_B)$$

where

H_{GEP} = GEP stack height
H_B = building height
W_B = effective building width

The GEP stack height is equal to the building height plus 1.5 times the lesser of the building's height or width. A structure is defined as "nearby" if the stack is located within 5 times the lesser dimension of building height, H_B, or building width, W_B.

ENSR has carried out a detailed analysis of all the nearby structures and compared the GEP formula height, the actual stack height, and the default height of 65 meters (213 feet). The analysis indicated that the proposed incinerator stack height of 213 feet is greater than the GEP formula height of 199 feet and is equal to the default value. The proposed stack height of 213 feet is therefore acceptable.

4.2.2.3 <u>Particle Deposition Calculations</u>. ENSR estimated the emissions of particulate matter based on APCS design specifications provided by Calvert[2]. Calvert provided ENSR with an estimated size distribution of the particulate matter emitted from the incinerator stack, which ENSR used to calculate a particle deposition velocity. The deposition velocity was used in the health risk assessment to calculate the concentration of metals deposited in the soil and the subsequent ingestion exposure. For deposition calculations and their application to the health risk assessment, see Section 4.4 where they are reviewed and discussed in detail.

4.2.3 Air Quality Analysis of Criteria Pollutants*

This section discusses air quality impacts of criteria pollutant emissions primarily from a regulatory standpoint. The calculated air impacts (emission rates and/or ambient air concentrations) are compared with existing, proposed, and draft regulatory standards. The calculated ambient air concentrations

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* Particulate matter is discussed from the standpoint of the ambient air quality and existing and proposed emission standards for particulate matter. Volatile organic substances (VOS) are discussed from the standpoint of the ambient air quality standards for ozone, the status of VOS as ozone precursors, and existing and proposed emission standards for VOS. The health risks associated with specific inorganic constituents emissions are discussed in Section 4.4.

provide input data for calculation and discussion of the health effects of the various constituents in Section 4.4.1.

4.2.3.1 Emissions of Criteria Pollutants. ENSR estimated the emissions of six criteria pollutants regulated under the Clean Air Act, including sulfur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), particulate matter (PM-10), volatile organic substances (VOS) and lead (Pb), from the incinerator stack and estimated fugitive emissions of VOS from the waste storage and handling system. The stack emissions estimates were used by ENSR to conduct air dispersion modeling to estimate ambient concentrations of criteria pollutants for comparison with ambient air quality standards. ENSR also estimated emissions from the emergency vent stack and modeled the resulting ambient concentrations. Fugitive emissions of VOS from the waste handling operations associated with the incinerator were also estimated by ENSR.

The stack emission estimates, modeled concentrations, and assumptions upon which they were based have been reviewed and critically evaluated. The assumptions made by ENSR were generally found to be conservative and reasonable. In some instances additional information was requested from ENSR to support particular assumptions. Certain assumptions have been modified by ICF Technology, as discussed in this section, for the purposes of the analysis of health effects in Section 4.4.

Sulfur Dioxide (SO_2). ENSR estimated the emissions of SO_2, before application of air emission controls, to be 1000 lb/hr. Based on a nominal waste and auxiliary fuel feed rate to the incinerator of 17,500 lb/hr (140 million BTU/hr heat input), and assuming all of the sulfur present in the incinerator feed is converted to SO_2, this uncontrolled emission estimate corresponds to a total feed, including both waste and auxiliary fuel, averaging 2.8 percent sulfur. The emission rate with control has been estimated based on the performance of an equivalent SO_2 emission control system employed at another hazardous waste incinerator facility in New Jersey.

Du Pont did not identify any high sulfur-content waste streams in the characterization of Du Pont-generated waste streams in the Draft RCRA Part B Permit application. It is not expected that commercial wastes and fuels accepted by Du Pont will contain large amounts of sulfur. The assumption that the hazardous waste and auxiliary fuel fed to the incinerator will contain an average of 2.5 percent sulfur is considered to be reasonable based on the waste characterization information provided by Du Pont and the expected composition of commercial hazardous waste.

The incinerator air pollution control system (APCS) will be designed for 97 percent removal of SO_2 from the inlet gas containing 1000 lb/hr SO_2, according to design data provided to ENSR and Du Pont by Calvert. Du Pont has stated in the Draft Air Permit Application included with the Draft Part B Application that "A continuous emission monitor and appropriate operational and administrative controls will be used to limit SO_2 emissions to approximately 100 ppm corrected to 7% O_2." This exhaust concentration is equivalent to an emission rate of 30 lb/hr. The incinerator APCS is expected to be capable of achieving 97 percent removal of SO_2, based on evaluation of the design information provided by Calvert. A similar APCS installed on a permitted hazardous waste incinerator located in New Jersey is designed for 97 percent removal of SO_2. However, review of the permit conditions for this incinerator indicate that NJDEP required the scrubber to achieve an SO_2 removal efficiency of about 90 percent. The design efficiency of the Calvert scrubber exceeds NJDEP requirements for SO_2 removal.

Nitrogen Oxides (NO_x). Du Pont and Ford, Bacon, and Davis estimated the emissions of NO_x before application of air emission controls to be 426 lb/hr, based on an average of 4.5 percent nitrogen waste feed to the incinerator. The uncontrolled NOx emission rate was estimated based on the assumption that approximately 16 percent of the nitrogen present in the waste and auxiliary fuel would be converted to NO_x if no controls are applied. The amount of NO_x generated by combustion equipment is dependent on combustion conditions including temperature, gas residence time, available oxygen, the degree of turbulence or mixing in the incinerator, and on the amount of nitrogen in the waste and fuel burned (EPA data indicate that oxidation of nitrogen in the combustion air is less significant than oxidation of fuel nitrogen at combustion temperatures found in hazardous waste incinerators).

ENSR has identified several Du Pont-generated waste streams containing nitrogen compounds, including 3,4-dichloroaniline tars, meta-phenylenediamine tars, and mononitrochlorobenzene[3,4]. These wastes are all approximately 10 percent nitrogen, and represent three of the 20 largest volume Du Pont-generated waste streams. It is expected that similar commercial wastes and fuels accepted by Du Pont will contain similar amounts of nitrogen. The assumption that the hazardous waste and auxiliary fuel fed to the incinerator will contain approximately 4.5 percent nitrogen overall is considered to be reasonable based on the waste characterization information provided by Du Pont (see Section 2) and the expected composition of commercial hazardous waste.

The incinerator fuel and waste low NO_x burners will be designed to provide 60 percent reduction in NO_x emissions from the level generated by conventional burners. The incinerator APCS (Exxon $DeNO_x$ system) will be designed to provide an additional 60 percent removal of NO_x from the inlet gas, according to design data provided to ENSR and Du Pont by Exxon[5]. This represents a total reduction in NO_x emissions of 84 percent from uncontrolled levels (60% of uncontrolled emissions plus another 60% reduction of the remaining [100% minus 60%]). Du Pont has stated in the Air Permit Application that continuous emission monitoring will provide data that will be used to limit NO_x emissions to approximately 330 ppm corrected to 7% O_2 on a daily basis and to 182 ppm as an annual average. These exhaust concentrations are equivalent to emission rates of 71 lb/hr and 171 ton/yr, respectively. ENSR provided an extensive discussion of alternative NO_x control systems in the BACT discussion in the draft air permit application. The Exxon $DeNO_x$ system was selected based on its demonstrated performance in similar applications. No hazardous waste incinerator is currently equipped with an NO_x control system. The incinerator combustion system and APCS are expected to be capable of achieving 84 percent reduction of NO_x, based on evaluation of the design information and performance data provided by Exxon, Du Pont, and ENSR.

Carbon Monoxide (CO). ENSR estimated the maximum concentration of CO in the incinerator exhaust gas to be 100 ppm, corrected to 7% O_2, based on operating data from incinerators with designs similar to that proposed for Chambers Works. This CO concentration corresponds to that included in the recently released draft standards for control of emissions of products of incomplete combustion (PICs) from hazardous waste incinerators. ENSR estimated the concentration of volatile organic substances (VOS) in the incinerator exhaust gas to be 20 ppm (20 percent of the exhaust gas CO concentration), based on available data from EPA[6].

The estimated exhaust concentrations of 100 ppm CO and 20 ppm VOS are reasonable based on available data and are in accordance with the draft regulations. Du Pont has stated that waste feed interlocks will be installed that will cut off waste feed to the incinerator if the CO concentration in the stack exhaust exceeds 100 ppm (1-hour average) or 500 ppm (10-minute average). As only draft standards have been published at this time, it cannot be stated whether the averaging times cited by ENSR and Du Pont will correspond to those included in the final regulations when promulgated.

Long-term deviations of the CO exhaust concentration from the standard (and the potential associated decrease in the destruction and removal efficiency (DRE) below 99.99%) will occur only if the operator attempts to operate the incinerator with insufficient combustion air. The incinerator combustion control and monitoring system and waste feed interlocks are designed such that long-term deviations in CO concentrations are not expected to be of concern. Short-term deviations above 100 ppm, while not having a significant effect on the VOS emissions, may result in exhaust concentrations above the 100 ppm hourly average or 500 ppm short-term average.

Deviations in CO concentrations above the proposed 100 ppm long-term and 500 ppm short-term averages may be caused by short-term "CO spikes". These are short-term events (usually lasting less than a few seconds) during which a small portion of the total waste feed having an abnormally high heating value is oxidized so rapidly that there is insufficient oxygen in and around its immediate vicinity to supply the oxidation needs. The result is that this portion of the waste feed undergoes incomplete oxidation and produces products of incomplete combustion: carbon (soot), carbon monoxide, and other PICs. The other portions of the wastes being fed to the incinerator are not so affected and undergo sufficiently complete oxidation such that the incinerator meets the DRE performance standard of 99.99%. However, enough carbon monoxide may be produced by the under-oxidized waste to produce a CO spike of several hundred ppm and a 1-hour average CO concentration of greater than 100 ppm.*

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* For example, during a given hour, a 5 pound portion of a 17,500 lb/hr waste feed rate (approximately 1 second of the waste feed during the hour) can be under-oxidized so as to produce 1.0 lb of CO. At the design gas flow of 38,250 dry standard cubic feet per minute (dscfm) at 60°F, this will produce a 1-hour average CO emission of about 110 ppm (14.1 lb/hr) and thereby will exceed the proposed 100 ppm limit.

The most frequent cause of CO spikes are the small portions of high-BTU wastes sometimes found in containers of wastes being fed to the incinerator. Because these portions of wastes are located in containers, they cannot be homogenized with the other wastes being fed to the kiln, and therefore may undergo rapid oxidation when released from the container in the kiln. Less frequent causes of CO spikes are portions of aqueous or sludge waste feeds that have not been adequately mixed with the other parts of the waste feed and thus are injected as a "glob" into the kiln where they undergo the rapid oxidation described above. As the Chambers Works incinerator is expected to burn containerized, aqueous, and sludge wastes, the occurrence of CO spikes may represent a potential concern with regard to regulatory compliance. The CO concentration of the exhaust gas will be continuously monitored, and the incinerator will be equipped with interlocks that will shut down the unit if CO limits are exceeded. Changes may be required in the proposed incinerator design and/or operating procedures, depending upon the form of the final EPA regulations concerning control of emissions of CO and PICs.

Particulate Matter. ENSR provided estimates of the emissions of total particulate and metal compounds from the incinerator stack.[7] The estimated total solid particulate emission rate of 3.8 lb/hr corresponds to an exhaust gas particulate concentration of 0.015 grains/dry standard cubic foot (gr/dscf) corrected to 7 percent oxygen in the flue gas, which is 50 percent of the NJAC regulatory standard for particulate emissions from hazardous waste incinerators.

ENSR estimated particulate emissions based on the potential for residual carbon compound and metallic oxide formation as well as nonmetallic oxide formation. Based on design calculations by Ford, Bacon, and Davis, it has been estimated that a maximum of 202 lb/hr phosphorus remoxide (P_2O_5) will enter the emission control system in addition to the solid particulate.[8] For the purpose of this estimation, ENSR assumed that all of the phosphorus contained in the incinerator feed streams converts into P_2O_5. This substance exists as a gas at high temperatures and condenses to a particulate aerosol when the flue gases cool below 480 °F. This condensation occurs at a point downstream as the flue gases are about to enter the particulate control system. P_2O_5 decomposes in water to form phosphoric acid (H_3PO_4). According to the design calculations included in the Air Permit Application, the particulate emissions from the incinerator are comprised of 3.8 lb/hr solid particulate and 0.3 lb/hr P_2O_5 aerosol for a total particulate emission rate of 4.1 lb/hr. Approximately 7 percent of the total particulate emissions consist of P_2O_5.[9]

The BACT discussion for particulate emissions in Section 5 of the Air Permit Application and particulate emission and control efficiency data provided in Tables 5-12, 5-13, and 5-14 Section 5 of the Application provide data concerning particulate emissions from U.S. and foreign hazardous waste and PCB waste incinerators. Only two of the twelve rotary kiln hazardous waste incinerators for which data were provided in the Air Permit Application reported exhaust concentrations of 0.015 gr/dscf or lower. One of these was a Du Pont-operated facility, the other a PCB waste incinerator. Exhaust concentrations reported by the other rotary kilns ranged from 0.02 to 0.08 gr/dscf. The BACT discussion provides justification for assuming a particulate exhaust concentration of 0.015 gr/dscf, which is 50 percent of the New Jersey emission standard. It is difficult to justify the technical feasibility of the proposed incinerator air pollution control system achieving a particulate emission of 0.015 gr/dscf considering all of the emissions data presented in Table 5-12 for all 12 tested incinerators. Many hazardous waste incinerators have historically had difficulty meeting the Federal particulate emission standard of 0.08 gr/dscf, an emission limit much higher than the NJAC standard and that proposed by Du Pont. Further, many of the incinerators for which test data are presented burn liquid or other low ash content wastes, and may therefore have lower particulate loadings to their air pollution control systems than would be expected for the proposed Du Pont incinerator. However, data provided by ENSR in Tables 5-13 and 5-14 of the BACT discussion indicate that the Calvert collision scrubber proposed for the Du Pont incinerator air pollution control system should illustrate significantly better performance than most of the incinerators for which test data are available.

ENSR presents in Table 5-14 of the BACT discussion particulate emissions data for a rotary PCB waste incinerator equipped with a Calvert collision scrubber similar to that proposed for the Du Pont incinerator. The scrubber operated at an average pressure drop of 51.7 inches of water during the tests. Particulate emissions from this incinerator averaged 0.0137 gr/dscf corrected to 7 percent oxygen in the flue gas over 15 tests.

PCB waste incinerators generally burn wastes with a lower solids content and higher chlorine content than hazardous waste incinerators, and would ostensibly be expected to have a lower particulate loading than a hazardous waste incinerator. However, data from an EPA study presented in Table 5-13 of the BACT discussion indicates that there is no clear correlation between the ash content of waste incinerated and the particulate loading of the flue gas. Further, the removal efficiency of wet scrubbers is directly related to the pressure drop at which the scrubber is operated. The Calvert scrubber proposed for the Du Pont incinerator will operate at a pressure drop of 70 inches of water, approximately 20 inches of water higher than the scrubber tested. This should offset any increase in the particulate loading to the scrubber and enable operation within the proposed emission limit of 0.015 gr/dscf.

In order to be conservative in assessing the health risks from the incinerator metal emissions (discussed in Section 4.4) and in assessing the compliance with the proposed regulations on metal emissions from hazardous waste incinerators, ICF Technology has assumed that the total particulate concentration of the incinerator exhaust will meet 50 percent of the NJAC emission limit of 0.03 gr/dscf (0.015 gr/dscf approximately 4 lb/hr). Metal emissions from the incinerator stack are based on a total particulate emission rate of 4 lb/hr.

Volatile Organic Substances (VOS). Emissions of VOS from the Chambers Works incinerator will result from both the incinerator stack and the waste storage and handling system. ENSR estimated the concentration of volatile organic substances (VOS) in the incinerator exhaust gas to be 20 ppm (20 percent of the exhaust gas CO concentration), based on available data from EPA.[10] This concentration corresponds to that included in the proposed regulations concerning organic products of incomplete combustion (PICs), and is equivalent to a VOS emission rate of 1.5 lb/hr and 6.6 ton/yr.

ENSR also estimated fugitive VOS emissions from the waste storage and handling system to be about 4.0 ton/yr, based on fugitive emission factors developed by Du Pont. See Appendix E for analysis of the fugitive VOS emissions estimate. The estimate of fugitive emissions is conservative. ENSR assumed that all the valves and flanges in the waste storage and handling system, the principal sources of the fugitive emissions, are exposed to waste containing volatile organic substances 8760 hr/yr. This assumption does not account for incinerator shutdown periods or for the handling of non-volatile and aqueous wastes.

Lead (Pb). Lead is a criteria air pollutant and will also be regulated as a hazardous metal under the proposed metal emissions standards for hazardous waste incinerators. ENSR estimated lead emissions from the incinerator based on the composition of particulate emissions from operating hazardous waste incinerators. ENSR assumed the concentration of lead in the particulate emitted from the incinerator stack to be 50,000 ppm. This value is 20 percent higher than the average concentration of lead reported in particulate emitted from eight tested hazardous waste incinerators, and is considered to be conservative.

As previously discussed, ENSR based the lead emission rate on a total particulate emission concentration of 0.015 gr/dscf (4 lb/hr). This particulate emission rate is justified in the BACT discussion provided by ENSR in the Air Permit Application. In order to be conservative in assessment of compliance with the ambient air quality standards for lead, ICF Technology has assumed that the total particulate concentration of the incinerator exhaust will meet 50 percent of the NJAC emission limit of 0.03 gr/dscf (approximately 4 lb/hr). Lead emissions are based on a total particulate emission rate of 4 lb/hr, corresponding to a lead emission rate of 0.175 lb/hr or 0.75 tons per year.

ENSR modeled the ambient concentration of lead resulting from incinerator stack emissions of 0.175 lb/hr, and determined the maximum concentration to be 0.0174 micrograms/cubic meter (ug/m^3), approximately 10 percent of the significant impact level of 0.1 ug/m^3. It is therefore concluded that lead emissions from the incinerator will not result in a violation of the ambient air quality standard for lead.

4.2.3.2 Modeling Results. The dispersion of the criteria pollutants from the incinerator stack was modeled by ENSR to determine short term and long term impacts. The air quality assessment prepared by ENSR demonstrates that SO_2, NO_x, CO, lead, and particulate (PM-10) emissions resulting from operation of the incinerator will have a negligible impact on local air quality. Exhibits 4-2 and 4-3 show the emissions, exhaust concentrations, and maximum ambient concentration of each criteria pollutant, with the exception of ozone, modeled by ENSR, and the applicable existing, proposed, and draft State and Federal Ambient Air Quality Standards for each pollutant.

EXHIBIT 4-2

STACK EMISSIONS AND EXHAUST CONCENTRATIONS
OF CRITERIA POLLUTANTS
FROM THE DU PONT HAZARDOUS WASTE INCINERATOR

POLLUTANT	EMISSION RATE (lbs/hr)	EXHAUST CONCENTRATION
Particulates (PM^{-10})[a]	4.0	0.015 gr/dscf at 7% O_2
Sulfur dioxide (SO_2)	30.0	100 ppm at 7% O_2
Nitrogen oxides (NO_x)		
Hourly Maximum	71.2	330 ppm at 7% O_2
Annual average	39.2	182 ppm at 7% O_2
Carbon monoxide (CO)	13.1	100 ppm at 7% O_2
Volatile Organic Substances	1.5	20 ppm at 7% O_2
Lead (Pb)	0.175	---

[a] Based on studies conducted by the scrubber manufacturer, ENSR assumed that particulate emissions consist entirely of PM-10 material.

EXHIBIT 4-3

MAXIMUM MODELED AMBIENT AIR CONCENTRATIONS OF CRITERIA POLLUTANTS RESULTING FROM PROPOSED INCINERATION STACK EMISSIONS[a] AND COMPARISON WITH STATE AND FEDERAL AIR QUALITY STANDARDS

POLLUTANT	AVERAGING PERIOD	AMBIENT STANDARD ($\mu g/m^3$) (primary)	(secondary)	MAXIMUM IMPACT (ug/m3)
SO2	Annual	80	60	0.32
	24-Hour	365	260	3.0
	3-Hour	None	1300	14.4
NO2	Annual	100	100	0.415
	1-Hour	475[b]	--	55.44
CO	1-Hour	40,000	40,000	10.2
	8-Hour	10,000	10,000	3.4
TSP[c]	Geo. Mean	75	60	0.042
	24-Hour	260	150	0.398
PM-10	Arith. Mean	50	50	0.042
	24-Hour	150	150	0.378
Pb[d]	3-Month	1.5	1.5	0.0174
	24-hour	1.5	1.5	0.0174

[a] Maximum impacts based on ambient air quality modeling conducted by ENSR.

[b] May be proposed as NJAAQ Standard in the future.

[c] TSP and PM-10 modeled concentrations are based on an assumed particulate emission rate of 4.0 lb/hr including P205 emissions.

[d] ENSR modeled the maximum 24-hour concentration for lead, and used that concentration as an estimate of the maximum 3-month average. This is a conservative estimate, as the maximum 3-month average will always be less than or equal to the maximum 24-hour average.

Stack and fugitive VOS emissions from the Du Pont incinerator and waste storage and handling system were estimated by ENSR and totaled approximately 10.6 tons per year. The effect of VOS emissions from sources of this small size on ambient ozone concentrations is not generally estimated for the purposes of air permit applications, as the effects are generally negligible, and ENSR did not conduct such modeling. For the purposes of this assessment, ICF Technology conducted a screening analysis to estimate the effect of the stack and fugitive VOS emissions on ambient ozone levels. The estimated incremental increase in ozone concentrations resulting from the emissions was negligible as expected.

4.2.3.3 Comparison with Ambient Air Quality Standards. As discussed in Section 4.2.2, the proposed incinerator and waste storage and handling systems are subject to State and Federal ambient air quality standards for criteria pollutants. These standards are specifically applicable for five of the criteria pollutants, SO_2, PM-10, NO_x, lead and CO as shown in Exhibit 4-1. Comparison of the modeled maximum impacts of the criteria pollutants (SO_2, PM-10, NO_x, lead and CO) with the NAAQS/NJAAQS indicates that the impacts due to emissions of these pollutants from incinerator operations are well within the primary and secondary ambient air quality standards.

ICF Technology performed a screening analysis to estimate the ozone increment due to the VOS and the nitrogen oxides (NO_x) emitted from the incinerator.[11] The increment, measured as maximum hourly concentrations, was found to be much less than 0.011 ppm. The value, 0.011 ppm, is the lower calculation limit (similar to an analytical lower detection limit) using the EPA screening tables to determine the ozone increment. Calculations are presented in Appendix F. The fugitive VOS emissions, using the revised estimates, were also included in this analysis. The assumption that the fugitive emissions can be modeled as part of the plume from the incinerator is very conservative[12] since the incinerator plume travels a longer distance. This is because the plume is emitted at a very high altitude and its dispersion is governed by its momentum, in addition to the atmospheric stability conditions. The fugitive emissions emitted at low altitudes disperse rapidly and in reality do not impact as large an area as that affected by the incinerator stack plume.

This screening technique was developed to "be both robust and simple to use, while maintaining several inherent assumptions that lead to conservative (high ozone) ozone increment predictions" (as per Mr. Richard D. Scheffe, US EPA). If the ozone increment predicted from this analysis is within acceptable limits, then no further analysis is recommended.

The primary and secondary ambient air quality standards for ozone (NJAC 7:27-13.6) are:

> <u>Primary Standard:</u> During any 12 consecutive months, daily maximum one-hour average concentrations of ozone in ambient air may exceed 0.12 ppm no more than once.
>
> <u>Secondary Standard:</u> During any 12 consecutive months, one-hour average concentrations of ozone in ambient air may exceed 0.08 ppm no more than once.

The ozone increment (maximum hourly concentration) due to the VOS and NO_x has been estimated to be well below 0.011 ppm. The estimation technique does not indicate how much lower the estimated concentration is than 0.011 ppm. Therefore it can be assumed that the ozone increment is equal to 0.011 ppm. This assumption builds in additional conservatism. Even under this conservative assumption, the ozone increment due to the proposed operation is well within the New Jersey primary and secondary standards.

In addition, secondary air quality standards exist for SO_2 and particulate matter. The specific secondary standards for SO_2, and particulates are given within parentheses in Exhibit 4-1. A comparison of the maximum modeled concentrations of SO_2 and particulate matter with secondary standards for these pollutants indicates that their levels are well within the secondary standards. The emissions will have a negligible effect on ambient air quality in the vicinity of Chambers Works.

4.2.3.4 <u>Comparison with Air Pollutant Emission and Control Technology Standards</u>. The New Jersey Regulations on Hazardous Waste Incinerators limit the emissions of particulate matter from hazardous waste incinerators to no more than 0.03 gr/dscf corrected to 7% O_2 in the exhaust gas, equivalent to particulate emissions of approximately 8 lb/hr for the proposed incinerator. The air impacts calculated by ENSR for the proposed incinerator and included in the Air Permit Application are based on particulate emissions of 4 lb/hr, 50 percent of the NJAC standard. Du Pont is required to apply BACT for particulate emissions under the PSD regulations. Du Pont proposed in the Permit Application that an exhaust concentration of 0.015 gr/dscf particulate be considered BACT.[13] The proposed APCS is expected to meet State requirements for BACT and is expected to be capable of achieving emissions of 0.015 gr/dscf.

A destruction and removal efficiency (DRE) of 99.99% for Principle Organic Hazardous Constituents (POHCs) fed to the incinerator is required by both EPA and NJDEP and a minimum gas residence time of 2.5 seconds. The air impacts calculated by ENSR for the proposed incinerator and included in the Air Permit Application are based on a DRE of 99.99% and residence time. It is expected that the Chambers Works incinerator will be capable of meeting the DRE requirements, based on the design and proposed method of operation of the unit.

Du Pont is required under the PSD regulations to apply BACT to the incinerator to control emissions of NO_x. Du Pont proposed the application of the Exxon thermal DeNOx process and use of specially designed "LONOx" burners for high nitrogen-content wastes. It is expected that the proposed control system with a design efficiency of 84 percent will meet State requirements for BACT for NO_x emissions.

Du Pont is also required to apply BACT to the incinerator to control emissions of SO_2. Du Pont proposed the application of the Calvert collision scrubber. It is expected that the proposed control system with a design efficiency of 97 percent will meet State requirements for BACT for SO_2 emissions.

The Chambers Works incinerator can be expected to meet the proposed emission standard for CO of 100 ppm based on the incinerator design, as previously discussed. However, as only draft standards have been published, it is not known whether the averaging times and waste feed interlocks cited by Du Pont and ENSR in the Air Permit Application will ensure compliance with the proposed standard.

4.2.4 Air Quality Analysis of Metals and Other Inorganic Compounds

Metal compounds and other inorganic compounds for which there are no ambient air quality standards are emitted from the incinerator stack. Selection of air contaminants for discussion was based on existing and proposed emission standards, other regulations, and the health effects of the constituents.

EPA is developing standards for emissions of certain metals from hazardous waste incinerators; metals proposed to be regulated under the draft standards are antimony, arsenic, barium, beryllium*, cadmium, chromium, lead**, mercury*, silver, and thallium. In addition, New Jersey has imposed permit conditions limiting the feed rates of vanadium and nickel to a permitted hazardous waste incinerator,[14] and these metals are also discussed. Of the metals discussed, arsenic, beryllium, cadmium, nickel, and chromium are suspected carcinogens with potential chronic health effects.*** The remaining metals have potential acute health effects at high concentrations. The health effects of metal emissions from the incinerator are discussed in Section 4.4.

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* This metal is presently regulated under the Clean Air Act as a hazardous air pollutant.

** This metal is presently regulated under the Clean Air Act as a criteria pollutant.

*** EPA declined to regulate nickel emissions when promulgating standards for industrial boilers and furnaces burning hazardous waste, stating that the most carcinogenic forms of nickel (i.e., nickel subsulfide) are not expected to be emitted from combustion sources. Nickel emissions from the incinerator are nonetheless considered in this analysis, as the State considers these emissions to be of potential concern.

New Jersey regulations limit the concentration of hydrogen halides (hydrogen fluoride, hydrogen chloride, and hydrogen bromide) in the exhaust gas from hazardous waste incinerators to less than 50 ppm, corrected to 7 percent O_2. Hydrogen fluoride (HF) is regulated under the PSD regulations, and an emission increase of 3 or more tons per year of HF is considered a "significant" increase subject to control technology requirements.

ENSR also identified phosphorus pentoxide and sulfuric acid mist (SO_3) as constituents emitted from the incinerator stack. Emissions of sulfuric acid mist are regulated under the PSD regulations, and an emission increase of 7 or more tons per year of SO_3 is considered a "significant" increase subject to control technology requirements. Phosphorus pentoxide is not specifically regulated under either the Clean Air Act or RCRA. However, Du Pont identified several waste streams containing phosphorus, and as previously discussed, the APCS design calculations showed P_2O_5 to represent approximately 7 percent of the total particulate emissions.

Both P_2O_5 and SO_3, as acid aerosols, can cause acute toxic effects at high concentrations, as can hydrogen halides. Hydrogen halides, particularly HF, are also significant for their potential to affect vegetation. Ecological and health effects of acid aerosol and acid gas emissions are discussed in Sections 4.3 and 4.4.

4.2.4.1 Emissions of Metals and Other Inorganic Compounds

Metals. In order to be conservative in assessment of the health risks from metal emissions from the incinerator, and in assessment of compliance with the proposed regulations on metal emissions from hazardous waste incinerators, ICF Technology has assumed that the particulate concentration of the incinerator exhaust will meet 50 percent of the NJAC emission limit of 0.03 gr/dscf (approximately 4 lb/hr), and that these emissions will be entirely solid particulate.

Emissions of specific metals from the Chambers Works incinerator were calculated by ENSR using data on concentrations of metals in the particulate emissions from operating hazardous waste incinerators, and the assumed total particulate emission rate of the Chambers Works incinerator. This approach is reasonable given the limited data on metal concentrations in the waste feeds. ENSR's calculations were retained and used in this analysis. The estimated concentration of arsenic in the particulate emissions from the incinerator was adjusted based on review of the emissions data used by ENSR and review of other emissions data for incinerators.[15] The calculated emissions of metals and modeled ambient air concentrations are summarized in Exhibit 4-4.

Hydrogen Halides. ENSR estimated the emissions of HCl before application of air emission controls to be 3600 lb/hr and emissions of HF to be 263 lb/hr. The uncontrolled HCl and HF emission rates were estimated based on the assumption that all of the chlorine and fluorine present in the incinerator feed is converted to HCl or HF. The uncontrolled hydrogen halide emission estimates correspond to the total feed to the incinerator containing 20.5 percent chlorine

EXHIBIT 4-4

SUMMARY OF EMISSIONS AND MODELED INCREMENTAL CONCENTRATIONS OF PARTICULATE METALS FROM THE DU PONT HAZARDOUS WASTE INCINERATOR STACK BASED ON MODELING CONDUCTED BY ENSR

POLLUTANT	EMISSION RATE (lb/hr)	CONCENTRATION IN PARTICULATE (ppm)	MAXIMUM INCREMENT ($\mu g/m^3$) ANNUAL AVERAGE	24-Hr AVERAGE
Antimony	0.020	5000	2.12E-4	1.99E-3
Arsenic	0.004	1000	4.23E-5	3.98E-4
Barium	0.020	5000	2.12E-4	1.99E-3
Beryllium	0.00008	20	4.25E-7	4.0E-6
Cadmium	0.02	5000	2.12E-4	1.99E-3
Chromium (Cr^{+3})	0.0096	2400	1.01E-4	9.50E-4
Chromium (Cr^{+6})	0.0024	600	2.54E-5	2.39E-4
Lead	0.175	50,000	3.70E-3	3.48E-3
Manganese	0.012	3000	[1.27E-4] [a]	[1.12E-3]
Mercury	0.020	5000	2.12E-4	1.99E-3
Nickel	0.012	3000	1.27E-4	1.19E-3
Selenium	0.012	3000	1.27E-4	1.19E-3
Silver	0.012	3000	1.27E-4	1.19E-3
Thallium	0.008	2000	8.25E-5	7.95E-4
Tin	0.14	35,000	2.96E-4	2.79E-3
Vanadium	0.024	6000	2.54E-4	2.39E-3
Zinc	0.14	35,000	2.96E-4	2.79E-3
Total Particulate	4.0		0.042	0.398
Total PM-10 [b]	4.0		0.042	0.398

[a] No data are available for the concentration of manganese in incinerator particulate emissions. The concentration of manganese is assumed to be the same as the concentration of chromium.

[b] Calvert, the scrubber designer, indicated that the particulate emissions are entirely PM-10. A total particulate emission rate of 4 lb/hr was used for the purposes of this assessment.

and 1.4 percent fluorine, based on a total incinerator feed rate of 17,500 lb/hr. The emission rate with control has been estimated based on a control efficiency of 99.2 percent for HF and 99.9 percent for HCl. The calculated emission rates for HCl and HF after application of controls are 15.8 tons per year and 9.2 tons per year, respectively.

ENSR has identified several Du Pont-generated waste streams containing chlorinated organic compounds, including 3,4-dichloroaniline tars, methylene chloride, terphthaloyl chloride tars, isophthaloyl tars, and mononitrochlorobenzene[16,17]. These compounds range from 22.5 percent to 83.6 percent chlorine, and represent six of the 20 largest volume Du Pont-generated waste streams. It is expected that commercial wastes accepted by Du Pont will contain similar amounts of chlorine. The assumption that the hazardous waste fed to the incinerator will contain approximately 20.5 percent chlorine is considered to be reasonable based on the waste characterization information provided by Du Pont and the expected composition of commercial hazardous waste. It is expected that, in the absence of specific permit limitations, the waste feed to the incinerator could contain more than 20.5 percent chlorine over the short term, but is not expected to average more than 20.5 percent chlorine on an annual basis.

None of the 20 largest volume Du Pont-generated waste streams identified by ENSR contain fluorinated organic compounds. Du Pont is a manufacturer of chlorofluorocarbons, and is expected to incinerate some fluorine-containing waste in the proposed incinerator. ENSR has stated in the Air Permit Application that "the waste feed [to the incinerator] will contain less than 250 lb/hr [1.4 percent] of fluorine which will produce 263 lb/hr of HF before control."[18] This statement may be interpreted by state regulatory officials as a proposed permit limitation, effectively limiting the amount of fluorine that may be fed to the incinerator. It is expected that the waste feed to the incinerator could otherwise contain more than 1.4 percent fluorine over the short term, but is not expected to average more than 1.4 percent fluorine on an annual basis.

The incinerator APCS will be designed for 99.9 percent removal of HCl and 99.2 percent removal of HF from the inlet gas containing 3600 lb/hr of HCl and 263 lb/hr of HF, according to design data provided to ENSR and Du Pont by Calvert. Emissions data for hazardous waste incinerators reported in the Air Permit Application indicate that several incinerators achieved greater than 99 percent removal of HCl. A similar APCS installed on a permitted hazardous waste incinerator located in New Jersey is designed to meet total hydrogen halide emissions of 50 ppm, 99 percent removal of HCl, and 99 percent removal of HF. The APCS proposed for the Chambers Works includes several modifications to this system, including addition of a saturator and operation at a higher scrubber pressure drop. Both these modifications are expected to increase the removal efficiency for HCl and HF.

Sulfuric Acid. ENSR estimated the emissions of SO_2, before application of air emission controls, to be 1000 lb/hr and assumed that the emissions of SO_3 were 3.5 percent of the SO_2 emissions, based on data from an operating hazardous waste incinerator in New Jersey. The emission rate with control has been estimated based on an equivalent SO_2 emission control system employed at another hazardous waste incinerator in New Jersey and assumes that the control efficiency for SO_2 is equal to that for SO_3. Sulfuric acid mist emissions are calculated by ENSR to be 4.6 tons per year. This emission rate is less than the significant emission increase under the PSD regulations. There are therefore no specific control system requirements for SO_3 emissions applicable to the proposed incinerator.

Phosphorus Pentoxide. ENSR estimated particulate emissions based on the potential for residual carbon compound and metallic oxide formation as well as nonmetallic oxide formation. As previously discussed, Du Pont and Ford, Bacon, and Davis estimated that approximately 7 percent of the total particulate emissions consist of condensed phosphorus pentoxide (P_2O_5), assuming all of the phosphorus contained in the incinerator feed streams converts into P_2O_5. The particulate emissions from the incinerator are comprised of 0.3 lb/hr P_2O_5 aerosol. The P_2O_5 emission rate of 0.3 lb/hr corresponds to an exhaust concentration of about 0.001 gr/dscf. There are no specific emission limits or control system requirements for P_2O_5 emissions.

4.2.4.2 Modeling Results. The dispersion of the non-criteria pollutants from the incinerator stack was modeled by ENSR to determine short-term and long-term impacts. The air quality assessment prepared by ENSR demonstrates that emissions of particulate metals and acid gases resulting from operation of the incinerator will have a negligible impact on local air quality. Exhibit 4-4 shows the maximum ambient concentration of each particulate metal modeled by ENSR. Exhibit 4-5 shows the modeled concentrations of other inorganic compounds.

4.2.4.3 Comparison with Draft Metal Emission Standards. EPA proposed the draft metal emission standards for hazardous waste incinerators in August 1988, and expects to promulgate them at a later date after receiving public comments. Based on information contained in the EPA Draft Guidance Document entitled Draft Guidance on Metals and Hydrogen Chloride Controls for Hazardous Waste Incinerators, June 9, 1988, an applicant can calculate metals feed rate limits for its facility based on Tier I generic air dispersion modeling parameters and risk- and health-based factors developed by EPA and contained in the Guidance Document, or, as an alternative to the limits calculated through Tier I, perform a site-specific Tier III analysis.[19] EPA recommends in the Guidance Document that in cases where the facility stack is greater than 20 meters in height and the facility is less than 5 kilometers from a body of water, site specific Tier III analysis be used in lieu of the generic Tier I calculations. This is the case for the proposed Chambers Works incinerator[20].

In anticipation of the expected inclusion of metal emission standards in the Chambers Works incinerator operating permit, ICF Technology has prepared a Tier III analysis for the incinerator, based on the risk- and health-based methodology contained in the EPA Draft Guidance Document, the assumed particulate emission rate of 4 lb/hr (0.015 gr/dscf), and the maximum modeled ambient concentrations of the metals. The modeled concentrations of metals were compared with the EPA Draft Standards for metal emissions from hazardous waste incinerators. None of the modeled concentrations exceeded the draft standards.

EXHIBIT 4-5

MAXIMUM MODELED AMBIENT AIR CONCENTRATIONS OF NON-CRITERIA POLLUTANTS BASED ON MODELING CONDUCTED BY ENSR

POLLUTANT	STACK EMISSION RATE	AVERAGING PERIOD	MAXIMUM IMPACT (ug/m3)
HCl	3.60 lb/hr	24-hour	0.356
	15.8 ton/yr	Annual	0.038
HF	2.10 lb/hr	24-hour	0.208
	9.2 ton/yr	Annual	0.023
SO3	1.05 lb/hr	24-hour	0.104
	4.6 ton/yr	Annual	0.011
P2O5	0.3 lb/hr	24-hour	0.079
	1.3 ton/yr	Annual	0.003

The EPA Draft Standards include a Table entitled "Air Pollution Control Devices (APCDs) and Their Conservatively Estimated Efficiencies for Controlling Toxic Metals."[21] Included in this Table are the control efficiencies of "proprietary wet scrubber designs", including that offered by the Calvert Environmental Equipment Co. EPA intends that these conservative values be used in the calculation of metal emissions from incinerators as part of the Tier III calculations, rather than design values. The conservative control efficiency for metals such as arsenic, beryllium, chromium, and cadmium included in the Table is 95 percent, which is substantially less than the design efficiency of 99.6 percent for total particulate provided by Calvert.

Assuming that the concentrations of metals in the particulate emissions from the incinerator are those estimated by ENSR, Du Pont could not demonstrate compliance with the Draft Standards for metal emissions using the Tier III calculation methodology if the conservative control efficiencies provided by EPA were used in the Tier III calculations. The actual control efficiency of the Calvert pollution control system for metals is expected to be significantly greater than 95 percent; therefore, it is expected that Du Pont would be able to demonstrate compliance with the Draft Standards for Metal Emissions through stack testing during the incinerator trial burn.

4.2.4.4 Comparison With Other Emission Standards. Du Pont has stated in the Air Permit Application included with the RCRA Part B Application that "Emissions of HCl, HF, and total hydrogen halides will be continuously monitored. Stack gas concentrations will be limited to 42 ppm HCl, 12 ppm HF, and 50 ppm total hydrogen halides corrected to 7 percent O_2." This is in accordance with New Jersey regulations.

The calculated HF emission rate is greater than the significant emission increase under the PSD regulations. Du Pont is therefore required to apply BACT for HF emissions. Du Pont proposed the application of the Calvert collision scrubber. It is expected that the proposed control system will meet State requirements for BACT for HF emissions, as a similar system installed on a hazardous waste incinerator has been permitted.[22]

Sulfuric acid mist emissions are calculated to be 4.6 tons per year. This emission rate is less than the significant emission increase under the PSD regulations. There are therefore no specific control system requirements for SO_3 emissions applicable to the proposed incinerator.

4.2.4.5 Comparison with Operating Hazardous Waste Incinerators. ICF Technology obtained emissions estimates and permit conditions for an operating hazardous waste incinerator located in New Jersey. These are summarized in Exhibit 4-6 for the purposes of comparison with the emissions estimates and other information contained in the Air Permit Application and RCRA Part B Application for the proposed Du Pont incinerator. As previously discussed, the control efficiencies for both metals and HCl for the operating New Jersey incinerator are significantly lower than those estimated by ENSR, Du Pont, and the designers of the Chambers Works incinerator APCS.

EXHIBIT 4-6

SUMMARY OF STACK EMISSIONS, ALLOWABLE FEED RATES, AND UNCONTROLLED EMISSIONS OF REGULATED POLLUTANTS FROM A RCRA PERMITTED HAZARDOUS WASTE INCINERATOR LOCATED IN NEW JERSEY

POLLUTANT	STACK EMISSION RATE (lb/hr)	ALLOWABLE FEED RATE (lb/hr)[a]	ASSUMED CONTROL EFFICIENCY
Arsenic	0.024	0.50	0.952
Beryllium	0.00092	0.019	0.952
Cadmium	0.038	0.79	0.952
Chromium	0.045	0.94	0.952
Lead	0.26	5.40	0.952
Mercury	0.18	0.18	0.00
Nickel	0.04	0.84	0.952
Heavy Metals[b]	3.73	287.36	0.987
NO_x	75	150[c]	0.50
Total Organics	1.5	15,000	0.9999

Controlled Emission Pollutant	Uncontrolled Emission Rate (ppmv)	Assumed Control Rate (lb/hr)	Efficiency
SO_2	310 (12% CO_2)	675 (as S)	0.78
HCl	50 (7% O_2)	1750	0.99

[a] Assuming 20 percent of all metals except mercury is retained in the incinerator wet slag.

[b] Includes arsenic, antimony, barium, cadmium, chromium, lead, mercury, nickel, selenium, silver, thallium, and vanadium.

[c] Uncontrolled emission rate in lb/hr.

There are several significant differences between the proposed APCS for the Du Pont incinerator and that installed on the operating incinerator. In particular, the increased pressure drop at which the Du Pont scrubber will be operated is expected to increase the control efficiencies for metals and HCl above those for the operating incinerator. However, as previously discussed, design information cannot be used to predict with absolute certainty that the APCS will meet control efficiency and emission limitations in practice. Du Pont will be required under Federal and State regulations to demonstrate by conducting a trial burn that the emissions of metals and HCl meet regulatory requirements. If the emissions limitations cannot be achieved during the trial burn, Du Pont will be required to modify equipment or operating procedures to meet the conditions and requirements of their permit.

4.2.5 Air Quality Analysis of Volatile and Non-Volatile Organic Compounds

There are no Federal or State standards for emissions of specific volatile organic substances (VOS) or non-volatile organic substances (NVOS) from hazardous waste incinerators. Emissions of VOS and NVOS are regulated by the requirement that organic constituents of wastes fed to the incinerator be destroyed in the incinerator of removed from the incinerator exhaust stream to an efficiency of 99.99 percent or greater. In general, the DRE of an incinerator is determined during the trial burn tests by selecting several Principal Organic Hazardous Constituents (POHCs) of the waste feed, and determining the ratio of each POHC in the waste feed to that in the incinerator exhaust by sampling and analysis.

POHCs are selected based on their expected concentration in the wastes to be fed to the incinerator and based on their difficulty to incinerate. It is generally assumed by regulatory officials that if the incinerator meets the DRE requirement for the selected POHCs, it will meet the requirement for other organic substances that are less difficult to incinerate or present at lower concentrations than the POHCs.

Du Pont has stated that the incinerator will meet the minimum DRE of 99.99 percent, and ENSR has based their calculation of emissions of specific organic compounds on 99.99 percent DRE. The DRE for a hazardous waste incinerator is a function of the primary and secondary combustion chamber temperatures, gas residence time, amount of excess oxygen, and amount of mixing in the combustion chamber. According to design information provided by Du Pont, the incinerator is designed to maintain temperatures greater than 2000°F exiting the afterburner chamber, at a design gas residence time in the afterburner chamber of greater than 2.5 seconds.[23,24] These design values exceed the minimum 1800°F temperature and 2.0 second residence time required by Federal and State hazardous waste incinerator regulations.

Du Pont has prepared a trial burn plan for the incinerator in accordance with State and Federal regulations, and has stated in the Draft RCRA Part B Application that the incinerator will be operated within the limits demonstrated during the trial burn that meet a DRE of 99.99 percent, as required by State and Federal regulations.[25] Waste feed interlocks will be installed to cut off automatically the waste feed to the incinerator if the temperature of the afterburner exhaust gas falls below 2000°F (1-hour average), the oxygen concentration falls below 3.0 percent, or the flow rate exceeds 51,700 actual cubic feet per minute (acfm).* It is expected based on the design information and operating procedures described in the Draft RCRA Part B Application, that the proposed incinerator will be capable of meeting 99.99 percent DRE if constructed and operated to design specifications.

4.2.5.1 Emissions of Volatile and Non-Volatile Organic Substances. ENSR estimated the emissions of approximately 100 organic substances from the incinerator stack and modeled the ambient air concentration of each compound to conduct a health risk assessment of the incinerator emissions. ENSR estimated the emissions of each organic compound, with the exception of those not contained in the waste feed to the incinerator, by assuming the concentration of each organic constituent in the waste feed to the incinerator, and assuming that each constituent is destroyed to 99.99 percent efficiency in the incinerator. This calculation methodology is reasonable for compounds that are expected only to be Principle Organic Hazardous Compounds (POHCs), but may underestimate the emissions of compounds that are both POHCs and Products of Incomplete Combustion (PICs).

ICF Technology has not recalculated the emissions of all the organic compounds selected by ENSR for analysis as ENSR performed calculations for approximately 100 compounds. Instead, eight VOS and three classes of NVOS were selected for inclusion in the health risk assessment in Section 4.4, based on their suspected carcinogenicity and estimated level of emissions. The compounds selected and their estimated emissions are listed in Exhibit 4-7. The rationale for selection of these compounds from a toxicity standpoint is discussed in Section 4.4. The rationale for estimation of emissions of each compound is discussed below.

Benzene. Benzene emissions from the incinerator stack were estimated by ENSR based on an assumed maximum long term concentration of benzene in the waste feed of 10,000 ppm (1 percent). ENSR has stated in the Draft Air Permit Application that Du Pont expects to accept wastes that contain more than 10 percent benzene. It is not expected that such wastes will represent more than 10 percent of the total waste feed to the incinerator, therefore the waste concentration made by ENSR is considered reasonable. However, ENSR has identified several Du Pont-generated waste streams containing potential benzene precursors (organic compounds that when incompletely combusted may produce benzene). These compounds include 1,4-dichlorobenzene and mononitrochlorobenzene. As the ENSR estimate of 1 percent benzene in the waste feed is expected to overestimate the actual amount of benzene in the waste, the estimate has not been adjusted to account for the presence of benzene precursors.

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* The exhaust gas flow rate is inversely proportional to the gas residence time.

EXHIBIT 4-7

STACK EMISSIONS AND MODELED AMBIENT CONCENTRATIONS OF ORGANIC COMPOUNDS FROM THE DU PONT HAZARDOUS WASTE INCINERATOR BASED ON MODELING CONDUCTED BY ENSR

CONSTITUENT	MAXIMUM AMBIENT CONCENTRATION	BASIS FOR CALCULATION	COMMENTS
Benzene	1.8 E-4* ug/m3	Assumed 10,000 ppm benzene in waste [ENSR] (2.5 E-3 g/s emissions)	ENSR assumed 50,000 ppm 1,4-dichloro-benzene in waste
Chloroform	9.0 E-4 ug/m3	Assumed 612.5 ug/m3 stack gas concentration equivalent to 50,000 ppm chloroform in waste [Trenholm, 1985][a] (1.25 E-2 g/s emissions)	Precursors include TCE (50,000 ppm) PCE (50,000 ppm)
Napthalene	7.2 E-5 ug/m3	Assumed 50 ug/m3 stack gas concentration, equivalent to 4000 ppm napthalene in waste [Trenholm, 1985]	ENSR did not assume any napthalene in waste
Methylene Chloride	1.8 E-4 ug/m3	Assumed 10,000 ppm methylene chloride in waste [ENSR] (2.5 E-3 g/s emissions)	ENSR assumed 50,000 ppm 1,4-dichloro-benzene in waste

[a]Trenholm, A., and D. Oberacher, 1985. Summary of Testing Program at Hazardous Waste Incinerators, In: Proceedings of the Eleventh Annual Research Symposium. Cincinnati, OH US Environmental Protection Agency Publication no. EPA/600/9-85/028, September 1985.

*E-4 is scientific notation for 10^{-4}

EXHIBIT 4-7

STACK EMISSIONS AND MODELED AMBIENT CONCENTRATIONS OF ORGANIC COMPOUNDS FROM THE DU PONT HAZARDOUS WASTE INCINERATOR BASED ON MODELING CONDUCTED BY ENSR
(continued)

CONSTITUENT	MAXIMUM AMBIENT CONCENTRATION	BASIS FOR CALCULATION	COMMENTS
1,4-Dichloro-benzene	9.0 E-4 ug/m3	Assumed 50,000 ppm dichloro benzene in waste [ENSR] (1.25 E-2 g/s emissions)	
Formaldehyde	1.8 E-5 ug/m3	Assumed 1000 ppm formaldehyde in waste [ENSR] (2.5 E-3 g/s emissions)	Not identified as PIC by Trenholm
Polychlorin-ated Biphenyls (PCBs)	9.0 E-7 ug/m3	Assumed 50 ppm PCBs in waste [regulatory limit] (1.25 E-5 g/s emissions)	ENSR assumed max. emission rate
PCDD/PCDF	2.4 E-9 ug/m3	Based on PCB incin-erator emissions data [MRI, 1986][b] (3.3 E-8 g/s emissions)	Emissions expected to be lower

[b]MRI, 1986. Trial Burn Test Report: Pyrochem, Coffeyville, Kansas. Midwest Research Institute, Kansas, MO., December 17, 1986.

1,4-Dichlorobenzene. Emissions of 1,4-dichlorobenzene from the incinerator stack were estimated by ENSR based on an assumed maximum concentration of 1,4-dichlorobenzene in the waste feed of 50,000 ppm (5 percent), based on waste characterization data provided by Du Pont. This estimate is considered to be conservative. 1,4-dichlorobenzene was identified as a PIC in only one of eight incinerator tests reported in a recent survey of incinerator emissions by Trenholm.[26] The ENSR estimate was therefore not adjusted to account for the presence of precursors.

Chloroform. Chloroform emissions from the incinerator stack were estimated by ENSR based on an assumed maximum concentration of chloroform in the waste feed of 1000 ppm (0.1 percent). Although significant amounts of chloroform may not be expected in the waste feed, ENSR has identified several chlorinated organic compounds in the waste feed that are potential chloroform precursors, including trichloroethylene and perchloroethylene. ENSR assumed that the concentration of each of these compounds in the waste is 5 percent. Also, ENSR cites data indicating that chloroform has been identified as a PIC in several incinerator emissions tests. The concentration of chloroform in the exhaust gas of five incinerators tested ranged from 1 to 1350 ug/m3 (chloroform was not detected in the other incinerators tested). The exhaust concentration of chloroform corresponding to a waste feed concentration of 0.1% is approximately 12 ug/m3, which is less than the average concentration for the five tested incinerators. The waste concentration estimated by ENSR has therefore been adjusted by ICF to 50,000 ppm (5 percent), corresponding to a concentration of chloroform in the exhaust gas of 612.5 ug/m3, approximately 50 percent of the highest concentration reported by Trenholm.[27]

Naphthalene. ENSR did not estimate the emissions of naphthalene from the incinerator stack. Naphthalene is a suspected carcinogen and was identified as a PIC in three incinerator emissions tests reported by Trenholm. Based on the data reported by Trenholm, ICF Technology has assumed a concentration of 50 ug/m3 naphthalene in the incinerator stack gas, equivalent to 4000 ppm naphthalene in the waste feed to the incinerator.

Methylene Chloride. Methylene chloride wastes were identified by ENSR as one of the 10 largest volume Du Pont-generated wastes. ENSR estimated the emissions of methylene chloride from the incinerator stack based on an assumed concentration of methylene chloride in the waste feed of 10,000 ppm (1 percent). ENSR has identified several Du Pont-generated waste streams containing potential methylene chloride precursors, including trichloroethylene, trichloroethane, and other chlorinated organic compounds. However, the exhaust concentration of methylene chloride that corresponds to the waste feed concentration of 10,000 ppm assumed by ENSR is 120 ug/m3, approximately a factor of 4 higher than the highest exhaust concentration reported by Trenholm. The ENSR estimate was therefore not adjusted to account for the presence of precursors.

Carbon Tetrachloride. Emissions of carbon tetrachloride from the incinerator stack were estimated by ENSR based on an assumed maximum concentration of carbon tetrachloride in the waste feed of 1000 ppm (0.1 percent), based on waste characterization data provided by Du Pont. ENSR has not identified any Du Pont-generated wastes containing carbon tetrachloride and commercial wastes are also not expected to contain high carbon tetrachloride concentrations. Carbon tetrachloride was not identified as a PIC in the incinerator tests reported by Trenholm, and is not expected to be produced in the combustion process. The ENSR estimate was therefore not adjusted.

Formaldehyde. Emissions of formaldehyde from the incinerator stack were estimated by ENSR based on an assumed maximum concentration of formaldehyde in the waste feed of 1000 ppm (0.1 percent), based on waste characterization data provided by Du Pont. ENSR has not identified any Du Pont-generated wastes containing formaldehyde, and commercial wastes are also not expected to contain high formaldehyde concentrations. Although it may be expected that precursors of formaldehyde would be present in commercial waste, the compound was not identified as a PIC in the incinerator tests reported by Trenholm. This may be because formaldehyde is water-soluble and not easily detected by routine sampling methods, or because formaldehyde precursors were not present. The ENSR estimate was not adjusted to account for the presence of formaldehyde precursors.

Polychlorinated Biphenyls (PCBs). Du Pont has stated in the Draft RCRA Part B Application that the proposed incinerator will not accept PCB wastes. The regulatory definition of a "PCB waste" is any waste having a concentration PCB compounds of 50 ppm or greater. Wastes containing less than 50 ppm PCB compounds is considered a "non-PCB waste" under State and Federal regulations. Therefore, although Du Pont will not accept regulatory defined PCB wastes, wastes containing less than 50 ppm PCB compounds may be accepted and incinerated by the proposed incinerator. ENSR has conservatively assumed that the waste feed to the incinerator will contain precisely 50 ppm of PCB compounds. This assumption has not been adjusted, as Du Pont can not accept wastes containing more than 50 ppm PCB compounds and remain within Federal and State regulations.

Chlorinated Dioxins and Furans (PCDDs/PCDFs). Du Pont has stated in the Draft RCRA Part B Application that the proposed incinerator will not accept wastes containing chlorinated dioxins and furans. However, chlorinated dioxins and furans (PCDDs/PCDFs) can be created from incomplete combustion of chlorinated compounds, including PCBs, in hazardous waste incinerators. Emissions of PCDDs/PCDFs are of much greater concern from municipal waste incinerators, and the major portion of emissions data available for these compounds is from municipal waste combustion sources. ENSR cited dioxin and furan emissions data for a PCB incinerator designed by Ford, Bacon, and Davis, the design firm for the proposed Chambers Works incinerator.[28] In calculating the emissions of PCDFs/PCDDs, ENSR multiplied the exhaust concentration measured for the PCB incinerator (as 2,3,7,8-TCDD) by a factor of 5, yielding an estimated PCDD/PCDF concentration of 5 nanograms per dry standard cubic feet (ng/dscf) for the proposed incinerator. Comparison of the concentration used by ENSR with data for municipal waste incinerators shows similar PCDD/PCDF concentrations.

It is expected that emissions of PCDDs/PCDFs from PCB and municipal waste incinerators will be greater than that from the proposed Chambers Works incinerator. The incinerator afterburner will provide an additional level of emission control not present in typical municipal waste incinerators, and the incinerator waste feed is expected to contain a lower concentration of PCDD/

PCDF precursors than a PCB incinerator. The PCDD/PCDF emission rate calculated by ENSR has therefore not been adjusted.

Polynuclear Aromatic Hydrocarbons (PAHs) Polynuclear aromatic hydrocarbons (PAHs) are discussed in the health risk assessment in Section 4.4. Emissions of these compounds were estimated by ENSR and included in their health risk assessment in the Air Permit Application. PAHs were not detected in any of the incinerator tests reported by Trenholm, nor were they found in tests of an operating hazardous waste incinerator in New Jersey. Emissions of these compounds are generally associated with solid and liquid fossil fuel combustion. The emissions estimates used by ENSR for the risk assessment were based on emissions data for a coal-fired power plant. These data were not considered appropriate for inclusion in this assessment, as the emissions from coal combustion would not be subject to the temperature, excess oxygen and mixing conditions present in a hazardous waste incinerator.

ICF Technology obtained information from the general literature concerning PAH emissions from resource recovery facilities, combustion sources that are more representative of hazardous waste incinerators than are coal-fired steam boilers. The concentration of PAH in the exhausts of four municipal waste combustion facilities were obtained, and a mean emission factor, in units of grams PAH per ton of waste feed, was calculated. As the exhaust concentrations and emission factors varied by several orders of magnitude between the four resource recovery facilities, a geometric mean, rather than an arithmetic average, was used. Data for the four facilities are summarized in Exhibit 4-8. Based on the geometric mean emission factor of 0.0768 grams PAH/ton waste feed and total average waste feed rate of 17,500 lb/hr, the estimated PAH emissions from the proposed hazardous waste incinerator are 1.87×10^{-4} grams/second. This corresponds to an annual emission rate of 13 pounds total PAH, and an estimated average ambient concentration of 1.98×10^{-6} μg/m3.

4.2.5.2 Modeling Results. The dispersion of the volatile and non-volatile organic compounds from the incinerator stack was modeled by ENSR to determine short-term and long-term impacts for the purposes of health risk assessment. There are no State or Federal ambient air quality standards for these compounds. Exhibit 4-7 shows the maximum annual average ambient concentrations of each organic compound modeled by ENSR, and also those added to the analysis by ICF Technology for the purposes of the health risk assessment. Comparison of the modeled concentrations with acute and chronic health effects criteria are included in Section 4.4.

4.2.6 Hazardous Waste Landfill Operations

ENSR did not evaluate the potential for fugitive dust emissions from the proposed landfill operation,[29,30] as ENSR did not consider the potential for fugitive dust emissions from the landfill operation to be significant because the materials disposed of in the landfill are handled wet (35 percent to 40 percent moisture), and monitoring data from the existing landfill and years of operating experience by du Pont indicate no problems with fugitive emissions.

EXHIBIT 4-8

OPERATING AND PAH EMISSIONS DATA FOR RESOURCE RECOVERY FACILITIES

FACILITY NAME	PAH EXHAUST CONCENTRATION (ng/Nm^3)	WASTE FEED RATE (ton/day)	STACK GAS FLOW RATE (m^3/min)	PAH EMISSION FACTOR (grams/ton)
Braintree[a]	1.1 E+04	240	592	3.91 E-02
Pittsfield[b]	1.44 E+02	242	431	3.69 E-04
[unknown][c]	5.83 E+06	125	360	2.42 E+01
[unknown][d]	1.52 E+04	50	228	9.98 E-02
	Geometric Mean Emission Factor			7.68 E-02

a Midwest Research Institute (MRI), "Environmental Assessment of a Waste-to-Energy Process: Braintree Municipal Incinerator," prepared for Industrial Environment Research Laboratory, Cincinnati, Ohio, August 1980.

b Midwest Research Institute (MRI), "Results of the Combustion and Emissions Research Project at the Vicon Incinerator Facility in Pittsfield, Massachusetts." Final Report, Vol. I, prepared for New York State Energy Research and Development Authority, Energy Authority Report 87-16. June 1987.

c Batelle, "Characterization of Stack Emissions from Municipal Refuse-to-Energy Systems," prepared for Environmental Protection Agency, Research Triangle Park, NC, EPA/600/3-86/055, October 1986.

d Ibid.

The documentation supporting this assumption is contained in the RCRA Part B and Air Permit Applications, and ENSR has concluded that fugitive emissions are not of concern. ICF performed a qualitative assessment of fugitive emissions from landfill operations, which is included in this section, to further verify the conclusion.

4.2.6.1 <u>Regulatory Analysis</u>. There are no specific particulate or volatile organic substances (VOS) emission limits applicable to hazardous waste landfills. Section 264.301(i) of RCRA requires operators of hazardous waste landfills to cover or otherwise manage the landfill to control wind dispersal of any particulate matter. All particulate emission sources are required to comply with State and Federal ambient air quality standards for total particulate material (PM) and inhalable particulate (PM-10).

Section 264.314 prohibits, with certain exceptions, the disposal of hazardous or non-hazardous free or containerized liquids in hazardous waste landfills. 40 CFR Part 268 of RCRA, referred to as the land disposal restrictions, prohibit the disposal of specific regulated organic compounds in landfills unless treated before disposal.

4.2.6.2 <u>Characteristics of Wastes to be Disposed in Landfill</u>. Du Pont has identified four types of waste that will be disposed in the proposed landfill expansion. These are wastewater treatment plant (WWTP) primary sludge, ash from the proposed hazardous waste incinerator, asbestos waste generated by Du Pont facilities, and spill residues and bulky wastes generated by Du Pont facilities. Waste characterization data are included in the RCRA Part B Permit Application.[31]

<u>Volatile Organic Substances (VOS)</u>. According to waste characterization data provided by Du Pont, the incinerator ash, WWTP primary sludge, and asbestos wastes to be disposed in the proposed landfill will contain insignificant amounts of VOS. Spill residues generated at Chambers Works and other Du Pont facilities are expected to contain VOS. Du Pont has stated that only spill residues that cannot practicably be incinerated will be disposed in the landfill, and that no ignitable (D001) wastes will be disposed in the landfill.[32,*] This will preclude the land disposal of some wastes containing significant amounts of organic material. Du Pont will be further prohibited from disposing wastes containing free liquids and specific regulated organic substances under the RCRA landfill regulations and land disposal restrictions. This will further preclude Du Pont from disposing wastes containing VOS in the landfill.

Despite the numerous regulatory and internal restrictions imposed on the proposed hazardous waste landfill, Du Pont expects that some wastes containing

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[*] Note that D001 is listed as an acceptable waste code in Table 1-5, page II-1-52 of Volume II of the Draft Part B Application, but is specifically excluded in Table 1-6, page II-1-54 of Volume II. It is assumed that NJDEP will consider the specific exclusions contained in Table 1-6 to be permit conditions precluding acceptance of these wastes.

volatile organic compounds will be disposed in the landfill.[33] Volatile organic substances listed in the RCRA Part B Application as potential constituents of wastes disposed of in the landfill include benzene, chloroform, acetonitrile, acrylonitrile, dichlorobenzene, vinyl chloride, 1,1,1-trichloroethane, and trichloroethylene. Du Pont expects to dispose of approximately 8,000 tons per year of bulky hazardous waste in the landfill, representing approximately 16 percent, on a dry basis, of the total waste disposed in the landfill.

Fugitive VOS emissions from land disposal facilities can be evaluated if the amounts of specific volatile organic compounds disposed in the landfill can be estimated. Fugitive VOS emissions from the proposed Chambers Works landfill expansion cannot be accurately estimated, given the expected variable nature of spill residues generated at industrial facilities and lack of waste characterization data. It is expected that disposal of VOS in the proposed landfill will be extremely limited, based both on information provided by Du Pont and considering existing regulatory restrictions. Spill residues containing more than 1000 PPM of VOCs will be incinerated rather than landfilled, and other landfill wastes contain insignificant amounts of VOCs. Emissions of volatile organic substances from the proposed landfill expansion are therefore not expected to be of concern.

Fugitive Dust. All the waste types identified by Du Pont for disposal in the landfill are solid or sludge wastes that are potential sources of fugitive dust emissions if the materials are allowed to become dry and remain unconfined. On-site inspection of the existing Chambers Works landfill indicates that the WWTP sludge is approximately the consistency of coarse dirt when dry. The physical characteristics of the bottom ash and slag from the proposed incinerator are not known, but it is expected that this material will be coarse particles. These materials, although coarse, may be dispersable if they are allowed to dry and weather.

Waste characterization data for spill residues and bulky wastes generated by Du Pont facilities have not been presented by Du Pont, as the expected composition of the wastes is variable. Spill residues generated by Du Pont facilities are expected to include contaminated soil and other particulate solid materials that may be dispersed by wind when dry. Asbestos wastes generated by Du Pont facilities is required to be handled and disposed of in plastic bags, and is handled wet. The asbestos material, although wetted and bagged, may be dispersable if exposed and allowed to dry.

4.2.6.3 Air Quality Analysis

This section discusses air quality impacts primarily from a regulatory standpoint, and compares the calculated air impacts (emission rates and/or ambient air concentrations) with existing, proposed, and draft regulatory standards.

Fugitive Dust. Fugitive dust emissions from landfill operations are generally difficult to predict, as they are dependent on the characteristics and volumes of wastes disposed in the landfill, wind direction and rainfall, and heavily dependent on landfill operating procedures and dust control measures. For these reasons, ICF Technology has not conducted a quantitative analysis of fugitive dust emissions from the landfill. Further, based on fugitive dust monitoring data from the existing landfill operations, no fugitive dust problem is anticipated.

Du Pont has conducted environmental sampling at their existing hazardous waste landfill for the determination of ambient concentrations of particulate material. This sampling efforts were conducted specifically for the purposes of worker exposure assessment, and both personnel monitoring samples and area samples were collected at various locations at the landfill. The samples were collected during daytime working hours only, as the landfill is not operated at night and no workers would be exposed to dust during those hours.

For the purposes of evaluating the potential for off-site transport of fugitive dust during landfill operations, consideration of the area rather than personnel sampling data is appropriate. Area particulate concentrations ranged from 0.04 to 8.93 mg/m3 for data collected in 1985, and from 0.09 to 9.41 mg/m3 for data collected in 1988. Both area and personnel monitoring results were compared by Du Pont to the OSHA "nuisance dust" 8-hour TWA of 10 mg/m3 for the purposes of evaluation of worker exposure.

Dust concentrations measured on-site are not directly comparable with ambient air quality standards for particulate material. The 24-hour average primary ambient air quality standard for particulate material is 260 ug/m3 (0.26 mg/m3). Concentrations of fugitive dust were measured over an 8-hour period during operation of the landfill, not over a 24-hour period. The 24-hour average ambient concentration will be less than the measured 8-hour average, due to the variation in wind direction over the 24-hour period, and because the landfill is not operated during nighttime hours, and therefore generates less dust. Also, ambient air quality standards are only applicable in locations outside the site boundary where members of the public could be exposed. The amount of dispersion expected to take place between the point of dust generation and off-site locations must be accounted for in comparing the measured concentrations with air quality standards.

The ambient concentrations of particulate material in off-site locations will depend on the distance from the landfill to the location, wind speed and wind direction. The site of the proposed landfill is approximately one mile from site boundary. It is expected that the concentration of fugitive dust generated from the landfill will decrease by approximately a factor of 10 over this distance. No violations of ambient air quality standards for particulate material are expected to occur as a result of landfill operations.

<u>Volatile Organic Substances</u>. Screening analysis of estimated fugitive VOS emissions from the proposed incinerator waste storage and handling system (approximately 4.0 tons per year), indicates that the maximum short-term ambient air concentration of VOS at the site boundary may be approximately 5 ug/m3,

assuming Class F (most stable) meteorological conditions*. The estimated ambient VOS concentration at average meteorological conditions (Class C) is 0.5 mg/m3. If a similar amount of VOS were to be disposed of in the expanded landfill (an extremely conservative estimate), the ambient offsite VOS concentrations estimated through screening analysis of the landfill emissions are expected to be similar to that estimated for the incinerator. The offsite exposures associated with VOS emissions from the incinerator are expected to be similar to or less than those resulting from landfill operations.

4.2.6.4 Fugitive Dust Emission Control and Mitigation Procedures. According to Du Pont, both the incinerator ash and WWTP sludge contain 35 to 45 percent moisture as generated, and remain wet during transport to and disposal in the landfill. According to process information provided by Du Pont, both the WWTP sludge and incinerator ash are generated by water-based processes, and it is expected that these materials will remain wet during transport. However, dry weather conditions could cause the materials to become dry after disposal in the landfill, and Du Pont has indicated that water sprays will be used as required to prevent disposed materials from becoming dry.[34,35] Du Pont will use a truck washing station to decontaminate waste transport trucks prior to their leaving the landfill site. This will prevent waste and other landfill materials from being dispersed on-site.

Asbestos waste will be handled and disposed in sealed plastic bags in accordance with National Emission Standards for Hazardous Air Pollutants (NESHAP) regulations. Compliance with these regulations by Du Pont will prevent the dispersal of asbestos from the landfill. Du Pont has indicated that spill residues and bulky wastes will be watered as required during transportation and disposal to prevent dust generation. Dust control procedures implemented by Du Pont are expected to minimize effectively the generation and dispersal of fugitive dust from landfill operations.

4.2.7 Hazardous Waste Landfill Construction

Air emissions from short-term operations such as construction activities are generally outside the scope of air permit applications, and assessment of such emissions is not generally required by State regulatory authorities. Therefore, ENSR did not include an assessment of the air impacts of construction of the proposed hazardous waste landfill in the Draft Air Permit Application and Part B Application.[36] Air emissions from construction operations are appropriate for inclusion in an EHIS, however, and are discussed in this section.

Detailed information concerning fugitive dust emissions from landfill construction activities or proposed mitigation procedures to be used during the construction are not available. Landfill construction generally involves

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* As previously discussed, the screening analysis procedures were developed to provide an extremely conservative estimate of short-term ambient concentrations.

operation of heavy earth-moving equipment. Du Pont has stated that all materials used in constructing the landfill will either be native materials excavated on-site or tested materials transported from off-site locations.[37]

The use of materials excavated on-site in construction of the landfill will minimize the need for transport of materials from off-site locations and associated generation of fugitive dust. Compaction of the landfill liner foundation will be by loading of foundation materials, and no heavy equipment will be used for compaction. This will serve to minimize dust generation from the foundation construction.

Excavation, on-site transportation, storage of construction materials, and construction of berms and other landfill structures have the potential for fugitive dust generation if adequate dust control measures are not implemented. It is expected that use of water sprays, a proposed dust control measure for landfill operations, will be compatible with engineering requirements for all phases of landfill construction.

The potential for off-site transport of fugitive dust generated from landfill construction activities is expected to be the same as for dust generated from landfill operations. As previously discussed, the proposed landfill site is approximately one mile from the Chambers Works site boundary. The ambient concentration of dust at off-site locations will therefore be less than that which would occur on-site. Fugitive dust generated from landfill construction activities is not expected to result in any violations of ambient air quality standards, assuming that fugitive dust control measures are implemented during the construction activities.

4.3 ECOLOGY

This section assesses the potential impacts on terrestrial and aquatic organisms associated with the construction and operation of the proposed landfill and incinerator. The plant and animal life on and in the vicinity of the Du Pont Chambers property have been described previously in Section 3.4. The potential environmental impacts of the landfill are discussed separately from the incinerator because these units are different in their location, design and operation.

4.3.1 Landfill

Potential impacts on aquatic and terrestrial systems associated with landfill construction and operation are expected to be limited to habitat loss. No chemical-related impacts are expected to occur because the design features of the proposed landfill (e.g., double liner, leak detection system, leachate collection system, run-off and run-on controls, ground-water monitoring system, and ground-water interceptor system) are considered adequate to prevent migration of chemicals from the landfill to adjacent aquatic systems. Periodic flooding of the Delaware River is not expected to affect the landfill because the dike surrounding the landfill will have a minimum height that is above the 100-year flood level.

Approximately 0.25 acres or less of wetland aquatic habitat will be lost as a result of filling during construction of the landfill. The wetlands to be filled have been classified by the New Jersey Bureau of Wetlands as being of moderate value. Therefore, some loss of moderately valuable aquatic habitat will occur as a result of landfill construction. However, the impacts are somewhat limited by the relatively small size and isolated nature of the wetlands to be filled. (In general, the value of wetlands is greater for larger wetlands and for wetlands that are connected to other wetland systems.)

Stormwater runoff from the landfill area to adjacent wetlands and rainfall from the area to upper aquifer will be reduced by the landfill system. The system is designed to collect all rainfall onto the landfill and to convey it to the Chambers Works WWTP. However, the flow diverted from the wetlands and the upper aquifer will be insignificant, and no associated adverse impacts to wetlands are anticipated. The landfill area that contributes flow to wetlands and recharge is very small relative to the total area contributing runoff to wetlands and recharge (refer to Exhibit 3-50). The Delaware River and its local tributaries also contribute much more significantly to ground-water recharge in the area and the water requirements of the area's wetlands.

Approximately 40 acres of terrestrial wildlife habitat will be lost as a result of construction of the landfill, the truck waste station, and associated roads. However, the value of the terrestrial habitat potentially lost is low. The proposed landfill site is the former site of a nitrocellulose factory and in many places there are old road beds and foundation remains which are of little or no value to wildlife, given the absence of food resources and cover. The remaining areas that are vegetated are relatively disturbed and have limited plant diversity, which in turn limits the species that can be supported in these areas.

4.3.2 Incinerator

Both habitat loss and chemical-related impacts may occur as a result of construction and operation of the proposed incinerator. Construction of the incinerator and associated structures (e.g., truck farm, storage area, roads) will result in the loss of approximately 15 acres of terrestrial wildlife habitat (see Section 2.6). However, similar to the landfill site, the proposed site for the incinerator is already disturbed (e.g., old road remains, limited plant diversity are present) and is of limited value for wildlife.

Given the limited habitat value of the proposed incinerator site, the most important environmental impacts associated with the proposed incinerator are chemical-related effects on aquatic and terrestrial systems near the incinerator that are of potentially higher habitat value. Chemical-related effects could occur in these areas following the atmospheric release and subsequent deposition of chemicals in aquatic and terrestrial environments. (Because of the safety design features of the incinerator, the potential for chemical releases from spills and other operational incidents during incinerator operation is low.) The results of the air dispersion and deposition modeling conducted by ENSR (see Section 4-2) are used in this section to estimate potential chemical-related impacts associated with incinerator operation.

Based on the results of the deposition modeling, the maximum deposition of contaminants occurs approximately 1 mile (1.6 kilometers) southeast of the incinerator as shown in Exhibit 4-9. This area is a mixture of wetlands and some developed and residential areas. The characteristics of the wetlands in this area are likely similar to those described for the Bouttown Creek wetlands located on the Chambers works property, and likely provide good wildlife habitat (see Section 3.4). Potential chemical impacts in this area are evaluated to provide a worst case evaluation of potential effects, since exposures in this area are the maximum exposures that could occur. Deposition in on-site areas would be approximately half of the deposition rate at the maximum deposition point. Sites further from the maximum deposition point would also have proportionately lower deposition rates [see Exhibit 4-9].

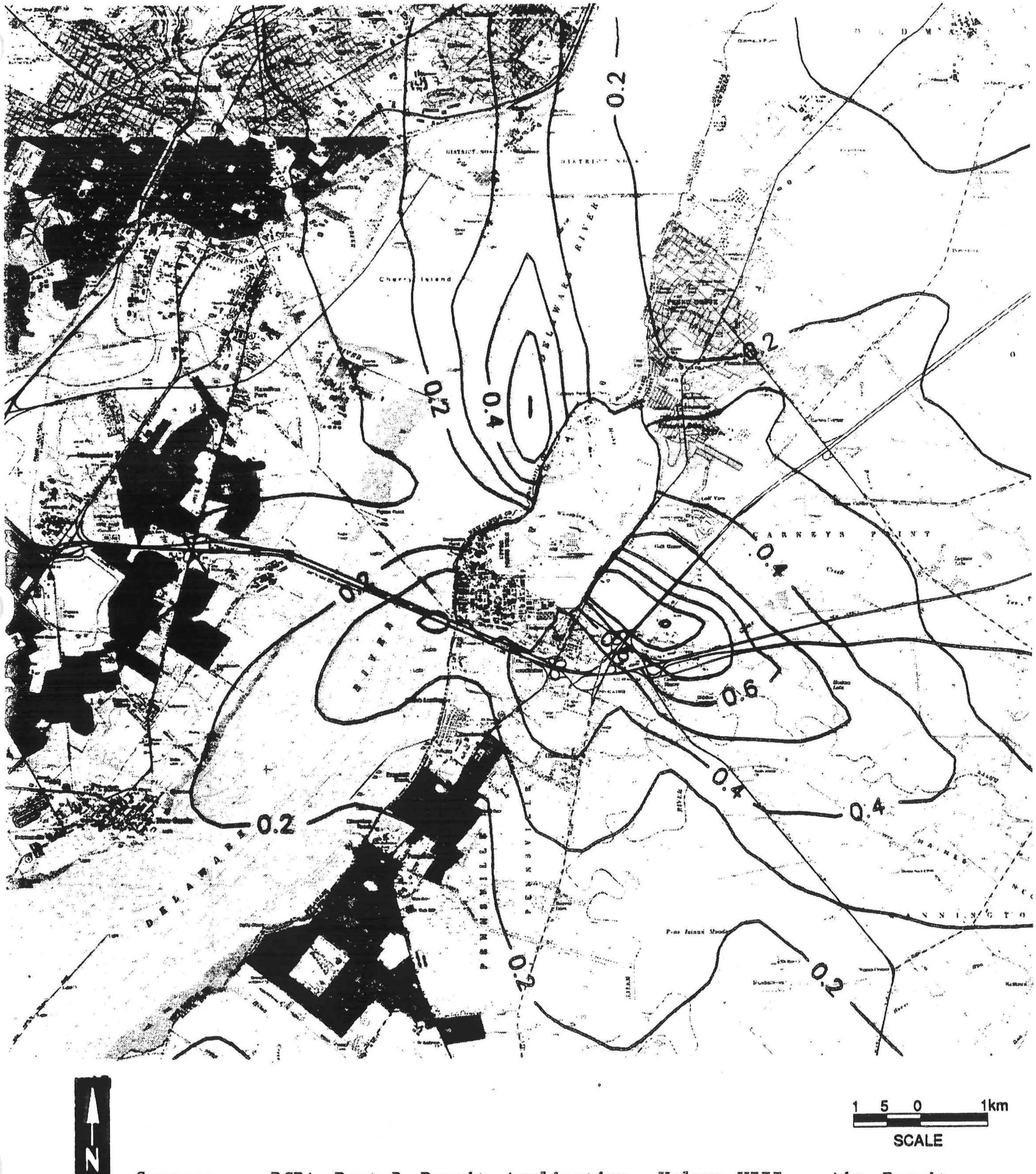
The chemicals selected for further evaluation are those with the highest potential for adverse effects in aquatic and terrestrial systems based on toxicity, bioconcentration potential, and estimated environmental concentrations. These are the following: arsenic, beryllium, cadmium, chromium, nickel, polychlorinated biphenyls (PCBs), and polychlorinated dibenzo-p-dioxins (PCDDs). The toxicity of these chemicals to aquatic and terrestrial organisms is briefly summarized, and the potential environmental impacts are evaluated below.

4.3.2.1 Aquatic and Terrestrial Toxicity of Major Contaminants Released by the Incinerator. This section briefly summarizes the toxicity of the selected chemicals to aquatic and terrestrial wildlife. Ambient water quality criteria established by the U.S. Environmental Protection Agency[38] for the protection of aquatic life and lowest-observed-effect levels (LOELs) are reported for aquatic organisms as a measure of toxicity, and bioconcentration factors (BCFs) in fish are reported as a measure of the bioaccumulation potential of these chemicals in aquatic systems. For terrestrial species, LOELs are reported as a measure of toxicity.

PCBs. In general the toxicity of PCBs to aquatic organisms increases as the degree of chlorination decreases[39]. In fish, PCBs have caused death, behavioral abnormalities, increased locomotor activity, decreased success in capturing food, neurochemical alterations, disrupted osmoregulation, reproductive effects, and liver and thyroid effects. EPA[40] has established 4-day and 1-hour concentration criteria for PCBs in freshwater of 0.014 and 2.0 ug/liter not to be exceeded more than once every 3 years. These criteria are protective of fish but were designed specifically to protect mink that eat fish from PCB-contaminated waters. Salt-water acute and chronic criteria with values of 10 ug/L and 0.03 ug/L, respectively, are less stringent than freshwater criteria[41]. Bioconcentration factors in freshwater fish (whole-body) of 60,000 to 270,000 have been reported by EPA.[42]

EXHIBIT 4-9

SPATIAL DISTRIBUTION OF MAXIMUM ANNUAL AVERAGE CONCENTRATIONS FROM PROPOSED INCINERATOR STACK EMISSIONS



Source: RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989. Section 7.

PCBs can cause death and a variety of sublethal effects in birds via dietary exposures. Sublethal effects following chronic exposures include enzyme induction, porphyria, altered vitamin A metabolism, alteration of the thyroid, and cardiac, behavioral, and hormonal effects. Oral LD_{50}s for Aroclor 1260 reported by Eisler[43] range from 747 ppm-diet for bobwhite to 2186 for Japanese quail. There is significant variability in the sensitivity of birds to the reproductive effects of PCBs. Chickens appear to be the most sensitive species to the reproductive effect of PCBs, with effects noted at dietary levels of 8 to 10 ppm.

Mammals are apparently more sensitive than birds with respect to the acute toxicity of PCBs. The acute oral LD_{50} for Aroclor 1260 in rats is 1.3-10.0 mg/kg[44]. In general, acute toxicity decreases with an increase in the degree of chlorination. The acute LD_{50}s for mink for Aroclors 1221, 1242, and 1254 are 1000, 3000, and 4000 mg/kg, respectively[45].

Mink are particularly susceptible to the reproductive effects of PCBs. Mink fed approximately 0.2 mg/day PCBs in the form of residues in Great Lake carp failed to reproduce[46], and mink fed contaminated beef from cows fed Aroclor 1254 developed reproductive complications at residue levels as low as 0.64 ppm[47]. Cattle showed severe reproductive effects at 0.64 ppm PCBs in the diet[48]. Using a dietary conversion factor for cattle of 0.015 mg/kg per ppm in food[49] the dose is approximately 0.010 mg/kg. The maximum tolerable level for mink is less than 0.0015 mg/kg based on reproductive effects and Eisler[50] suggests that the recommended level for mink may be less than 0.001 mg/kg.

PCBs are not very toxic to terrestrial plants, probably because of their strong sorption to soils. Soil concentrations of 10 mg/kg (dry weight) have shown a reduction in growth in soybean plants[51]. However, other researchers have shown conflicting results. Fries and Marrow[52] observed no significant effects on soybean growth at 2 to 3 mg/kg PCBs.

PCDDs/PCDFs. Ambient water quality criteria have not been established by USEPA[53]. The acute LOEL is 0.01 ug/L and the chronic LOEL is 0.00001 ug/L.[54] Bioconcentration factors in freshwater fish of 2000 to 86,000 have been reported.[55,56,57,58]

PCDDs pose potential hazards to terrestrial wildlife because they accumulate in the food chain and are toxic at low levels. Top predators are particularly susceptible to dioxin because of potentially high dioxin levels in their prey.

Dioxin exposure in birds has been most prominently linked with "chick edema" disease, which is characterized by increased pericardial fluid, interstitial edema of the myocardium, and pulmonary edema. Levels as low as 1 to 10 ug/kg of 2,3,7,8-TCDD were sufficient to cause this response in chicks exposed for 21 days by oral intubation.[59] This corresponds to a dose of 0.125 to 1.25 ug/kg-body weight (using a conversion factor in Lehman 1954).[60]

Very little information is available on the toxicity of 2,3,7,8-TCDD in wild species. Gilbertson reported symptoms characteristic of chick edema disease in herring gulls in the Great Lakes area.[61] Although no cause and effect relationship could be established, a decrease in edema symptoms in herring gulls from 1971 to 1981 was accompanied by a decrease in 2,3,7,8-TCDD in eggs. In another study in the Great Lakes area, reproductive failure of Foster's terns was associated with significant differences in the egg concentrations of 2,3,7,8-TCDD as well as other contaminants that have similar mechanisms of toxicity.[62] Quantitative dose-response data in wild species are limited to LD_{50} values. LD_{50} values calculated 37 days after a single oral dose of 2,3,7,8-TCDD varied from 15 ug/kg in northern Bobwhite quail to more than 810 ug/kg in ringed turtle doves.[63]

Limited information is available on the toxicity of 2,3,7,8-TCDD to wild mammals. Histopathological effects have been reported in rabbits and horses poisoned by 2,3,7,8-TCDD but dose-response information is not available.[64] Hochstein et al. reported a single-dose, 28-day LD_{50} of 4.2 ug/kg-body weight for mink.[65] In a 128-day study with mink, a dietary LC_{50} of 0.85 ppb was reported.[66] In laboratory animals, rats chronically exposed to daily doses equivalent to 0.12 to 0.29 ppb 2,3,7,8-TCDD in the diet had decreased litter sizes, increased number of stillborns, and reduced survival and growth of young in both the F_1 and F_2 generations. No reproductive effects were observed in rats exposed daily to 2,3,7,8-TCDD in amounts equivalent to 0.012 to 0.03 ppb in the diet. A LOEL of 0.0004 ug/kg-diet has been reported for Rhesus monkeys exposed for 8 months.[67] At the lowest observed effect level bone marrow and axial lymph nodes were adversely affected.

No information regarding toxicity of PCDDs/PCDFs to plants was available.

Arsenic. Arsenic is toxic to aquatic animal species, and induces its toxic effects via enzyme inhibition. In aquatic species, arsenic has induced death following acute exposures and has caused death and deformity following chronic exposures. USEPA has established, for aquatic species, a continuous concentration criterion of 190 ug/l and a 1-hour average concentration criterion of 360 ug/l for trivalent arsenic.[68] The chronic LOEL for pentavalent arsenic is 48 ug/L.[69] A BCF of 4 and a biologic half-life of one day was derived for bluegills.[70]

In laboratory species, arsenic has been found to be carcinogenic, teratogenic, embryotoxic, and fetotoxic. Quantitative data on the toxicity of arsenic to terrestrial wildlife species are limited. Median oral lethal doses (LD_{50}) for rabbits and hares have been reported in the range of 10.5 to 40.4 mg/kg body weight.[71] Lethal oral doses for sodium arsenite for most domestic mammals are between 1 to 25 mg/kg-body weight, and 3 to 10 times that range for arsenic trioxide. Median lethal concentrations in the diets of wild birds have been reported in the range of 480 ppm (approximately 58 mg/kg-body weight) for the bobwhite quail to 5000 ppm for mallards.[72,73] NAS has proposed the following maximum tolerable levels for dietary arsenic for domestic animals: 50 ppm for inorganic arsenic and 100 ppm for organic forms of arsenic.[74]

Arsenic is toxic to plants, and can inhibit mitosis, photosynthesis, and respiration, and interfere with nucleic acid and protein synthesis. Soil arsenic concentrations of 500 mg/kg have been reported to inhibit growth completely in six vegetable crops.[75] Concentrations of arsenic in soils as low as 15 mg/kg have been reported to be phytotoxic.[76] The lowest value reported to cause injury in plants is 1.0 mg/kg.[77]

Beryllium. Insufficient data are available to develop ambient water quality criteria for beryllium.[78] The LOELs for acute and chronic toxic effects in freshwater organisms are 130 and 5.3 ug/L, respectively. Acute toxicities have been found to range from 130 to 20,000 ug/L apparently variable according to water hardness.[79] A BCF of 19 has been reported for freshwater fish.[80]

No information on the toxicity of beryllium to terrestrial wildlife is available. No effect was observed in rats exposed to 1 mg/kg beryllium for 2 years.[81] No effect was further reported at a dose of 10 mg/kg for 19 months.[82]

Reduced growth in tomato and bush bean plants was observed at 0.5 mg/kg.[83] Kabata and Kabata-Pendias reported that three different researches found levels of 10 mg/kg to be phytotoxic.[84]

Cadmium. In aquatic systems, the toxicity of cadmium decreases as water hardness increases. Ambient water quality criteria state that freshwater organisms will not be unacceptably affected if the four-day average concentration does not exceed 0.66 ug/L and if the one-hour average concentration is not in excess of 1.8 ug/L,[85] based on a hardness of 50 mg/l $CaCO_3$. BCFs for cadmium in freshwater range from 3 for brook trout muscle[86] to 12,400 for whole body mosquitofish.[87]

There is no evidence that cadmium is an essential mineral.[88] Mammals have no effective mechanism for the elimination of ingested cadmium; therefore, with time, the cadmium tends to accumulate in the liver and kidney. It tends to be very persistent in the kidney and can cause renal tubular damage.[89] Toxic effects include decreased growth rates, anemia, infertility, fetus abnormalities, abortions, kidney disease, intestinal disease, and hypertension. Doyle et al. found that 30 to 60 ppm cadmium in the diet of sheep for 191 days reduced growth and feed intake.[90] In a 30-month study with rats elevated blood pressure occurred at 1 ppm, the lowest level tested.[91] Mallard ducks were chronically dosed with cadmium contaminated food by DiGiulio and Scanlon.[92] They found significant effects on energy metabolism at 450 mg/kg but not at 150 mg/kg. The maximum tolerable level set by NAS for domestic mammals and poultry is 0.5 ppm.[93] This level is equivalent to a dose of 0.015 mg/kg for rabbits and 0.0625 mg/kg for chickens (based on conversion factors in Lehman 1954).[94]

Cadmium in soil is absorbed passively by plants and translocated freely within the plant. Its phytotoxicity is related to alteration of cell membrane permeability and at least some toxic effects are linked specifically to interference of zinc-dependent uptake and translocation processes.[95] Chlorosis is one of the general symptoms of cadmium toxicity in plants and appears to be caused by direct or indirect interaction of cadmium with foliar iron.[96] Levels of 3 to 8 mg/kg (5.25 mg/kg mean of four studies) were reported as phytotoxic by Kabata and Kabata-Pendias.[97]

Chromium. The toxicity of chromium (VI) to aquatic species appears to increase as pH and/or hardness decreases.[98] LC_{50}s (static 96-hour bioassays) conducted by White (Manuscript) were found to range from 36,300 ug/l for yellow perch to 1,870,000 ug/l for a stonefly. The EPA ambient water quality criteria for chromium (VI) are 11 ug/L for a 4-day average concentration, and 16 ug/L for the 1-hour average concentration.[99] For chromium (III) the 4-day average concentration is 120 ug/L and the 1-hour average is 980 ug/L based on a hardness of 50 mg/L.[100] The chronic criterion is 120 ug/L and the acute criterion is 980 ug/L. In aquatic systems, plants and polychaete worms appear to be the most sensitive groups tested. Chronic toxicity of chromium (VI) to freshwater species has been tested by Benoit, Sauter et al., Pickering, Trabalka and Gehrs and Mount among others.[101,102,103,104,105] Chronic values range from 2.5 ug/l (for a daphnid) to 3950 ug/l (fathead minnow). Bioaccumulation is of extremely low potential. A BCF of 3.4 was found by Calamari et al. for hexavalent chromium in rainbow trout.[106]

It appears that the primary source of uptake of chromium by small mammals is through ingestion of contaminated soil while grooming.[107] Short biologic half-life and fractional assimilation indicates a reduced toxic effect, especially under chronic exposures. Feeding studies done on cotton rats demonstrated low assimilation (0.8%) and rapid loss (99% in one day) of hexavalent chromium. The LD_{50} is 19.8 mg/kg chromium (VI) and 600-2600 mg/kg for chromium III.[108] Hexavalent chromium was fatal to dogs in three months when fed 100 ppm in their diet, but was not lethal at 11.2 ppm over four years when administered in their water.[109] They also found the toxic threshold in rats to be 1000 ppm chromium (VI) in the diet and 100% survival when exposed to 134 ppm in their drinking water for three months.

Data on hexavalent chromium effects on birds are few, male domestic chickens fed a diet containing up to 100 ppm hexavalent chromium for 32 days showed no adverse effects in survival, growth, or food utilization efficiency.[110]

The chromium content of plants is controlled mainly by the amount of soluble chromium in the soils. Chromium (VI) is the most soluble and available to plants, but it is also the most unstable form under normal soil conditions. Usually chromium distribution in plants results in the highest concentrations in the roots, then the leaves and stems and the lowest concentrations in the grain.[111] Typical symptoms of chromium phytotoxicity are wilting of plant tops, root injury, chlorosis in young leaves, brownish-red leaves and chlorotic bands on cereals.[112] Phytotoxic soil concentrations were 100 mg/kg.[113] Concentrations as low as 0.01 mg/kg in the soil was found to cause a reduction in the dry weight of bean leaves.[114]

Nickel. The adverse effects of nickel in aquatic organisms include alteration of cell membranes, formation of precipitates on gills, hematological effects and reproductive impairment. The toxicity of nickel to freshwater organisms decreases with increasing water hardness. At a water hardness of 50 mg/l $CaCO_3$, the 4-day and 1-hour EPA ambient water quality criteria are 88 and 790 ug/liter, respectively.[115] Calamari et al. found a BCF of 1.1 for fish.[116]

No adverse effects were observed in Japanese quail (Coturnix) at up to 5000 ppm nickel for 5 days.[117] Chickens showed no adverse effects at 300 ppm nickel after 4 weeks, while at 500 ppm decreased growth was observed.[118] In a feeding study with mallard ducklings a LOEL of 200 mg/kg was established based on neurological effects observed in the highest dose group after 14 days.[119] The weights of the ducks in the highest dose group also significantly decreased at 28 days.

Mammals have shown a low to moderate toxicity to nickel. They appear to have a mechanism which limits absorption of the element in the intestine.[120] The oral LD_{50} for nickel is 136 mg/kg in mice and 116 mg/kg in rats.[121] Death and runting occurred in first and third generation rats given 5 ppm nickel in drinking water during weaning. The maximum tolerable level for cattle recommended by NAS[122] is 50 ppm (approximately 0.75 mg/kg-body weight) based on studies showing no adverse effects at this level.[123] At higher levels (100 ppm) decreased food intake was observed in young cattle, and decreased growth rate occurred at 1000 ppm.[124]

Kabata-Pendias and Pendias[125] identified the concentration of nickel in surface soils that were phytotoxically excessive was 100 mg/kg (dry weight). USEPA reports levels of 50 mg/kg (DW) as causing reduced crop yields.[126]

4.3.2.2 Potential Impacts in the Aquatic Environment. Aquatic environments may receive chemicals released from the proposed incinerator by direct deposition or through surface water runoff and loading of contaminated soils and sediments to aquatic habitats. Aquatic organisms may be exposed to chemicals by direct contact with contaminated water or sediments, or through consumption of contaminated organisms in the food chain.

Potential impacts to aquatic environments are assessed in this section by comparing the maximum estimated concentrations of chemicals in surrounding surface water with ambient water quality criteria established by the Environmental Protection Agency for the protection of aquatic life.[127] The maximum surface water concentrations are estimated based on the maximum predicted deposition rate, as provided by ENSR. As discussed previously, the maximum chemical deposition will occur in the wetlands located approximately 1 mile southeast of the incinerator. Chemical deposition rates and subsequent surface water concentrations will be less in other areas near the site (including the Delaware River), and consequently, the potential risks to aquatic organisms in these areas also will be less.

Methods for Calculating Chemical Concentrations in Water from Aerial Deposition. Maximum concentrations of chemicals in the wetlands southeast of the proposed incinerator were calculated based on the maximum rates of aerial deposition. Chemical emissions which deposit into wetland areas are assumed to settle and fully mix in the top 1 centimeter of sediment. The sediments are then assumed to act as a continuing source of chemical release in to the water column.

Chemical concentrations in the sediments can be estimated as follows for the selected chemicals except PCDDs/PCDFs (see below for PCDDs/PCDFs):

$$C_{sed} = \frac{(D) * (AT) * (X)}{(SD) * (BD)}$$

Where:

C_{sed} = concentration of chemical in sediments (mg/kg)
D = chemical-specific deposition rate ($g/m^2/yr$)
AT = accumulation time (30 years)
SD = sediment depth of mixing (0.01 m)
BD = sediment bulk density (1.33×10^3 kg/m^3), and
X = conversion factor (1000 mg/g)

This model conservatively assumes chemical concentrations in sediments will not be reduced by processes such as biodegradation, sediment movement, or background dustfall.

The potential biodegradation of PCDDs/PCDFs in sediments was taken into account using the equation:

$$C_s = \frac{(D) * (X)}{(k_s) (SD) (BD)} * (1 - \exp[-k_s(AT)])$$

Where k_s = biodegradation rate, 0.0578/year for the average case.[128]

Chemical concentrations in the water are then estimated using a linear partitioning model as follows:

$$C_{sw} = C_{sed}/K_d$$

Where: C_{sw} = dissolved chemical concentration in water (mg/L) and
K_d = sediment:water partition coefficient (unitless)

This partitioning model estimates dissolved chemical concentrations in sediment pore spaces and the thin water layer immediately above the sediments. It is conservative in that it does not take into account any dilution of pore space concentrations with the water volume comprising the entire pond, nor does it take into account any turnover of pond water.

Comparisons with Ambient Water Quality Criteria (AWQCs). The estimated surface water chemical concentrations are compared to the Federal AWQCs or LOELs in Exhibit 4-10. As the comparisons reveal, the estimated concentrations in water are below the AWQCs by at least a factor of 1000. Thus, based on this comparison, it appears unlikely that any adverse effects will be experienced by aquatic organisms due to emissions from the incinerator. Again, it is important to note that the estimated concentrations represent the maximum possible exposures (and impacts), because they are based on the maximum deposition point, and they are for interstitial waters and do not account for dilution that would occur in the overlying water column. Therefore, the situation evaluated

EXHIBIT 4-10

CHEMICAL CONCENTRATIONS IN INTERSTITIAL WATER COMPARED TO AWQCs

Chemical	Concentration in Water (ug/L)	AWQC (ug/L)[a] Acute	AWQC (ug/L)[a] Chronic
Arsenic	9.94E-04	360[b]	48[c]
Beryllium	3.33E-06	130[d]	5.3[d]
Cadmium	1.65E-03	3.9[e]	1.1[e]
Chromium	3.97E-04	16	11
Nickel	4.97E-04	1400[e]	160[e]
PCBs	6.58E-07	2	0.014
PCDDs/PCDFs	1.94E-09	0.01[d]	1E-05[d]

[a]Source: EPA (1986), values are AWQCs unless otherwise indicated, see Appendix A

[b]Value is for trivalent Arsenic

[c]AWQC is not available, value is LOEL for pentavalent arsenic

[d]AWQC is not available, value is LOEL

[e]AWQC is hardness-based, value is for a water hardness of 100 mg/L $CaCO_3$

represents a worst case exposure. Chemical concentrations in on-site wetland areas or other surface water areas located away from the maximum deposition point would be less because the deposition rates in these areas are also less.

4.3.2.3 Potential Impacts in the Terrestrial Environment. Terrestrial animals may be potentially exposed to chemicals released from the incinerator by a variety of routes (e.g., inhalation, dermal exposure, ingestion of contaminated media, including food that has accumulated chemicals). However, unlike aquatic organisms, environmental criteria for the protection of terrestrial wildlife species have not been developed. Therefore, the evaluation of potential impacts in terrestrial systems associated with incinerator emissions is more qualitative than that for aquatic systems, and is based on general considerations of toxicity and food-chain accumulation potential of the chemicals of concern.

Of the chemicals selected for evaluation, PCBs and PCDDs/PCDFs are the most toxic to wildlife species. In addition, these chemicals also can accumulate in the terrestrial and aquatic foodchains. Therefore, carnivorous or omnivorous species (which feed on other animals) may be exposed to concentrations of these chemicals that are elevated over what occurs in the abiotic environment (e.g., soil, water). It is difficult to model foodchain accumulation and subsequent exposure in terrestrial species. However, potential impacts associated with foodchain accumulation can be roughly evaluated for PCBs using the AWQC established for this chemical. The AWQC for PCBs, in addition to protecting aquatic organisms, was established to protect mink, which are fish-eating mammals that are the wildlife species most sensitive to the toxic effects of PCBs. PCBs are known to accumulate in aquatic species to concentrations much higher than those that occur in the water column, and the AWQC for PCBs accounts for this high bioconcentration potential, as well as the high sensitivity of mink to dietary PCBs. Therefore, by comparing the estimated maximum concentration of PCBs in the water column with the AWQC, some measure of potential foodchain effects can be gained. As was shown previously in Exhibit 4-10, the estimated maximum concentration of PCBs in water is approximately 10,000 times less than the AWQC. Thus, it is very unlikely that wildlife species would be at risk of adverse effects from exposure to PCBs in the aquatic foodchain. Exposure to PCBs that have accumulated in the terrestrial foodchain are expected to be less since the chemical does not accumulate to the same degree in terrestrial systems. Potential impacts associated with exposure to PCDDs/PCDFs are expected to be similar to those estimated for PCBs since these chemicals are similar in toxicity and bioaccumulative potential.

The inorganic chemicals (arsenic, beryllium, cadmium, chromium, and nickel) released from the incinerator have higher estimated environmental concentrations than PCBs and PCDDs/PCDFs because of their higher emission rates. However, potential impacts associated with exposure to these chemicals are expected to be less than PCBs or PCDDs/PCDFs given their lower toxicity and lower bioaccumulation potential in aquatic or terrestrial organisms. Therefore, it is unlikely that any adverse effects in terrestrial species would occur as a result of exposure to these chemicals at the low concentrations estimated to occur in the environment (parts per trillion range).

4.3.3 Endangered, Threatened and Rare Species and Critical Habitats

As discussed in Section 3.4, no endangered or threatened species of wildlife are known to inhabit the Du Pont Chambers Works property. However, two federally endangered bird species, the bald eagle and the peregrine falcon, are known to occur nearby. Bald eagles winter approximately 0.5 miles southwest of Chambers Works and nesting bald eagles occur at Mannington Meadow, approximately 8 miles south of Chambers Works. Peregrine falcons have nested on the Delaware Memorial Bridge, located approximately 1 mile southwest of the proposed incinerator site.

Given their location relative to the incinerator, it is likely that both bald eagles and peregrine falcons forage to some degree in areas potentially receiving chemical deposition from the proposed incinerator. Bald eagles feed predominantly on fish taken from rivers and lakes,[129,130,131] with some small portion of their diet comprised of small mammals and waterfowl. Peregrine falcons feed predominantly on birds in flight.[132,133] Both avian and mammalian prey species could potentially bioaccumulate some of the chemicals potentially released from the proposed incinerator, and thus, bald eagles and peregrine falcons could be exposed to the contaminants of concern through ingestion of contaminated prey.

It is unlikely that these species would be exposed to significant concentrations of the chemicals released from the incinerator, because accumulation in the foodchain is expected to be minimal given the estimated low environmental concentrations of the released chemicals, as discussed in the previous section. Further, both bald eagles and peregrine falcons have large home range areas, generally of at least several square miles[134,135], and therefore, will spend some time foraging in both uncontaminated areas as well as contaminated areas. Given the estimated low environmental concentrations of the chemicals released from the incinerator and the large home range of these species, the potential for exposures that may result in adverse effects, such as decreased reproduction (see Section 4.3.2.1), is expected to be negligible.

4.3.4 National Wildlife Refuges and Other Wildlife Areas

Supawna Meadows and Killcohook National Wildlife Refuges are more than 5 miles to the south-southwest of the incinerator site. Chemical deposition rates in this area would be less than 1/10th of the maximum point. No adverse effects to wildlife are expected to occur in these areas since none are expected even at the maximum deposition point.

Mannington Meadows is approximately 8 miles south of the incinerator site. Glassboro Wildlife Management Area is more than 20 miles to the east of the site. No adverse effects are expected in these areas because of their considerable distances from the site. Chemical deposition rates in these areas would be negligible.

4.4 PUBLIC HEALTH ASSESSMENT

The purpose of this public health assessment is to determine whether the proposed incinerator may pose a threat to human health. This assessment provides a screening of potentially significant public health impacts and identified the most important potential pathways of exposure to the public. Conservative assumptions and maximum plausible scenarios were employed throughout the assessment so that the estimation of potential risks would err on the health protection side. The landfill is not addressed in this assessment because the significant exposure pathways (i.e., inhalation and ingestion) arise from continuous air pollutant emissions. The only operation in the proposed project which can be characterized as a continuous emission source is the incinerator. The landfill will have no release of hazardous air pollutants if constructed and operated as planned (Section 2.3.3).

4.4.1 Overview

The potential public health risks associated with emissions from the proposed incinerator were assessed according to guidelines recommended by the National Research Council[136], the U.S. Environmental Protection Agency[137,138,139], and the Draft Risk Assessment Guidelines for Resource Recovery Facilities from the NJDEP Division of Environmental Quality[140]. The NJDEP guidelines were adapted for the proposed hazardous waste incinerator by selecting a set of chemicals for detailed evaluation based on anticipated waste streams to the proposed facility. The four general steps followed in this assessment are hazard identification, dose-response assessment, exposure assessment and risk characterization.

The goal of the hazard identification is to identify a set of individual chemicals that may be emitted from the proposed facility that are most likely to be of concern to human health (chemicals of concern). These chemicals are evaluated in detail in this assessment. The set of chemicals are selected from emissions modeled for a "worst case" waste mixture as described in Section 4.2. The acute health criteria assessment compares acute exposure guidelines with the modeled ambient air concentrations presented in Section 4.2. The dose-response assessment describes the quantitative relationship between the level of exposure and occurrence of specific health effects for a chemical.

In the dose-response assessment, exposures were conservatively estimated for a person assumed to be located at the maximum impact point based on the atmospheric dispersion modeling. This person is referred to as the maximum exposed individual (MEI). It was further assumed that the individual would be exposed for a 70-year lifetime. In accordance with NJDEP guidelines, it was assumed that the facility would operate 24 hours per day, 365 days per year. The purpose of the exposure assessment is to identify pathways of exposure to be evaluated in this analysis, and then to predict, using conservative assumptions, potential human intakes via these pathways.

The risk characterization section combines estimated chemical exposures with the health criteria to predict potential risks to the MEI from site emissions.

4.4.2 Acute Health Criteria Assessment

The modeled ambient concentrations of metals, acid aerosols, and other inorganic compounds with the potential for acute health effects have been compared with acute exposure guidelines derived from occupational exposure standards. The modeled concentrations and derived guidelines are listed in Exhibit 4-11. The derived guidelines are based on [8-hour] worker exposure, and the modeled ambient concentrations of hazardous constituents are presented as [8-hour] averages for this reason (note that related discussions of chronic health effects are in terms of annual average concentrations).

Exhibit 4-11 illustrates that the modeled concentrations of metals, acid aerosols, and other inorganic compounds are far less than the comparable exposure guidelines. Acute health effects from public exposure to these substances, therefore, are not expected to be of concern.

Both fugitive and stack emissions of volatile and non-volatile organic compounds were modeled for the purposes of assessing the potential for acute and chronic health effects from public exposure to these substances. The modeled concentrations of selected organic compounds were compared with derived acute exposure guidelines. The modeled concentrations and derived guidelines are listed in Exhibit 4-11. The modeled concentrations are again far less than the comparable exposure guideline, indicating that acute health effects from exposure to hazardous organic compounds is not expected.

4.4.3 Hazard Identification and Dose-Response Assessment

This section presents the framework for evaluation of the potential human health effects associated with chemical emissions from the proposed Chambers Works Hazardous Waste Incinerator Facility. The first subsection discusses the chemicals of concern that were selected for detailed evaluation. The second subsection presents a summary of health effects associated with exposure to these chemicals (toxicity profiles). The third subsection discusses the quantitative toxicity values (i.e., dose-response values) for these chemicals that will be used to estimate potential human health risks.

4.4.3.1 Selection of Chemicals of Potential Concern. Sixteen chemicals were selected for further detailed evaluation in this assessment based on projected emissions from the proposed incinerator including carcinogens, chemicals listed in the New Jersey Guidelines, and other chemicals deemed to have sufficient potential for systemic toxicity based on professional judgement. These chemicals were identified as shown in Exhibit 4-12 based on: 1) guidance on selecting chemicals of potential concern for resource recovery facilities provided by NJDEP; 2) chemicals frequently associated with combustion that are considered

EXHIBIT 4-11

COMPARISON OF MODELED POLLUTANT CONCENTRATIONS WITH ACUTE EXPOSURE GUIDELINES FOR INORGANIC AND ORGANIC COMPOUNDS BASED ON MODELING CONDUCTED BY ENSR

POLLUTANT	EMISSION RATE (g/s)	MAXIMUM AMBIENT AIR CONCENTRATION (μg/m3)	AVERAGING PERIOD	ACUTE EXPOSURE GUIDELINE (μg/m3)
Hydrogen Chloride	0.454	0.93	8-Hour	70
Hydrogen Fluoride	0.265	0.54	8-Hour	2.5
Phosphorus Pentoxide	0.0378	0.0077	8-Hour	10
Sulfur Trioxide	0.132	0.271	8-Hour	
Lead	0.022	0.045	8-Hour	
Mercury	0.0025	0.005	8-Hour	
Methylene Chloride	2.5 E-3	6.45 E-4	8-Hour	
Chloroform	1.25 E-2	3.22 E-3	8-Hour	
Aldehydes (as formaldehyde)	2.5 E-4	6.45 E-5	8-Hour	150
Chromium (Cr^{+3})	0.0012	2.4	8-Hour	

EXHIBIT 4-12

CHEMICALS SELECTED FOR EVALUATION IN THE HEALTH RISK ASSESSMENT FOR THE PROPOSED CHAMBERS WORKS INCINERATOR

CHEMICAL	MINIMUM LIST PROVIDED BY NJDEP[a]	OPTIONAL LIST PROVIDED BY NJDEP[a]	CHEMICALS FREQUENTLY ASSOCIATED WITH COMBUSTION AND CONSIDERED MOST LIKELY TO POSE RISKS	CHEMICALS THAT HAVE ACCOUNTED FOR PREPONDERANCE OF RISK IN OTHER ASSESSMENTS
Arsenic	X	--	X	X
Benzene	--	X	--	--
Beryllium	--	X	X	--
Cadmium	X	--	X	X
Carbon Tetrachloride	--	X	--	X
Chlorobenzene	--	X	--	--
Chloroform	--	X	--	--
Chromium	X	--	X	X
1,4-dichlorobenzene	--	X	--	--
Formaldehyde	--	X	X	--
Lead	--	X	X	X
Mercury	X	--	X	--
Methylene Chloride	--	--	--	--
Nickel	X	--	X	X

a New Jersey Department of Environmental Protection Risk Assessment Guidelines for Resource Recovery Facilities (1987).

EXHIBIT 4-12
(continued)
CHEMICALS SELECTED FOR EVALUATION IN THE HEALTH RISK ASSESSMENT FOR THE PROPOSED CHAMBERS WORKS INCINERATOR

CHEMICAL	MINIMUM LIST PROVIDED BY NJDEP[a]	OPTIONAL LIST PROVIDED BY NJDEP[a]	CHEMICALS FREQUENTLY ASSOCIATED WITH COMBUSTION AND CONSIDERED MOST LIKELY TO POSE RISKS	CHEMICALS THAT HAVE ACCOUNTED FOR PREPONDERANCE OF RISK IN OTHER ASSESSMENTS
PCDDs and PCDFs (expressed as 2,3,7,8-TCDD equivalents)[b]	X	--	X	X
Polycyclic aromatic hydrocarbons (treated as benzo[a]pyrene)	X	X	X	X
Polychlorinated biphenyls	X	--	X	X

[a] New Jersey Department of Environmental Protection Risk Assessment Guidelines for Resource Recovery Facilities (1987).

[b] PCDDs and PCDFs may be referred to as dioxins and furans, respectively.

most likely to pose human health risks; and 3) chemicals that accounted for the preponderance of risks in risk assessments of other similar facilities.

The NJDEP guidance included a minimum and a discretionary list of chemicals or families of chemicals to be evaluated in a resource recovery risk assessment. Although derived for a resource recovery facility, the State's list includes inorganic chemicals that may also be emitted from the proposed facility: arsenic, beryllium, cadmium, chromium, lead, mercury, and nickel. The minimum list also included organic compounds that are generally present as mixtures in emissions. These include the families of polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (referred to in this report as PCDDs/PCDFs), and polychlorinated biphenyls (PCBs). This assessment includes all chemicals on the minimum list except for polycyclic aromatic hydrocarbons (PAHs) which are generally associated with combustion. However, as explained in Section 4.2, there was insufficient information to estimate the amount of PAHs that might be emitted from this incinerator. Therefore, PAHs are not included in the risk assessment.

In addition to these chemicals, several additional chemicals were selected based on their potential to be present in emissions. These chemicals are benzene, carbon tetrachloride, chlorobenzene, chloroform, 1,4-dichlorobenzene, formaldehyde and methylene chloride.

4.4.3.2 Dose-Response Assessment. For the purposes of risk assessment, chemicals are divided into two general classes, those associated with carcinogenic effects and those associated with noncarcinogenic effects. The dose-response values (e.g., health effects criteria) used for carcinogens are cancer potency factors developed by EPA's Carcinogen Assessment Group and provided in EPA's Integrated Risk Information System (IRIS). For non-carcinogens, the toxicity criteria are reference doses (RfDs) developed by EPA's RfD workgroup and reported in IRIS. In the absence of information in IRIS, these toxicity criteria may often be obtained form various documents such as Health Effects Assessment Documents. Health effects criteria for chronic inhalation of the selected chemicals of potential concern are presented in Exhibit 4-13 and criteria for chronic ingestion of these chemicals are presented in Exhibit 4-14. The basis and derivation of these criteria are briefly described in this section. Regulatory efforts are generally geared to protect the public health, including the most sensitive members of the population.

For chemicals exhibiting carcinogenic effects, USEPA's Carcinogen Assessment Group (CAG) has estimated the excess lifetime cancer risks associated with various levels of exposure to potential human carcinogens by developing a value called a cancer potency factor. The cancer potency factor is expressed in units of $[\text{mg chemical/kg body weight/day}]^{-1}$ or 1 over mg chemical/kg body weight/day. It describes the increase in an individual's risk of developing cancer over a 70-year lifetime per unit of exposure where the unit of exposure is expressed as mg chemical/kg body weight/day. When the upper bound cancer potency factor is multiplied by the lifetime average dose of a potential carcinogen (in mg/kg/day), the product is the individual's upper bound lifetime excess cancer risk associated with exposure at that dose. Upper bound means that

EXHIBIT 4-13

HEALTH EFFECTS CRITERIA FOR INHALATION EXPOSURE TO CHEMICALS OF CONCERN

CHEMICAL	REFERENCE DOSE (RFD) MG/KG/Day	UNCERTAINTY FACTOR	SOURCE[a]	EPA/CAG CANCER POTENCY FACTOR $(MG/KG/Day)^{-1}$	WEIGHT OF EVIDENCE[b]	SOURCE[a]
Arsenic	- -	- -	- -	50	A	IRIS
Benzene	- -	- -	- -	2.9×10^{-2}	A	IRIS
Beryllium	- -	- -	- -	8.4	B2	IRIS
Cadmium	- -	- -	- -	6.1	B1	HEA
Carbon Tetrachloride	- -	- -	- -	1.3×10^{-1}	B2	IRIS
Chlorobenzene	5×10^{-3}	10,000	HEA	- -	- -	- -
Chloroform	- -	- -	- -	8.1×10^{-2}	B2	IRIS
Chromium VI	- -	- -	- -	41	A	IRIS
1,4-dichlorobenzene	- -	- -	- -	- -	- -	- -
Formaldehyde	- -	- -	- -	4.55×10^{-2}	B1	EPA (1987a)
Lead	4.3×10^{-4} [c]	- -	NAAQS	- -	- -	- -
Mercury	- -	- -	- -	- -	- -	- -
Methylene Chloride	- -	- -	- -	1.4×10^{-2}	B2	IRIS
Nickel	- -	- -	- -	0.84	A	IRIS
PCBs	- -	- -	- -	- -	- -	- -
PCDDs and PCDFs (as 2,3,7,8 - TCDD equivalents)	- -	- -	- -	1.56×10^{5} [d]	- -	CAG

[a] - Sources are abbreviated as follows:

IRIS - Environmental Protection Agency (1988a). Integrated Risk Information System (IRIS) Environmental Criteria and Assessment Office. Cincinnati, OH.

HEA Quart Update - Environmental Protection Agency (1988b). June Quarterly Update for HEA and HEED Chemicals. Memorandum from Chris DeRosa. Environmental Criteria and Assessment Office, Cincinnati, this to Bruce Mears. July 15, 1988.

HA - Health Advisory (Office of Drinking Water).

[b] - Weight of evidence classification scheme for carcinogens: A - Human Carcinogen, sufficient evidence from human epidemiological studies; B1 - Probable Human Carcinogen, limited evidence from epidemiological studies and adequate evidence from animal studies; B2 - Probable Human Carcinogan, inadequate evidence from epidemiological studies and adequate evidence from animal studies; C - Possible Human Carcinogen, limited evidence in animals in the absence of human data; D - Not Classified as to human carcinogenicity; and E - Evidence of Noncarconogenicity.

[c] - Conversion of NAAQs to units of mg/kg/day assumed that a 70 kg individual breathes 20 m^3 air each day.

[d] - Based on the oral cancer potency factor because no inhalation cancer potency factor has been developed for 2,3,7,8-TCDD.

EXHIBIT 4-14

HEALTH EFFECTS CRITERIA FOR ORAL EXPOSURE TO CHEMICALS OF CONCERN

CHEMICAL	REFERENCE DOSE (RFD) MG/KG/Day	UNCERTAINTY FACTOR	SOURCE[a]	EPA/CAG CANCER POTENCY FACTOR $(MG/KG/Day)^{-1}$	WEIGHT OF EVIDENCE[b]	SOURCE[a]
Arsenic	1×10^{-3}	1	HEA	1.75	A	HEA
Benzene	- -	- -	- -	2.9×10^{-2}	A	IRIS
Beryllium	0.005	100	IRIA	- -	- -	- -
Cadmium	5×10^{-4} (water)	10	HEA	- -	- -	- -
Carbon Tetrachloride	7×10^{-4}	1,000	IRIS	1.3×10^{-1}	B2	IRIS
Chlorobenzene	3×10^{-2}	1,000	HEA	- -	- -	- -
Chloroform	0.01	- -	- -	8.1×10^{-2}	B2	IRIS
Chromium VI	5×10^{-3}	- -	- -	41	A	IRIS
1,4-dichlorobenzene	0.1	- -	- -	- -	- -	- -
Formaldehyde	- -	- -	- -	4.55×10^{-2}	B1	[EPA (1987a)][d]
Lead	6×10^{-4} [c]	- -	- -	- -	- -	- -
Mercury (inorganic)	2×10^{-3}	1,000	HEA	- -	- -	- -
(methyl mecury)	3×10^{-4}	10	IRIS	- -	- -	- -
Methylene Chloride	0.06	100	IRIS	7.5×10^{-3}	B2	IRIS
Nickel	2×10^{-2}	100	IRIS	- -	- -	- -
PCBs	- -	- -	- -	7.7	- -	HEA
PCDDs and PCDFs (as 2,3,7,8 - TCDD)	1×10^{-9}	1000	HA	$1.56 \times 10^{+5}$	B2	HA

a Sources are abbreviated as follows:

IRIS - Environmental Protection Agency (1988a). Integrated Risk Information System (IRIS) Environmental Criteria and Assessment Office. Cincinnati, OH.

HEA Quart Update - Environmental Protection Agency (1988b). June Quarterly Update for HEA and HEED Chemical. Memorandum from Chris DeRose. Environmental Criteria and Assessment Office, Cincinnati, this to Bruce Mears. July 15, 1988.

HA - Health Advisory (Office of Drinking Water).

b Weight of evidence classification scheme for carcinogens: A - Human Carcinogen, sufficient evidence from human epidemiological studies; B1 - Probable Human Carcinogen, limited evidence from epidemiological studies and adequate evidence from animal studies; B2 - Probable Human Carcinogan, inadequate evidence from epidemiological studies and adequate evidence from animal studies; C - Possible Human Carcinogen, limited evidence in animals in the absence of human data; D - Not Classified as to human carcinogenicity; and E - Evidence of Noncarconogenicity.

c Based on the EPA's MCLG of 20ug/l drinking water. This MCLG has been withdrawn.

d U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA). 1987a. Assessment of Health Risks to Garment Workers and Certain Home Residents from Exposure to Formaldehyde. Office of Pesticides and Toxic Substances. Washington, D.C. April 1987 the risk estimate is unlikely to be underestimated but it may very well be overestimated. This is because of the inherent conservativeness in the cancer potency factors (i.e., they are upper bound estimates) and because the exposure assumptions used in risk assessment are also conservative. A cancer risk level of one in a million ($1x10^{-6}$), for example, represents an upper bound probability of 0.0001% that an individual will develop cancer over his or her lifetime as a result of lifetime exposure to a potential carcinogen.

Health effects criteria for chemicals exhibiting noncarcinogenic effects are generally developed using risk reference doses (RfDs) developed by the USEPA. These RfDs are usually derived either from human studies involving workplace exposures or from animal studies, and are adjusted using uncertainty factors. The RfD is an estimate of the average daily exposure to a chemical which appears to present a low risk of adverse effects during a lifetime of exposure by a person. The purpose of the RfD is to provide a level against which other chemical intakes into the body (e.g., those projected from human exposure to various environmental conditions) might be compared. The RfD is presented in units of mg/kg body weight/day for comparison with other rates of intake into the body also in mg/kg/day. Intakes that are less than the RfD are not likely to be of concern. Intakes that are greater than the Rfd may indicate an increased probability of adverse effects; however, that probability is not a certainty. The RfD is an approximate number, and although chemical intakes higher than the RfD have a greater chance of producing adverse effects, one should not infer that such intakes are, by definition "unacceptable."

4.4.2.3 Range of Potential Health Effects. This section includes a brief summary of the critical health effects (i.e., those most likely to occur first or at lower doses) associated with exposure to the selected chemicals of concern. For many of these chemicals, health effects are observed in humans and in experimental animal studies at higher concentrations than typically occur in the environment or are expected to occur as a result of emissions from the facility. The section below includes a brief summary of the health effects that have been associated with short-term (acute) and long-term (chronic) exposures. This summary is followed by a review of the basis for the health effects in Exhibits 4-13 and 4-14.

Arsenic. Both inorganic and organic forms of arsenic are readily absorbed via the oral and inhalation routes. Soluble forms are more readily absorbed than the insoluble forms[141]. Approximately 95% of soluble inorganic arsenic administered to rats is absorbed from the gastrointestinal tract[142,143]. Approximately 70%-80% of arsenic deposited in the respiratory tract of humans has been shown to be absorbed[144]. Dermal absorption is not significant. Acute exposure of humans to metallic arsenic has been associated with gastrointestinal effects, hemolysis, and neuropathy. Chronic exposure of humans to this metal can produce toxic effects on both the peripheral and central nervous systems, keratosis, hyperpigmentation, precancerous dermal lesions, and cardiovascular damage. Arsenic is embryotoxic, fetotoxic, and teratogenic in several animal species. Arsenic is a known human carcinogen. Epidemiological studies of workers in smelters and in plants manufacturing arsenical pesticides have shown that inhalation of arsenic is strongly associated with lung cancer and perhaps with hepatic angiosarcoma. Ingestion of arsenic has been linked to a form of skin cancer and more recently to bladder, liver, and lung cancer[145,146].

EPA has classified arsenic in Group A (Human Carcinogen) and has developed inhalation and oral cancer potency factors of 50 $(mg/kg/day)^{-1}$ [147] and 1.75 $(mg/kg/day)^{-1}$ (EPA 1988b)[148], respectively. The inhalation potency factor is the geometric mean value of potency factors derived from four occupational exposure studies on two different exposure populations[149]. The oral cancer potency factor was based on an epidemiological study in Taiwan which indicated an increased incidence of skin cancer in individuals exposed to arsenic in drinking water[150]. EPA[151] has reported an oral reference dose of $1x10^{-3}$ mg/kg/day based on the study by[152] in which blackfoot disease was observed in humans exposed to arsenic in their drinking water. An uncertainty factor of 1 was used to develop the RfD.

Benzene. Benzene is readily absorbed following oral and inhalation exposure. The toxic effects of benzene in humans and other animals following exposure by inhalation include central nervous system effects, hematological effects, and immune system depression. In humans, acute exposures to high concentrations of benzene vapors have been associated with dizziness, nausea, vomiting, headache, drowsiness, narcosis, coma, and death. Chronic exposure to benzene vapors can produce reduced leukocyte, platelet, and red blood cell counts[153]. Benzene induced both solid tumors and leukemias in rats exposed by gavage[154]. Many studies have also described a causal relationship between exposure to benzene by inhalation (either alone or in combination with other chemicals) and leukemia in humans[155].

Applying EPA's criteria for evaluating the overall evidence of carcinogenicity to humans, benzene is classified in Group A (Human Carcinogen) based on adequate evidence of carcinogenicity from epidemiological studies.[156] EPA derived both an oral and an inhalation cancer potency factor for benzene of $2.9x10^{-2}$ $(mg/kg/day)^{-1}$. This value was based on several studies in which increased incidences of nonlymphocytic leukemia were observed in humans occupationally exposed to benzene principally by inhalation[157,158,159].

Beryllium. Beryllium is not readily absorbed by any route of exposure. Occupational exposure to beryllium results in bone, liver and kidney disposition[160]. In humans, acute respiratory effects due to beryllium exposure include rhinitis, pharyngitis, tracheobronchitis, and acute pneumonitis. Dermal exposure to soluble beryllium compounds can cause contact dermatitis, ulceration and granulomas[161]. Ocular effects include conjunctivitis and corneal ulceration from splash burns. The most common clinical symptom caused by chronic beryllium exposure is granulomatous lung inflammation[162,163]. Chronic skin lesions sometimes appear after a long latent period in conjunction with the pulmonary effects. Systemic effects from beryllium exposure may include right heart enlargement with accompanying cardiac failure, liver and spleen enlargement, cyanosis, digital clubbing, and kidney stone development. Beryllium has been shown to be carcinogenic in experimental animals resulting primarily in lung and/or bone tumors when given by injection, intratracheal administration, or inhalation. Several epidemiological studies have suggested that occupational exposure to beryllium may result in an increased lung cancer risk although the data are inconclusive[164].

Beryllium has been classified by EPA in Group B2 (Probable Human Carcinogen) based on increased incidences of lung cancer and osteosarcomas in animals[165]. This classification applies to agents for which there is inadequate evidence of carcinogenicity in humans from epidemiological studies and adequate evidence from animal studies. EPA has calculated an inhalation cancer potency factor of 8.4 $(mg/kg/day)^{-1}$ based on the relative risk for lung cancer, estimated from an epidemiological study by Wagoner et al.[166]. EPA has also developed an oral reference dose (RfD) for beryllium of 5.0×10^{-3} mg/kg/day based on a study by Schroeder and Mitchner[167] in which rats exposed to 0.54 mg/kg/day beryllium sulfate (the highest dose tested) in drinking water for a lifetime did not exhibit adverse effects; an uncertainty factor of 100 was used to develop the RfD.

Cadmium. Gastrointestinal absorption of cadmium in humans ranges from 5-6%[168]. Pulmonary absorption of cadmium in humans is reported to range from 10% to 50%[169]. Cadmium bioaccumulates in humans, particularly in the kidney and liver. Chronic oral or inhalation exposure of humans to cadmium has been associated with renal dysfunction, itai-itai disease (bone damage), hypertension, anemia, endocrine alterations, and immunosuppression. Renal toxicity occurs in humans at a renal cortex concentration of cadmium of 200 ug/g. Epidemiological studies have demonstrated a strong association between inhalation exposure to cadmium and cancers of the lungs, kidney, and prostate. In experimental animals, cadmium induces injection-site sarcomas and testicular tumors. When administered by inhalation, cadmium chloride is a potent pulmonary carcinogen in rats. Cadmium is a well-documented animal teratogen[170].

EPA[171] classified cadmium as a Group B1 agent (Probable Human Carcinogen). This classification applies to agents for which there is limited evidence of carcinogenicity in humans from epidemiologic studies. EPA[172] derived an inhalation cancer potency factor of 6.1 $(mg/kg/day)^{-1}$ for cadmium based on an epidemiologic study by Thun et al.[173]. Using renal toxicity as an endpoint, and a safety factor of 10, EPA[174,175,176] has derived two separate oral reference doses (RfD). The RfD associated with oral exposures to drinking water is $5x10^{-4}$ mg/kg/day, and is based upon the lowest observed adverse effect level (LOAEL) of 0.005 mg/kg in humans. The RfD associated with exposure to cadmium in food or other nonaqueous oral exposures is $1x10^{-3}$ mg/kg/day.

Carbon Tetrachloride. Carbon tetrachloride (CCl_4) is readily absorbed following oral and inhalation exposure. About 60% of an oral dose was absorbed by 6 hours, and up to 86% was absorbed by 24 hours. Absorption from the lung has been estimated at about 30%[177]. CCl_4, like many other chlorinated hydrocarbons, acts as a central nervous system depressant[178]. The toxic effects of oral and inhalation exposure to CCl_4 in humans and animals include damage to the liver, kidney and lung, although the liver is the most sensitive tissue. In animals, acute oral administration produces fatty infiltration and histological alterations in the liver. High doses produce irreversible liver damage and necrosis while the effects observed following lower doses are largely reversible[179]. Humans occupationally exposed to 5-15 ppm of CCl_4 experience biochemical alterations, nausea, headaches and in more severe cases, liver dysfunction (jaundice, enlargement and fatty infiltration)[180,181]. Animals chronically exposed to CCl_4 exhibit effects similar to those observed following acute exposure. Prenatal toxicity has been demonstrated in mammalian fetuses and neonates after inhalation exposure in pregnant rat[182], although CCl_4 has not been shown to be teratogenic. Carbon tetrachloride is a carcinogen in animals producing mainly hepatic neoplasms. Oral administration of 30 mg/kg/day or higher for 6 months has been found to produce an increased frequency of hepatomas, hepatocellular adenomas and hepatocellular carcinomas in mice, rats and hamsters[183].

EPA[184] has classified CCl_4 as a B2 agent (Probable Human Carcinogen). The cancer potency factor for both oral and inhalation exposure is 1.3×10^{-1} $(mg/kg/day)^{-1}$. EPA established the cancer potency factor based on several gavage studies in which hepatocellular carcinomas and hepatomas were observed in rats, mice and hamsters[185,186,187,188]. EPA has derived an oral reference dose (RfD) of 7×10^{-4} mg/kg/day based on a subchronic rat gavage study in which liver lesions were the most sensitive effect[189]. A no observed adverse effect level (NOAEL) of 0.71 mg/kg/day and an uncertainty factor of 1,000 were used to derive the RfD.

<u>Chlorobenzene</u>. Evidence from toxicity studies suggests that chlorobenzene is absorbed after oral, inhalation, and dermal exposure. Acute and chronic exposures to chlorobenzene have been associated in humans and experimental animals with central nervous system (CNS) effects, liver and kidney lesions, and respiratory distress. Results of reproductive studies with rats and dogs also indicate that chlorobenzene induces testicular lesions[190].

EPA (1988)[191] derived an oral RfD for chlorobenzene of 3×10^{-2} mg/kg/day based on a study by Monsanto[192] in which dogs administered chlorobenzene in capsules for 90 days exhibited liver and kidney effects; an uncertainty factor of 1,000 was used to develop the RfD. EPA also reported an inhalation RfD for chlorobenzene of 5×10^{-3} mg/kg/day based on a study by Dilley[193] in which rats exposed to chlorobenzene for 120 days exhibited liver and kidney effects; an uncertainty factor of 10,000 was used to develop the RfD.

<u>Chloroform</u>. Chloroform, a trihalomethane, is rapidly absorbed through the respiratory and gastrointestinal tracts in humans and experimental animals; dermal absorption from contact of the skin with liquid chloroform can also occur[194]. In humans, acute exposures to chloroform may result in death caused by ventricular fibrillation. Acute exposure to chloroform may also cause irritation to the skin, eyes, and gastrointestinal tract[195]. In experimental animals, chronic exposure may lead to hepatic, renal, and cardiac effects and central nervous system depression. Chloroform has been reported to induce renal epithelial tumors in rats and hepatocellular carcinomas in mice. Suggestive evidence from human epidemiological studies indicates that exposure to chloroform and other trihalomethanes in contaminated water supplies may be associated with an increased incidence of bladder tumors[196].

Chloroform has been classified by EPA as a Group B2 Carcinogen (Probable Human Carcinogen)[197]. EPA developed an oral cancer potency factor for chloroform of 6.1×10^{-3} $(mg/kg/day)^{-1}$ based on a study in which kidney tumors were observed in rats exposed to chloroform in drinking water. EPA also developed an inhalation cancer potency factor of $8.1x10^{-2}$ $(mg/kg/day)^{-1}$ based on an NCI[198] bioassay in which liver tumors were observed in mice. EPA also derived an oral RfD of 0.01 mg/kg/day for chloroform based on a chronic bioassay in dogs in which liver effects were observed[199]; an uncertainty factor of 1,000 was used to derive the RfD.

Chromium. Chromium exists in two states, as chromium (III) and as chromium (VI). Following oral exposure, absorption of chromium (III) is low while absorption of chromium (VI) is high[200]. Chromium is an essential micronutrient and is not toxic in trace quantities[201]. High levels of soluble chromium (VI) and chromium (III) can produce kidney and liver damage following acute oral exposure; target organs affected by chronic oral exposure remain unidentified. Chronic inhalation exposure may cause respiratory system damage. Further, epidemiological studies of worker populations have clearly established that inhaled chromium (VI) is a human carcinogen; the respiratory passages and the lungs are the target organs. Inhalation of chromium (III) or ingestion of chromium (VI) or (III) has not been associated with carcinogenicity in humans or experimental animals. Certain chromium salts have been shown to be teratogenic and embryotoxic in mice and hamsters following intravenous or intraperitoneal injection[202].

EPA has classified inhaled chromium (VI) in Group A (Human Carcinogen)[203]. Inhaled chromium (III) and ingested chromium (III) and (VI) have not been classified with respect to carcinogenicity. EPA developed an inhalation cancer potency factor of 41 $(mg/kg/day)^{-1}$ for chromium (VI) based on an increased incidence of lung cancer in workers exposed to chromium over a 6 year period, and followed for approximately 40 years[204]. EPA derived an oral reference dose of $5.0x10^{-3}$ mg/kg/day for chromium (VI) based on a study by MacKenzie et al.[205] in which no observable adverse effects were observed in rats exposed to 2.4 mg chromium (VI)/kg/day in drinking water for 1 year. A safety factor of 500 was used to derive the RfD. EPA developed an oral RfD of 1 mg/kg/day for chromium (III) based on a study in which rats were exposed to chromic oxide baked in bread; no effects due to chromic oxide treatment were observed at any dose level[206]. A safety factor of 1000 was used to calculate the oral RfD.

1,4-Dichlorobenzene. 1,4-Dichlorobenzene is a solid used as an air deodorant and as an insecticide. All (100%) of an oral dose and 60% of an inhalation dose are absorbed when exposure persists for longer than one to three hours[207,208]. The principal toxic effects of this compound in humans and experimental animals from acute and longer-term exposure include central nervous system depression, blood dyscrasias, and lung, kidney, and liver damage[209]. In humans, pigmentation and allergic dermatitis have been reported after dermal contact. Chromosome breaks also have been observed in exposed humans[210]. 1,4-dichlorobenzene was found to cause renal adenocarcinomas in male rats and carcinomas and adenocarcinomas of the liver in female mice in a 103-week gavage study[211].

EPA classified 1,4-dichlorobenzene in Group B2 (Probable Human Carcinogen) based on adequate evidence of carcinogenicity in animals (EPA 1987d)[212]. An oral cancer potency factor of $2.4x10^{-2}$ $(mg/kg/day)^{-1}$ has been reported by EPA[213]. EPA also derived an oral reference dose (RfD) for 1,4-dichlorobenzene of 0.1 mg/kg/day based on the NTP rat study in which a no observed adverse effect level (NOAEL) of 150 mg/kg/day for renal lesions was identified. An uncertainty factor of 1000 was used to derive the RfD, which was used to develop a lifetime health advisory for 1,4-dichlorobenzene.

Formaldehyde. Formaldehyde is absorbed following oral, inhalation, dermal, and ocular exposure. In humans, acute dermal exposure to formaldehyde can cause skin irritation, skin sensitization, and contact urticaria. Acute ingestion of formaldehyde by humans has been reported to cause allergic reactions, corrosion of the gastrointestinal and respiratory tracts, loss of consciousness, vascular collapse, pneumonia, hemorrhagic nephritis, hepatic fatty degeneration, and spontaneous abortion. Observed effects in humans following acute inhalation exposure to formaldehyde include neurophysiological changes, eye, nose and throat irritation, pulmonary lesions, and death. Acute and subchronic inhalation exposure of various laboratory animals to low (<1 ppm) or moderate (10-50 ppm) concentrations of formaldehyde vapor is known to cause increased airway resistance, decreased sensitivity of the nasopalatine nerve, irritation of the eyes and respiratory system, and changes in the hypothalamus. Exposure to high doses (>100 ppm) of formaldehyde vapor can cause salivation, acute dyspnea, vomiting, cramps, and death. Rats and dogs administered formaldehyde for 90 days in drinking water or diet had reduced weight gain. Subchronic and chronic inhalation exposure in experimental animals has resulted in a variety of nasal cavity lesions, including dysplasia and squamous metaplasia of respiratory epithelium, purulent or seropurulent rhinitis, interstitial inflammation of the lungs[214], reduced weight gain, reduced liver weights, and lesions of the kidney, liver, cerebral cortex, and respiratory tract[215]. Oral and inhalation exposure to formaldehyde has been associated in experimental animals with increased maternal and fetal organ and body weights, and decreased newborn body weights[216]. Formaldehyde is mutagenic in yeast, fungi, Drosophila, bacteria and mouse lymphoma cells, and has been associated with cell transformation, and sister chromatid exchanges in cultured human lymphocytes and Chinese hamster ovary cells[217,218]. Formaldehyde causes nasal squamous cell carcinomas in rats[219,220,221].

EPA[222,223] classifies formaldehyde as a Group B1 agent (Probable Human Carcinogen). This weight-of-evidence classification applies to those substances for which there is sufficient evidence of carcinogenicity in animals and limited evidence of carcinogenicity in humans. EPA used the Chemical Industry Institute of Toxicology study in rats[224] to estimate a cancer risk value for formaldehyde. In this study, groups of rats exposed to formaldehyde for up to 24 months exhibited an increased incidence of squamous cell carcinomas of the nasal cavity. Using these data, EPA estimated a cancer potency factor (ql*) of 4.55×10^{-2} $(mg/kg/day)^{-1}$. The concentration of formaldehyde in air corresponding to a 10^{-6} excess lifetime cancer risk is 7.7×10^{-5} mg/m^3.

Lead. Absorption of lead from the gastrointestinal tract of humans is estimated at 10%-15%. For adult humans, the deposition rate of particulate airborne lead is 30%-50%, and essentially all of the lead deposited is absorbed. Lead is stored in the body in the kidney, liver and bone. The major adverse effects in humans caused by lead include alterations in the hematopoietic and nervous systems. The toxic effects are generally related to the concentration of this metal in blood. Blood concentration levels of over 80 g/dl in children and over 100 g/dl in sensitive adults can possibly cause severe, irreversible brain damage, encephalopathy, and death. Lower blood concentrations of lead (30-40 g/dl) have been associated in humans with altered nerve conduction, altered testicular function, renal dysfunction, and anemia. Lead exposure also has been associated in humans with spontaneous abortion, premature delivery, and early membrane rupture; however, reliable exposure estimates are lacking in these cases. Decreased fertility, fetotoxic effects, and skeletal malformations have been observed in experimental animals exposed to lead[225]. Chronic oral ingestion of certain lead salts (lead acetate, lead phosphate, lead subacetate) has been associated in experimental animals with increased renal tumors. Doses of lead that induced kidney tumors were high and were beyond the lethal dose in humans[226].

EPA classified lead salts in Group B2 (Probable Human Carcinogen)[227], although no cancer potency factor has been established[228]. This category applies to those agents for which there is sufficient evidence of carcinogenicity in animals and inadequate evidence of carcinogenicity in humans. EPA has noted that the available data provide an insufficient basis on which to regulate lead acetate, lead phosphate and lead subacetate as human carcinogens. EPA has also considered it inappropriate to develop a reference dose (RfD) for inorganic lead and lead compounds, since many of the health effects associated with lead intake occur essentially without a threshold.

Mercury. In humans, inorganic mercury is absorbed following inhalation and oral exposure but 7% to 15% of administered inorganic mercury is absorbed following oral exposure[229,230]. Organic mercury is almost completely absorbed from the gastrointestinal tract and is assumed to be well absorbed via inhalation in humans. A primary target organ for inorganic mercury compounds is the kidney. Acute and chronic exposures of humans to inorganic mercury compounds have been associated with anuria, polyuria, proteinuria, and renal lesions[231]. Chronic occupational exposure of workers to elemental mercury vapors (0.1 to 0.2 mg/m^3) has been associated with mental disturbances, tremors, and gingivitis[232]. Animals exposed to inorganic mercury for 12 weeks have exhibited proteinuria, nephrotic syndrome and renal disease[233]. Rats chronically administered inorganic mercury (as mercuric acetate) in their diet have exhibited decreased body weights and significantly increased kidney weights.[234] The central nervous system is a major target for organic mercury compounds. Adverse effects in humans, resulting from subchronic and chronic oral exposures to organic mercury compounds have included destruction of cortical cerebral neurons, damage to Purkinje cells, and lesions of the cerebellum. Clinical symptoms following exposure to organic mercury compounds have included paresthesia, loss of sensation in extremities, ataxia, and hearing and visual impairment[235]. Embryotoxic and teratogenic effects, including malformations of the skeletal and genitourinary systems, have been observed in animals exposed orally to organic mercury. Both organic and inorganic compounds are reported to be genotoxic in eukaryotic systems[236].

EPA[237] has reported an oral reference dose (RfD) for inorganic mercury of $2x10^{-3}$ mg/kg/day based on a chronic rat study in which kidney effects were observed[238]. An uncertainty factor of 1000 was used to derive the RfD. EPA[239] has also reported an oral RfD for methyl mercury of $3x10^{-4}$ mg/kg/day based on a study investigating central nervous system effects in humans exposed to mercury[240]; an uncertainty factor of 10 was used to develop the RfD.

Methylene Chloride. Methylene chloride is absorbed following oral and inhalation exposure. The amount of airborne methylene chloride absorbed following inhalation exposure increases in direct proportion to its concentration in inspired air, the duration of exposure, and physical activity. Dermal absorption has not been accurately measured. Acute human exposure to methylene chloride may result in irritation of eyes, skin, and respiratory tract; central nervous system depression; elevated carboxyhemoglobin levels; and circulatory disorders that may be fatal. Chronic exposure of animals can produce renal and hepatic toxicity. Methylene chloride is mutagenic for Salmonella typhimurium and produces mitotic recombination in yeast[241]. Several inhalation studies conducted in animals provide clear evidence of methylene chloride's carcinogenicity. There is only suggestive evidence in experimental animals that hepatocellular carcinomas and neoplastic nodules arise from oral exposure[242,243].

EPA[244] classified methylene chloride in Group B2 (Probable Human Carcinogen). It has been concluded by EPA[245] that the induction of distant site tumors from inhalation exposure and the borderline significance for induction of tumors in a drinking water study are an adequate basis for concluding that methylene chloride be considered a probable human carcinogen via ingestion as well as inhalation. EPA derived an inhalation cancer potency factor of $1.4x10^{-2}$ $(mg/kg/day)^{-1}$ based on the results of a National Toxicology Program (NTP) inhalation bioassay conducted in rats and mice (NTP 1986). Mammary tumors were noted in rats, while lung and liver tumors were observed in mice. EPA[246] determined an oral cancer potency factor of $7.5x10^{-3}$ $(mg/kg/day)^{-1}$ based on the results of the NTP[247] inhalation bioassay and on an ingestion bioassay conducted by the National Coffee Association (NCA)[248]. In the NCA study, hepatocellular adenomas and/or carcinomas were observed in male mice. An oral reference dose (RfD) of 0.06 mg/kg/day has been developed by EPA based on a 2-year rat drinking water bioassay[249] that identified no-observed-effect levels (NOELs) of 5.85 and 6.47 mg/kg/day for male and female rats, respectively. Liver toxicity was observed at doses of 52.58 and 58.32 mg/kg/day for males and females, respectively. An uncertainty factor of 100 was used to derive the RfD.

Nickel. Nickel compounds can be absorbed following inhalation, ingestion, or dermal exposure. The amount absorbed depends on the dose administered and the chemical and physical form of the particular nickel compound. Dermal exposure of humans to nickel produces allergic contact dermatitis[250]. Adverse effects associated with acute exposure in animals have included depressed weight gain, altered hematological parameters, and increased iron deposition in blood, heart, liver, and testes[251]. Chronic or subchronic exposure of experimental animals to nickel has been associated with reduced weight gain, degenerative lesions of the male reproductive tract, asthma, nasal septal perforations, rhinitis, sinusitis, hyperglycemia, decreased prolactin levels, decreased iodine uptake, and vasoconstriction of the coronary vessels. Teratogenic and fetotoxic effects have been observed in the offspring of exposed animals. Inhalation exposure of experimental animals to nickel carbonyl or nickel subsulfide induces pulmonary tumors. Several nickel salts cause localized tumors when administered by subcutaneous injection or implantation. Epidemiological evidence indicates that inhalation of nickel refinery dust and nickel subsulfide is associated with cancers of the nasal cavity, lung, larynx, kidney, and prostate[252].

Nickel refinery dust and nickel subsulfide are both categorized in Group A (Human Carcinogens). These classifications are based on an increase incidence of lung and nasal tumors observed in workers occupationally exposed to nickel refinery dust. These materials have inhalation cancer potency factors of 0.84 $(mg/kg/day)^{-1}$ and 1.7 $(mg/kg/day)^{-1}$, respectively. Nickel carbonyl is categorized in Group B2 (Probable Human Carcinogen); however, a potency factor has not been derived for it. EPA[253] derived an oral reference dose (RfD) for nickel of $2x10^{-2}$ mg/kg/day based on a study by Ambrose et al.[254] in which rats administered 5 mg/kg/day nickel in the diet for 2 years did not experience decreased weight gain. A safety factor of 300 was used to calculate the RfD.

Polychlorinated Biphenyls (PCBs). PCBs are complex mixtures of chlorinated biphenyls. The commercial PCB mixtures that were manufactured in the United States were given the trade name of "Aroclor." Aroclors are distinguished by a four-digit number (for example, Aroclor 1260). The last two digits in the Aroclor 1200 series represent the average percentage by weight of chlorine in the product.

PCBs are readily absorbed through the gastrointestinal tract and somewhat less readily through the skin; PCBs are presumably readily absorbed from the lungs, but few data are available that experimentally define the extent of absorption after inhalation. Dermatitis and chloracne (a disfiguring and long-term skin disease) have been the most prominent and consistent findings in studies of occupational exposure to PCBs. Several studies examining liver function in exposed humans have reported disturbances in blood levels of liver enzymes. Reduced birth weights, slow weight gain, reduced gestational ages, and behavioral deficits in infants were reported in a study of women who had consumed PCB-contaminated fish from Lake Michigan. Reproductive, hepatic, immunotoxic, and immunosuppressive effects appear to be the most sensitive end points of PCB toxicity in nonrodent species, and the liver appears to be the most sensitive target organ for toxicity in rodents[255]. A number of studies have suggested that PCB mixtures are capable of increasing the frequency of tumors including liver tumors in animals exposed to the mixtures for long periods[256,257,258,259]). Studies have suggested that PCB mixtures can act to promote or inhibit the action of other carcinogens in rats and mice[260].

EPA[261] classified PCB as a Group B2 agent (Probable Human Carcinogen) based on sufficient evidence in animal bioassays and inadequate evidence from studies in humans. The EPA Carcinogen Assessment Group[262] calculated a low-level cancer potency factor of 7.7 $(mg/kg/day)^{-1}$ for PCBs based on the incidence of hepatocellular carcinomas and adenocarcinomas in female Sprague-Dawley rats exposed to a diet containing Aroclor 1260 as reported in a study by Norback and Weltman[263].

Polychlorinated Dibenzofurans and Polychlorinated Dibenzo-p-dioxins. The most widely studied and toxic of the numerous polychlorinated dibenzo-p-dioxin compounds is 2,3,7,8-tetrachloro-dibenzo-p-dioxin (2,3,7,8-TCDD). 2,3,7,8-TCDD is absorbed in experimental animals following oral and dermal exposure. The absorption of this compound by inhalation exposure, however, has not been studied. Following absorption, 2,3,7,8-TCDD is distributed primarily to the liver and adipose tissue. In humans, acute or chronic exposure to 2,3,7,8-TCDD has been associated with chloracne, altered liver function, various hematological changes, porphyria, cutanea tarda, hyperpigmentation, hirsutism, and neural degeneration in the extremities. In studies with experimental animals, acute and short-term exposures to 2,3,7,8-TCDD induces weight loss, thymic atrophy, liver damage, internal hemorrhaging, degeneration of plasma membranes, alterations in enzyme activities, porphyria, hematological changes, and immunotoxicity. The primary adverse noncarcinogenic effect observed in experimental animals following subchronic or chronic exposure to 2,3,7,8-TCDD is hepatoxicity. 2,3,7,8-TCDD is highly fetoxic in experimental animals, causing decreased fetal weight, hepatic damage, and hemorrhages of the gastrointestinal tract. 2,3,7,8-TCDD is the most potent teratogen known in experimental animals and causes a variety of malformations[264]. 2,3,7,8-TCDD is also the most potent animal carcinogen ever tested[265]. 2,3,7,8-TCDD is categorized as a Group B2 Agent (Probable Human Carcinogen)[266].

The polychlorinated dibenzofurans (PCDFs) comprise a family of 135 congeners each of which can be categorized into one of eight homologues with varying degrees of chlorination. The PCDFs are similar in structure and in chemical and biological properties to the polychlorinated dibenzo-p-dioxins (PCDDs). In experimental animals, adverse effects are similar following acute, subchronic or chronic oral exposure to PCDFs. These include growth retardation, weight loss, loss of hair and nails, hematological changes, immunotoxicity, and lesions of the thymus, spleen, bone marrow, kidney, liver, stomach, skin, and eye. Exposure of experimental animals to PCDFs also has been shown to induce maternal toxicity, fetotoxicity, increased fetal mortality, and tetratogenicity. Ingestion of rice oil contaminated with PCDFs occurred in Japan and Taiwan, and has been associated with poisonings of large numbers of people. Adverse effects observed in these incidents included nausea, vomiting, headache, anorexia, joint pain and edema of the extremities, irregular menstrual cycles, chronic bronchitis, immunological changes, and reduced nerve conduction velocities. Fetotoxicity, reduced birth weights, and increased infant mortality have also been reported.

Specific health effects criteria have not generally been developed for the various polychlorinated dibenzo-p-dioxins other than 2,3,7,8-TCDD. In the absence of specific risk criteria for these compounds, EPA[267] has proposed an approach to risk assessment based on toxicity equivalency factors (TEFs). The basis of this approach is the similarity in mechanisms of action and toxic effects of the various polychlorinated dibenzo-p-dioxins (PCDDs). In the TEF approach, it is assumed that each PCDD congener acts by a similar mechanism, and that its potency can be characterized relative to that of 2,3,7,8-TCDD. To implement this approach, a TEF is assigned to each individual PCDD congener, or to subclasses of PCDDs, and it is assumed that a quantity q_i of the ith subclass is equivalent in toxic potency to a quantity $q_i t_i$ of 2,3,7,8-TCDD, where t_i is the TEF for the ith subclass. A further assumption is made that the potencies of different subclasses are additive. Thus, by using the TEF approach, the cancer potency factor developed for 2,3,7,8-TCDD can be used to evaluate the risk of other polychlorinated dibenzo-p-dioxins (PCDDs).

4.4.4 Exposure Assessment

Chemicals emitted from the proposed Chambers Works Incinerator will be dispersed widely in the air and may be deposited at varying rates onto a wide area of land and water. As a result, individuals may be exposed to these materials in varying quantities and proportions via a variety of exposure routes. These routes include inhalation of air and ingestion of outdoor soil, produce, and indoor dust. The frequency, extent, and duration of exposure for any individual person will depend on many factors, including location of residence, age, sex, and activity patterns.

In this report, a general approach to exposure assessment which has been described in general terms by the U.S. Environmental Protection Agency[268,269,270] was followed. In this approach, exposure assessment is conducted in three general steps. In the first step the exposure pathways most likely to be significant are extracted from a list of all possible pathways. This screening process is necessary to focus the assessment on the most significant exposure pathways and is justified by experience, which shows that in most circumstances exposure via a few exposure pathways to one or a few chemicals dominates estimates of potential risks. The second step is to predict concentrations at exposure points. This involves the quantification of the amounts of chemicals that may be released into the environment over time by the proposed incinerator, evaluation of the transport and fate of each chemical once released into the air and deposited onto the ground, and derivation of annual-average concentrations at the points of exposure. The third step is to develop an exposure scenario for each pathway based on assumptions about the environmental behavior and transport of the chemicals, and the extent, frequency, and duration of exposures. These factors are used to predict potential intakes of the chemicals of concern.

4.4.4.1 Identification of Exposure Pathways. Emitted chemicals may be suspended in the ambient air, transported in the atmosphere, and deposited on the ground. The purpose of this section is to identify the most significant potential pathways through which humans may be exposed to the chemicals released from the proposed facility.

An exposure pathway is composed of the following four elements [271]:

(1) A source and mechanism of chemical release to the environment;

(2) An environmental transport medium (e.g., air) for the released chemical, and/or a mechanism of transfer of the chemical from one medium to another (e.g., deposition of particles onto soil);

(3) A point of potential contact of humans or biota with the contaminated medium (the exposure point); and

(4) An exposure route (e.g., inhalation) at the exposure point.

All four elements must be present for a pathway to be considered complete.

One of the most important exposure pathways associated with resource recovery facilities and presumably other incinerators, involves the direct inhalation of airborne chemicals. Accordingly, potential exposures as a result of direct inhalation of airborne chemicals will be evaluated. This assessment will focus on the maximum exposed individual (MEI), that is, one assumed to remain at the point of maximum impact continuously for 70 years[272].

Some fraction of the chemicals emitted from the proposed incinerator will be deposited onto the ground or onto water and may result in indirect exposures through several pathways. Deposited chemicals may become mixed into soil where individuals, such as children or gardeners, may come into contact with them. Children in particular are known to ingest soils either incidentally or intentionally (i.e., habitual pica) while playing. Thus potential exposures due to the incidental ingestion of soil by both children and adults will be evaluated.

Chemicals in soils which come into contact with the exposed skin of children or backyard gardeners may also be absorbed. A detailed review of the results of seven resource recovery facility risk assessments[273] (Malcolm Pirnie[274]; Signal[275]; Radian[276]; Clement[277,278]), in which several indirect exposure pathways were evaluated, indicated that the dermal exposure pathway presents the lowest risks of all the indirect pathways evaluated by as much as one to two orders of magnitude. Hazardous waste facilities are expected to be similar to resource recovery facilities regarding significant pathways. In addition, available methodologies for quantifying exposures and risks associated with the dermal absorption of chemicals from a soil matrix as a result of short-duration exposures are not well developed due to the lack of relevant experimental data. Thus potential exposures to deposited chemicals adsorbed to soils via dermal absorption will not be quantitatively evaluated in this risk assessment.

Another potential exposure pathway is incidental ingestion of household dust. Ingestion of dust inside the home is considered because outdoor airborne particulate matter or tracking of surface soil contribute to a large percentage of the dust inside homes. Children playing or crawling on all fours inside the home collect dust on their hands. This dust may then be ingested when the children put their hands in their mouths. This pathway of exposure is not considered to be of importance for adults, nor are there experimental data indicating that such exposures may occur. Because this potential exposure pathway is not significant, potential exposures as a result of incidental dust ingestion in the home will not be evaluated.

As described in Section 3, residents in the area may maintain home vegetable gardens. In addition, there are commercial farms in the facility area from which individuals may purchase produce. Produce grown in the vicinity of the proposed incinerator may be exposed to emitted chemicals both directly via deposition onto exposed surfaces and indirectly via uptake from soils. In the process of preparing produce for eating, this contamination is likely to be washed off, peeled off, or released during cooking. In addition, local produce is unlikely to provide an individual's total food source because the frequency of exposure is limited by the growing season of vegetables and fruits. For these reasons, exposures to individuals who are assumed to eat home grown or locally produced produce will not be evaluated. However, the potential risks associated with this pathway, based on analogy to other incinerator risk assessments, will be discussed in the uncertainty section.

4.4.4.2 Estimating Exposure Point Concentrations. Exposure point concentrations are estimated based on the chemical emission and deposition rates. Section 4.2 (Air Quality) describes the quantities of chemicals potentially emitted from the proposed facility and the results of the air dispersion modeling. Exhibit 4-15 lists the annual average air concentrations predicted for the selected chemicals of potential concern for the maximum exposed individual based on these results.

Deposition modeling was required to estimate concentrations in soil. Deposition modeling estimates the rate at which chemicals believed to be associated with particles emitted from the incinerator stack would be deposited on the ground. Deposition rates were calculated by multiplying the predicted chemical-specific air concentrations by the estimated particle deposition velocity (0.11 cm/sec). The formula is as follows:

$$D = (C_a)\ (DV)\ (Y)\ (Z)$$

where

- D = chemical specific deposition rates (ug/m^2-yr)
- C_a = chemical specific concentrations in air (ug/m^3)
- DV = deposition velocity (0.11 cm/sec)
- Z = conversion factor (31,536,000 sec/yr)
- Y = conversion factor (m/100cm)

The concentration of a chemical in soil depends on deposition rate, accumulation time in the soil, and soil characteristics that affect mixing. The following formula was used to calculate chemical concentrations in outdoor soil for all the selected chemicals except PCDDs/PCDFs:

$$C_S = \frac{(D)(AT)(X)}{(SD)(BD)}$$

where

- C_s = concentration of chemical in soil (mg/kg/day),
- D = chemical-specific deposition rate (ug/m^2-yr),
- AT = accumulation time (70 yr),
- SD = soil depth of mixing (assumed to be 0.01 m),
- BD = soil bulk density (1.33×10^3 kg/m^3), and
- X = conversion factor (mg/1000ug).

EXHIBIT 4-15

ANNUAL AVERAGE AIR CONCENTRATIONS PREDICTED FOR THE PROPOSED CHAMBERS WORKS INCINERATOR

CHEMICAL	ANNUAL AVERAGE AMBIENT AIR CONCENTRATION (ug/m3) Maximum (a)
Arsenic and compounds	4.21E-05
Benzene	1.80E-04
Beryllium and compounds	8.50E-07
Cadmium and compounds	2.11E-04
Carbon tetrachloride	1.80E-05
Chlorobenzene	1.80E-04
Chloroform	9.00E-04
Chromium (total)	1.26E-04
Chromium (VI)	2.53E-05
1,4-Dichlorobenzene	9.00E-04
Formaldehyde	1.80E-05
Lead	1.84E-03
Mercury	2.11E-04
Methylene chloride	1.80E-04
Nickel and compounds	1.26E-04
Polychlorinated biphenyls	9.00E-07
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	2.30E-09

Note: 1.00E-02 is equivalent to 1.00x10-2 and 0.01.

(a) Air concentration is estimated by multiplying the chemical-specific emission rate by the estimated maximum air concentration for a unit (g/sec) emission rate.

The model used to calculate soil concentrations is conservative because it assumes that all of the emitted contaminants are associated with emitted particles and neglects all mechanisms of loss, including photodegradation, biodegradation, volatilization, runoff, resuspension of particulate matter, removal of soil, mixing to greater depths, and dilution with other deposited particles. At least some of these mechanisms are likely to affect actual chemical concentrations in soil. Soil concentrations for the chemicals of concern are listed in Exhibit 4-16.

The model for calculating soil concentrations of PCDDs/PCDFs is similar except that the potential changes in their soil concentrations over time due to biodegradation processes were taken into account. As reported in USEPA[279], 2,3,7,8-TCDD and other organic chemicals can be decomposed by the action of microorganisms in soils. USEPA recommends that in assessing exposures to PCDDs/PCDFs over extended periods such as those considered in this risk assessment (e.g., 70 years), "it is appropriate to obtain the average concentration of 2,3,7,8-TCDD in soil over the depth of concern and exposure duration." Thus, the concentration of PCDDs/PCDFs in soil were calculated by the equation:

$$C_s = \frac{(D)\ (X)\quad (1-\exp[-k_s(AT)])}{(k_s)\ (SD)\ (BD)}$$

where

k_s=rate constant (yr^{-1}).

The rate constant was estimated from the equation:

$$k_s = \frac{0.693}{t_{1/2}}$$

where

$t_{1/2}$=half-life in soil (yr).

The half-lives used to calculate PCDD/PCDF soil concentrations were 12 years (k_s = 0.578 yr^{-1}) for the average case (Young 1983)[280] and 29 years (k_s = 0.0239 yr^{-1}) for the maximum case[281]. Young[282] studied the rate of disappearance of 2,3,7,8-TCDD in a herbicide applied to a test grid and calculated a half-life of 10-12 years based on both biodegradation and photolytic degradation processes (e.g., assuming a 5% annual rate of loss due to volatilization). Bumpus et al.[283] derived a half-life estimate for first-order kinetics. USEPA[284] noted that the estimated half-life of 29 years may be uncertain because the reaction progress was monitored by analyzing the reaction product (CO_2) being evolved and the exact stoichiometric relationships between CO_2 evolution and 2,3,7,8-TCDD biodegradation are not known. In addition, the half-life is applicable to only one fungus type whereas actual soil is likely to contain a diverse number of microorganism types, including bacteria.

EXHIBIT 4-16

SOIL CONCENTRATIONS PREDICTED FOR THE PROPOSED CHAMBERS WORKS INCINERATOR

CHEMICAL	ANNUAL AVERAGE AMBIENT AIR CONCENTRATION (ug/m3) Maximum (a)	SOIL CONCENTRATION FOR CHAMBERS WORKS INCINERATOR (mg/kg) Maximum (a)
Arsenic and compounds	4.21E-05	7.69E-03
Benzene	1.80E-04	3.29E-02
Beryllium and compounds	8.50E-07	1.55E-04
Cadmium and compounds	2.11E-04	3.85E-02
Carbon tetrachloride	1.80E-05	3.29E-03
Chlorobenzene	1.80E-04	3.29E-02
Chloroform	9.00E-04	1.64E-01
Chromium (VI)	2.53E-05	4.62E-03
1,4-Dichlorobenzene	9.00E-04	1.64E-01
Formaldehyde	1.80E-05	3.29E-03
Lead	1.84E-03	3.36E-01
Mercury	2.11E-04	3.85E-02
Methylene chloride	1.80E-04	3.29E-02
Nickel and compounds	1.26E-04	2.30E-02
Polychlorinated biphenyls	9.00E-07	1.64E-04
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	2.30E-09	2.04E-07

Note: 1.00E-02 is equivalent to 1.00x10-2 and 0.01.

(a) Calculated using a deposition velocity of 0.11 cm/sec.

4.4.4.3 Estimated Exposures for Each Selected Pathway. In this section the potential chemical intakes estimated for the MEI, that is the person residing at the maximum impact point, are estimated. The intake is based on exposure concentration in air and soil as described above and on a plausible maximum exposure scenario.

Intakes due to inhalation were estimated by the equation:

$$CI_a = \frac{(C_a)\ (DER_a)\ (F)\ (YR)\ (X)\ (Bio_a)}{(BW)\ (T)}$$

where

- CI_a = chronic intake estimates from inhalation (mg/kg/day),
- C_a = chemical-specific ambient air concentration (ug/m^3),
- DER_a = daily exposure rate for inhalation (m^3/day),
- F = frequency of exposure (days/year),
- YR = total years exposed (yrs),
- X = conversion factor (mg/1000 ug),
- Bio_a = adjustment for fraction of chemical bioavailable,
- BW = average body weight (kg), and
- T = averaging time (25,550 days in a lifetime).

In this risk assessment, it was conservatively assumed that the bioavailability of all inhaled chemicals was 100% (i.e., $Bio_a = 1.0$). This assumption is likely to overestimate potential risks, perhaps by as much as an order of magnitude, because most of the chemicals of concern are known to adsorb tightly to fly ash even in harsh conditions such as low pH.

Intakes due to incidental ingestion of soil were estimated by the equation:

$$CI_s = \frac{(C_s)\ (DER_s)\ (Z)\ (F)\ (YR)\ (Bio_s)}{(BW)\ (T)}$$

where

- CI_s = chronic daily intake from soil ingestion (mg/kg/day),
- C_s = chemical concentration in soil (mg/kg),
- DER_s = daily exposure rate for incidental soil ingestion (mg/day),
- Z = conversion factor (kg/10^6mg),
- F = frequency of exposure (days/year),
- YR = total years exposed (yrs),
- Bio_s = soil ingestion bioavailability factor,
- BW = average body weight (kg), and
- T = averaging time (25,550 days in a lifetime).

A relative bioavailability factor was applied in estimating exposures to the chemicals of concern to account for the reduced bioavailability of chemicals that are adsorbed to ingested fly ash and soils compared to chemicals that are administered orally in an experimental setting in food mash or a solvent medium. These bioavailability factors were derived for the organic chemicals of concern based on the experimental studies on 2,3,7,8-TCDD conducted by Poiger and Schlatter[285], McConnell et al.[286], Lucier et al.[287], and van den Berg et al.[288]. For the inorganic chemicals of concern, the absorption factors were based on the fly ash leaching study results presented by Fraser and Lum[289]. Exhibit 4-17 summarizes the ingestion bioavailability factors used in this risk assessment.

To estimate intakes, information describing the extent, frequency, and duration of exposure was also developed as shown in Exhibit 4-18 for the inhalation pathway and Exhibit 4-19 for the soil ingestion pathway. For each exposure pathway, estimates of plausible maximum exposure rates are provided. The exposure rates describe the amount of daily contact with an environmental medium by an exposed individual (e.g., inhalation of 20 m^3 of air per day). The ingestion of 141 mg of outdoor soil per day is a weighted lifetime average of the maximum soil ingestion rates provided by Lagoy[290] for various age periods in an individual's lifetime. These exposure rates are multiplied by the estimated exposure point concentrations in each medium. For example, the exposure rates for inhalation in m^3/day are multiplied by ambient air concentrations in ug/m^3.

Based on the NJDEP Guidelines, the duration of exposure is assumed to be 70 years to represent the lifetime of the MEI. This estimate is conservative however, because 70 years is likely to exceed the operational lifetime of the incinerator. Also based on NJDEP Guidelines it was assumed that an individual may be exposed to airborne chemicals at the maximum level 365 days per year 24 hours/day. It was conservatively assumed that indoor air concentrations are equivalent to outdoor air concentrations. This assumption is likely to lead to overestimation of chemical intakes because experimental results indicate that indoor concentrations of outdoor generated pollutants are frequently lower than outdoor concentrations[291].

Some of the chemicals considered in this report are persistent in the environment so that the fraction that is deposited in soil may lead to human exposure even after the end of the operating lifetime of the facility. Therefore, the exposure duration for soil ingestion is also assumed to be lifetime, 70 years.

The frequency of exposure is the potential number of days per year that an individual may come into contact with a contaminated environmental medium. Contact with soil is assumed to occur only on days when temperatures are above 32°F. Climatological data for Greater Wilmington Airport shows that on 102 days temperatures were 32°F and below[292], so soil contact could occur on 263 days per year (i.e., 365-102). Assuming contact with soil two days per week, the frequency of exposure is 75 days per year (2/7 x 263). The daily inhalation rate (20 m^3/d) and average body weight (70 kg) were based on information provided by USEPA[293].

EXHIBIT 4-17

INGESTION BIOAVAILABILITY FACTORS

CHEMICAL	RELATIVE ORAL BIOAVAILABILITY FACTOR
Arsenic and compounds	0.290
Benzene	1.000
Beryllium and compounds	0.028
Cadmium and compounds	0.110
Carbon tetrachloride	1.000
Chlorobenzene	1.000
Chloroform	1.000
Chromium and compounds	0.003
1,4 Dichlorobenzene	1.000
Formaldehyde	1.000
Lead	0.024
Mercury	0.110
Methylene chloride	1.000
Nickel and compounds	0.048
Polychlorinated Biphenyls	0.500 (max.)
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	0.500 (max.)

EXHIBIT 4-18

EXPOSURE PARAMETERS FOR PROPOSED
CHAMBERS WORKS INCINERATOR

INHALATION PATHWAY

PARAMETER	PARAMETER VALUE MAXIMUM CASE
Daily Exposure Rate for Inhalation	20 m3/days
Frequency of Exposure	365 days/yr
Total Years Exposed	70 yrs
Average Body Weight	70 kg

EXHIBIT 4-19

EXPOSURE PARAMETERS FOR PROPOSED
CHAMBERS WORKS INCINERATOR

INCIDENTAL SOIL INGESTION PATHWAY

PARAMETER	PARAMETER VALUE MAXIMUM CASE
Daily Exposure Rate for Incidental Soil Ingestion	141 mg/days
Frequency of Exposure	75 days/yr
Total Years Exposed	70 yrs
Average Body Weight	70 kg

Exhibit 4-20 presents the estimated chronic inhalation intakes for the chemicals of concern. The chemical intake estimates will be combined with the health criteria for inhalation exposure presented in Exhibit 4-18 to determine the potential risks associated with direct inhalation of chemicals emitted from the Chambers Works incinerator.

The chronic daily soil ingestion intakes for the chemicals of concern are shown in Exhibit 4-21. Because the chemicals are assumed to remain in the soil, the intake estimates for both carcinogens and noncarcinogens are averaged over a 70-year exposure period. These intake estimates will be combined with health criteria for oral exposures to estimate the potential risks associated with this exposure pathway.

4.4.5 Risk Characterization

As mentioned earlier, the USEPA utilizes separate methodologies for estimating potential risk from carcinogenic and noncarcinogenic chemicals. At low doses (doses corresponding to risks lower than 10^{-2}), the lifetime risk for a chemical exhibiting carcinogenic effects is calculated by multiplying the upper bound cancer potency factor [in $(mg/kg/day)^{-1}$] by the estimated chronic chemical intake (in mg/kg/day). For noncarcinogens, potential risks are calculated by means of a ratio of the chronic intake to the reference dose (RfD). This ratio is then summed for all chemicals and is called the hazard index. Values of these ratios that are greater than one are indicative of a potential for adverse health effects.

4.4.5.1 Potential Inhalation Risks. The risk estimates for the inhalation pathway are shown in Exhibit 4-22. The chemicals that presented the highest estimated carcinogenic risk are polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran compounds (PCDDs/PCDFs) at $1x10^{-7}$ (i.e., 0.1 cases per million). This is an upper bound risk to the hypothetical MEI given a lifetime exposure at the maximum point of impact. Upper bound means that the actual risks are unlikely to be higher than these predicted risks but they may be considerably lower. The total hazard index for the chemicals with noncarcinogenic health effects criteria for inhalation (chlorobenzene and lead) is 0.003, more than 300 times lower than the threshold level of one.

4.4.5.2 Potential Risks Due to Soil Ingestion. Risk estimates for the soil ingestion pathway are shown in Exhibit 4-23. The highest excess lifetime cancer risk for this exposure pathway is from arsenic at 9.7×10^{-9}. The chemical that has the next greatest risk estimate is PCDDs/PCDFs at 6.6×10^{-9}. Risks for all other chemicals are approximately 10 times lower than these. These are upper-bound risks to the MEI and as stated before, actual risks are unlikely to be higher and may be much lower than these estimates. The hazard index is below one, indicating that adverse noncarcinogenic effects are unlikely to occur.

EXHIBIT 4-20

CHRONIC INHALATION INTAKE ESTIMATES FOR CHEMICALS EMITTED FROM THE PROPOSED CHAMBERS WORKS INCINERATOR

CHEMICALS EXHIBITING POTENTIAL CARCINOGENIC EFFECTS	ANNUAL AVERAGE AMBIENT AIR CONCENTRATION (ug/m3) Maximum (a)	CHRONIC INHALATION INTAKE ESTIMATES (mg/kg/day)(a) Maximum Case
Arsenic and compounds	4.21E-05	1.20E-08
Benzene	1.80E-04	5.14E-08
Beryllium and compounds	8.50E-07	2.43E-10
Cadmium and compounds	2.11E-04	6.03E-08
Carbon tetrachloride	1.80E-05	5.14E-09
Chloroform	9.00E-04	2.57E-07
Chromium (total)	1.26E-04	3.60E-08
Chromium (VI)	2.53E-05	7.23E-09
1,4-Dichlorobenzene	9.00E-04	2.57E-07
Formaldehyde	1.80E-05	5.14E-09
Methylene chloride	1.80E-04	5.14E-08
Nickel and compounds	1.26E-04	3.60E-08
Polychlorinated biphenyls	9.00E-07	2.57E-10
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	2.30E-09	6.57E-13

CHEMICALS EXHIBITING POTENTIAL NONCARCINOGENIC EFFECTS	ANNUAL AVERAGE AMBIENT AIR CONCENTRATION (ug/m3) Maximum (a)	CHRONIC INHALATION INTAKE ESTIMATES (mg/kg/day)(a) Maximum Case
Chlorobenzene	1.80E-04	5.14E-08
Lead	1.84E-03	5.26E-07
Mercury	2.11E-04	6.03E-08

Note: 1.00E-02 is equivalent to 1.00x10-2 and 0.01.

(a) The chronic daily intake estimates for carcinogens were averaged over a 70-year period. The chronic daily intake estimates for noncarcinogens were also averaged over a 70-year period because the assumed exposure is for a 70 year lifetime.

EXHIBIT 4-21

CHRONIC INCIDENTAL SOIL INGESTION ESTIMATES FOR CHEMICALS EMITTED FROM THE PROPOSED CHAMBERS WORKS INCINERATOR

CHEMICALS EXHIBITING POTENTIAL CARCINOGENIC EFFECTS	SOIL CONCENTRATION FOR CHAMBERS WORKS INCINERATOR (mg/kg) Maximum (a)	ESTIMATES OF CHRONIC SOIL INGESTION INTAKES (mg/kg/day)(a) Maximum Case
Arsenic and compounds	7.69E-03	9.23E-10
Benzene	3.29E-02	1.36E-08
Carbon tetrachloride	3.29E-03	1.36E-09
Chloroform	1.64E-01	6.80E-08
1,4-Dichlorobenzene	1.64E-01	6.80E-08
Methylene chloride	3.29E-02	1.36E-08
Polychlorinated biphenyls	1.64E-04	3.40E-11
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	2.04E-07	4.22E-14

CHEMICALS EXHIBITING POTENTIAL NONCARCINOGENIC EFFECTS	SOIL CONCENTRATION FOR CHAMBERS WORKS INCINERATOR (mg/kg) Maximum (a)	ESTIMATES OF CHRONIC SOIL INGESTION INTAKES (mg/kg/day)(a) Maximum Case
Arsenic and compounds	7.69E-03	9.23E-10
Beryllium and compounds	1.55E-04	1.80E-12
Cadmium and compounds	3.85E-02	1.75E-09
Carbon tetrachloride	3.29E-03	1.36E-09
Chlorobenzene	3.29E-02	1.36E-08
Chloroform	1.64E-01	6.80E-08
Chromium (IV)	4.62E-03	5.74E-12
1,4-Dichlorobenzene	1.64E-01	6.80E-08
Lead	3.36E-01	3.34E-09
Mercury	3.85E-02	1.75E-09
Methylene chloride	3.29E-02	1.36E-08
Nickel and compounds	2.30E-02	4.57E-10
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	2.04E-07	4.22E-14

Note: 1.00E-02 is equivalent to 1.00x10-2 and 0.01.

(a) The chronic daily intake estimates for carcinogens were averaged over a 70-year period. The chronic daily intake estimates for noncarcinogens were also averaged over a 70-year period because the assumed exposure is for a 70 year lifetime.

EXHIBIT 4-22

RISKS ASSOCIATED WITH INHALATION OF CHEMICALS EMITTED FROM THE PROPOSED CHAMBERS WORKS INCINERATOR

CHEMICALS EXHIBITING POTENTIAL CARCINOGENIC EFFECTS	CHRONIC INHALATION INTAKE ESTIMATES (mg/kg/day)(a) Maximum Case	CANCER POTENCY FACTOR (b) (mg/kg/day)-1	MAXIMUM EXPOSED INDIVIDUAL RISK (Lifetime) Maximum Case
Arsenic and compounds	1.20E-08	5.00E+01	6.01E-07
Benzene	5.14E-08	2.80E-02	1.44E-09
Beryllium and compounds	2.43E-10	8.40E+00	2.04E-09
Cadmium and compounds	6.03E-08	6.10E+00	3.68E-07
Carbon tetrachloride	5.14E-09	1.30E-01	6.69E-10
Chloroform	2.57E-07	8.10E-02	2.08E-08
Chromium (total)	3.60E-08	4.10E+01	1.48E-06
Chromium (IV)	7.23E-09	4.10E+01	2.96E-07
1,4-Dichlorobenzene	2.57E-07	2.40E-02	6.17E-09
Formaldehyde	5.14E-09	4.55E-02	2.34E-10
Methylene chloride	5.14E-08	1.40E-02	7.20E-10
Nickel and compounds	3.60E-08	8.40E-01	3.02E-08
Polychlorinated biphenyls	2.57E-10	7.70E+00 (b)	1.98E-09
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	6.57E-13	1.56E+05 (b)	1.03E-07

CHEMICALS EXHIBITING POTENTIAL NONCARCINOGENIC EFFECTS	CHRONIC INHALATION INTAKE ESTIMATES (mg/kg/day)(a) Maximum Case	HEALTH CRITERION (mg/kg/day)	HAZARD INDEX Maximum Case
Chlorobenzene	5.14E-08	5.00E-03	1.03E-05
Lead	5.26E-07	4.30E-04	1.22E-03
Mercury	6.03E-08	2.00E-03 (b)	3.01E-05

Note: 1.00E-02 is equivalent to 1.00x10-2 and 0.01.

(a) The chronic daily intake estimates for carcinogens were averaged over a 70-year period. The chronic daily intake estimates for noncarcinogens were also averaged over a 70-year period because the assumed exposure is for a 70 year lifetime.

(b) Toxicity criteria based on the oral route of exposure are used since inhalation criteria were not available.

EXHIBIT 4-23

RISKS ASSOCIATED WITH INCIDENTAL SOIL INGESTION
FOR CHEMICALS EMITTED FROM THE PROPOSED
CHAMBERS WORKS INCINERATOR

CHEMICALS EXHIBITING POTENTIAL CARCINOGENIC EFFECTS	ESTIMATES OF CHRONIC SOIL INGESTION INTAKES (mg/kg/day)(a)	CANCER POTENCY FACTOR (b) (mg/kg/day)-1	MAXIMUM EXPOSED INDIVIDUAL RISK (Lifetime)
	Maximum Case		Maximum Case
Arsenic and compounds	9.23E-10	1.75E+00	1.61E-09
Benzene	1.36E-08	2.90E-02	3.94E-10
Carbon tetrachloride	1.36E-09	1.30E-01	1.77E-10
Chloroform	6.80E-08	6.10E-03	4.15E-10
1,4-Dichlorobenzene	6.80E-08	2.40E-02	1.63E-09
Methylene chloride	1.36E-08	7.50E-03	1.02E-10
Polychlorinated biphenyls	3.40E-11	7.70E+00	2.62E-10
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	4.22E-14	1.56E+05	6.58E-09

CHEMICALS EXHIBITING POTENTIAL NONCARCINOGENIC EFFECTS	ESTIMATES OF CHRONIC SOIL INGESTION INTAKES (mg/kg/day)(a)	HEALTH CRITERION (mg/kg/day)	HAZARD INDEX
	Maximum Case		Maximum Case
Arsenic and compounds	9.23E-10	1.00E-03	9.23E-07
Beryllium and compounds	1.80E-12	5.00E-03	3.60E-10
Cadmium and compounds	1.75E-09	1.00E-03	1.75E-06
Carbon tetrachloride	1.36E-09	7.00E-04	1.94E-06
Chlorobenzene	1.36E-08	3.00E-02	4.53E-07
Chloroform	6.80E-08	1.00E-02	6.80E-06
Chromium (VI)	5.74E-12	5.00E-03	1.15E-09
1,4-Dichlorobenzene	6.80E-08	1.00E-01	6.80E-07
Lead	3.34E-09	6.00E-04	5.56E-06
Mercury	1.75E-09	2.00E-03	8.77E-07
Methylene chloride	1.36E-08	6.00E-02	2.27E-07
Nickel and compounds	4.57E-10	2.00E-02	2.29E-08
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	4.22E-14	1.00E-09	4.22E-05

Note: 1.00E-02 is equivalent to 1.00x10-2 and 0.01.

(a) The chronic daily intake estimates for carcinogens were averaged over a 70-year period. The chronic daily intake estimates for noncarcinogens were also averaged over a 70-year period because the assumed exposure is for a 70 year lifetime.

4.4.5.3 Summary of Risk Characterization. Risks were estimated in this assessment for an individual assumed to be exposed continuously to the highest predicted air and soil concentration. The chemicals that contribute most to the estimated risk are PCDDs/PCDFs, arsenic and chromium. As discussed above, the risk assessment approach taken tends to overestimate risks as a result of uncertainties in the several steps of the process and of the use of very conservative assumptions to compensate for these uncertainties. It is possible that an individual may be exposed to the same contaminant from more than one pathway. Exhibit 4-24 presents the total risk for the MEI. This evaluation for the hypothetical MEI tends to overestimate the risk to any individual because the maximum air concentration does not occur in the same place as the maximum soil concentration.

It should be recognized that the maximum case risks shown in Exhibits 4-21 and 4-22 are not associated with actual exposure scenarios but rather with hypothetical worst case exposure scenarios. For example, the inhalation scenario assumes that the individual breathes outdoor air 24 hours at the point of maximum air concentration 365 days/year for 70 years continuously. The following section discusses the sources of uncertainty in this assessment and how they may affect the risk estimates.

4.4.6 Discussion of Uncertainties

All risk assessments involve the use of assumptions, judgement, and imperfect data to varying degrees. This results in uncertainty in the final estimates of risk. Uncertainty in a risk assessment may arise from many sources including:

- Misidentification or failure to be all-inclusive in hazard identification;
- Choice of models or evaluation of toxicological data in dose-response quantification; and
- Assumptions concerning exposure scenarios and population distributions.

Uncertainty may be magnified in the assessment through a combination of these sources.

In risk assessments in which considerable uncertainty is anticipated, a technique commonly employed to compensate for uncertainty is to bias the assessment in the direction of overestimation of risk. This is often termed a "worst case" or "conservative" analysis. The net effect of combining numerous conservative assumptions is that the final estimates of risk may be greatly overestimated.

EXHIBIT 4-24

ESTIMATED POTENTIAL RISK FROM EXPOSURE TO CHEMICALS BY INHALATION AND SOIL INGESTION PATHWAYS: PROPOSED CHAMBERS WORKS INCINERATOR

CHEMICALS EXHIBITING CARCINOGENIC EFFECTS	ESTIMATED RISK FROM SOIL INGESTION	ESTIMATED RISK FROM INHALATION	ESTIMATED TOTAL RISK (a)
	Maximum Case	Maximum Case	Maximum Case
Arsenic	1.6E-09	6.0E-07	6E-07
Benzene	3.9E-10	1.4E-09	2E-09
Beryllium	NC	2.0E-09	2E-09
Cadmium	NC	3.7E-07	4E-07
Chromium (VI)	NC	3.0E-07	3E-07
Carbon tetrachloride	1.8E-10	6.7E-10	8E-10
Chloroform	4.2E-10	2.1E-08	2E-08
1,4-Dichlorobenzene	1.6E-09	6.2E-09	8E-09
Formaldehyde	NC	2.3E-10	2E-10
Methylene chloride	1.0E-10	7.2E-10	8E-10
Nickel	NC	2.6E-08	3E-08
Polychlorinated biphenyls (PCBs)	2.6E-10	2.0E-09	2E-09
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	6.6E-09	1.0E-07	1E-07

CHEMICALS EXHIBITING NONCARCINOGENIC EFFECTS	ESTIMATED HAZARD INDEX FROM SOIL INGESTION	ESTIMATED HAZARD INDEX FROM INHALATION	ESTIMATED TOTAL RISK (a)
	Maximum Case	Maximum Case	Maximum Case
Arsenic	9.2E-07	NC	9E-07
Beryllium	3.6E-10	NC	4E-10
Cadmium	1.8E-06	NC	2E-06
Carbon tetrachloride	1.9E-06	NC	2E-06
Chlorobenzene	4.5E-07	1.0E-05	1E-05
Chloroform	6.8E-06	NC	7E-06
Chromium (VI)	1.1E-09	NC	1E-09
1,4-Dichlorobenzene	6.8E-07	NC	7E-07
Lead	5.6E-06	1.2E-03	1E-03
Mercury	8.8E-07	3.0E-05	3E-05
Methylene chloride	2.3E-08	NC	2E-08
Nickel	2.3E-08	NC	2E-08
PCDDs/PCDFs (expressed as 2,3,7,8-TCDD equivalents)	4.2E-05	NC	4E-05

NOTE: 1.00E-02 is equivalent to 1.00x10-2 and 0.01.

(a) This estimate is conservative (protective) because the area of highest air concentration is located at a different point from the area of highest soil levels.

NC = Not calculated (health effects criteria not available.

4.4.6.1 Uncertainties in Hazard Identification. In almost all risk assessments, the largest source of uncertainty is in the health effects criteria. Uncertainties in health criteria may significantly affect the magnitude of the risk estimates presented in this report. Health criteria for evaluating long-term exposures such as risk reference doses or cancer potency factors are based on concepts and assumptions which bias an evaluation in the direction of overestimation of health risk. USEPA noted in its Guidelines for Carcinogenic Risk Assessment:

> There are major uncertainties in extrapolating both from animals to humans and from high to low doses. There are important species differences in uptake, metabolism, and organ distribution of carcinogens, as well as species and strain differences in target site susceptibility. Human populations are variable with respect to geometric constitution, diet, occupational and home environment, activity patterns, and other cultural factors.[294]

These uncertainties are compensated for by using upper bound 95th percentile upper confidence limits for cancer potency factors for carcinogens and uncertainty factors for reference doses for noncarcinogens. At best, the several sets of conservative assumptions used here provide a rough but plausible estimate of the upper limit of risk, but it could very well be considerably lower.

In addition, there are varying degrees of confidence in the weight of evidence for carcinogenicity of a given chemical. USEPA's[295] weight-of-evidence classification provides information which can indicate the level of confidence or uncertainty in the data obtained from studies in humans or experimental animals. For example, several of the carcinogens evaluated in this report are classified in Groups B1 (beryllium and cadmium) or B2 (PCDDs/PCDFs, formaldehyde), probable human carcinogens with limited or inadequate evidence from human studies and adequate evidence from animal studies. Some of the uncertainties in the hazard evaluation are further compensated for by assuming that animal carcinogens behave as human carcinogens.

In general, cancer potency factors are very uncertain and probably very conservative, but the sources of uncertainty differ among the chemicals. The chemicals of primary concern from the Chambers Works incinerator include PCDDs/PCDFs, arsenic, and chromium. For inorganic chemicals including arsenic, the major sources of uncertainty are limitations in the data based on the human epidemiological studies and uncertainty about the physical and chemical forms of the inorganic chemicals in the workplace (mostly smelters) from which the data were derived. The cancer potency factor for chromium is associated with only the hexavalent form, which is more toxic than the trivalent form. Preliminary studies show that the chromium emitted from this incinerator is likely to be less than 20% hexavalent[296]. In this assessment, however, all emitted chromium is treated conservatively as chromium VI. The carcinogenic potency for nickel is based primarily on nickel subsulfide which has a very low probability of being emitted from a hazardous waste incinerator. For the organic carcinogens, including PCDDs/PCDFs, the major sources of uncertainty are from the extrapolation from the carcinogenic effects of the compounds in laboratory test animals exposed to relatively high doses to humans exposed to relatively low doses. For PCDDs/PCDFs, the upper bound cancer potency factor as derived from the linearized multistage model differs from the lower bound by five orders of magnitude, yielding a large window of uncertainty in its interpretation. Recent information suggesting that PCDDs/PCDFs behave as promoters rather than initiators of cancer could lower the calculated risk by over an order of magnitude[297,298].

The carcinogenicity of ingested inorganic arsenic has been a matter of controversy for many years. Recently, USEPA has decided that arsenic is a human carcinogen (Category A) by the oral route. Several factors have lead USEPA to reconsider arsenic's potency. These factors are: 1) the epidemiology was conducted in other countries which may not be appropriate to the U.S.; 2) the primary response in these studies is skin tumors, which are relatively easily detected and treated; and 3) arsenic may be an essential nutrient. USEPA's Risk Assessment Forum has considered adjusting arsenic's risk downward by a factor of 10 (Memorandum from John Moore, Chair Risk Assessment Forum, September 18, 1987) but has not reached a final decision. However, it should be recognized that the risks from arsenic ingestion may be overestimated by a factor of ten.

4.4.6.2 Uncertainties in Exposure Assessment. There are two major areas of uncertainty in the exposure assessment. These include: 1) the choice of exposure models and input parameters used to estimate exposure point concentrations; and 2) the methods and parameters used to calculate chemical intakes.

The uncertainties involved in estimating exposure point concentrations include conservative assumptions used in calculating soil concentrations. These concentrations provide the basis for estimating chemical intakes via outdoor soil ingestion. The mixing depth, persistence, fate and transport, and half-lives are relatively uncertain quantities, so an effort was made to compensate for this uncertainty by applying conservative assumptions. Most of the assumptions are thus expected to overestimate exposure point concentrations and would therefore overestimate risks.

For the purposes of this assessment exposure by ingestion of homegrown and local produce was not quantitatively evaluated. The potential risk from ingestion of produce has been quantitatively evaluated in a risk assessment for a resource recovery facility that had soil ingestion risks of the same order of magnitude as the Chambers Works incinerator[299]. A rough comparison can be made to estimate the impact of produce ingestion on total cancer risks for the Chambers Works incinerator. Assuming additivity of risks across carcinogens, the total cancer risk from exposure by soil ingestion in this assessment is 2 x 10-8. Based on analogy to the other resource recovery risk assessment, the total cancer risk for soil and produce ingestion would be 3 x 10-8 for both pathways, based on the ratio of risks for produce to soil ingestion in the other risk assessment.

Major uncertainties are associated with the parameters used to characterize maximum case exposures, including the assumed points of exposure, the contact rates with exposure media, and the frequency and duration of exposure. For example, the MEI is assumed to be continuously located at the point of maximum exposure throughout a lifetime of 70 years. The addition of risks across pathways assumes an individual would be exposed to maximum air concentration and the maximum soil concentration simultaneously. This overestimates risks because these two exposure points are not actually listed in the same place.

4.4.6.3 Summary. The results of this assessment indicate that the incinerator emissions will have no significant impact on public health. Doses of all chemicals with non-carcinogenic effects were calculated to be far below the doses that cause adverse health effects. Risks (i.e., hazard indices) were several orders of magnitude below the threshold for chronic (long-term) effects. The highest risk for a chemical with carcinogenic effects was an upper bound limit for polychlorinated dibenzo-p-dioxin and polychlorinated dibenzofuran compounds (PCDDs/PCDFs) of $1x10^{-7}$ (i.e., 0.1 cases per million). The maximum risks for hexavalent chromium, cadmium, and arsenic are $3x10^{-7}$, $4x10^{-7}$, and $6x10^{-7}$, respectively. Risks estimated for all other chemicals were about 10 to 10,000 times lower. No acute (short-term) effects are expected.

4.5 WORKER HEALTH AND SAFETY

Routine operations at the proposed incinerator and landfill will not have significant impacts on the health and safety of employers, employees, and visitors at Chambers Works. The operations at the incinerator and landfill will be covered under the plant-wide health and safety program, and this program, together with proposed designs and other administrative controls, is sufficiently comprehensive in scope to protect worker health and safety. In the subsections that follow, key elements of the program are presented, as well as how these elements comply with regulations of the Occupational Safety and Health Administration (OSHA) to eliminate or reduce health and safety impacts during routine operations.

4.5.1 Protection for Workers Engaged in Hazardous Waste Operations

Du Pont's health and safety program provides protection to workers engaged in hazardous waste operations and generally complies with OSHA's interim final rule (29 CFR 1910.120, 1986). Elements that are required include:

1. Development of an employee safety and health program,
2. Site characterization and analysis,
3. Site control procedures,
4. Training,
5. Medical surveillance program,
6. Engineering controls and personal protective equipment to protect employees,

7. Air monitoring,
8. Information program on safety and health hazards in the workplace,
9. Material handling procedures,
10. Decontamination procedures,
11. Emergency response plan,
12. Appropriate illumination of the workplace,
13. Appropriate sanitary facilities,
14. Shoring and sloping are essential during excavation activities related to site preparation or response to spills/releases of chemicals, and
15. Contractors and subcontractors shall be informed of potential fire explosion, and other health and safety hazards

Two exceptions were noted. First, for individuals who require the initial 24 hours health and safety training course for hazardous waste operations at transportation, storage, disposal facilities there exists an 8 hour annual health and safety refresher training requirement. Although Du Pont officials state that employees engaged in hazardous waste operations receive more than 8 hours of annual health and safety refresher training, Chambers Works does not yet have an established 8 hour review course. According to Du Pont officials, they will soon have this course in place. However, OSHA has accepted the Du Pont refresher course as equivalent to an 8-hour annual training course in audits of the Chambers Works. Secondly, not all of the Du Pont employees who are engaged in regular response to hazardous waste incidents at the plant, and specifically in the chemical waste operations area (the area which will include the proposed incinerator and landfill), receive yearly physicals as required by paragraph (f). However, individuals who are potentially exposed during a response do report immediately to the plant hospital. If appropriate urine and/or blood samples are indicated, these samples are taken for biological monitoring purposes. The plant hospital also examines the spill responder for vital signs along with signs and symptoms of chemical exposures.

Visitors to Chambers Works, including State inspectors, are also covered under the Chambers Works health and safety program. Visitors on site for a few days are escorted by trained Du Pont employees. If visitors stay on site for an extended period (e.g., one to two weeks), they are expected to prepare a health and safety plan and submit it to Du Pont officials for approval.

4.5.2 Training

Each year any employee who works in the chemical waste operations area views a videotape and receives training in the following modules:

1. Chemical and physical hazards communications,
2. Toxic Substances Control Act,
3. Employee access to exposure and medical records,
4. Asbestos control,
5. Hearing conservation,
6. Spill and fume control,
7. First aid,
8. Air masks and respirator,

9. Fire brigade,
10. Chambers Works general safety and health rules,
11. Building safety and health rules,
12. Eye protection,
13. Protective clothing,
14. Inorganic lead communications,
15. Forklift training, and
16. Resource Conservation and Recovery Act (RCRA)

This training, especially modules 3, 8, 10, and 13, complies with 29 CFR 1910.120, paragraph (e).

4.5.3 Medical Surveillance Program

The Du Pont Chambers Works facility is beginning to institute a medical surveillance program in accordance with 29 CFR 1910.120, paragraph (f), but as previously indicated, not all employees responding to hazardous materials' incidents receive yearly physicals. The plant hospital has 2 full-time physicians, 1 physician's assistant, 6 medical technicians, and 7 nurses on duty during the day shift. There is 1 nurse on duty during the other shifts. The plant hospital has the capability to take x-rays, perform surgery, and take blood and urine samples for analysis at the plant. More sophisticated problems are referred to Salem Memorial Hospital, which has decontamination facilities to address radioactive or chemical exposures of employees.

4.5.4 Respiratory Protection

Du Pont Chamber Works has a respiratory protection program that complies with 29 CFR 1910.134. Paragraph (b) of the regulations outlines the requirements of an acceptable respiratory protection program. The first requirement establishes the need for "written standard operating procedures governing the selection and use of respirators...". The Chambers Works Respiratory Protection Manual meets the 11 requirements of paragraph (b). In accordance with requirement (10), Du Pont ensures that an employee is first capable of wearing a respirator through an assessment of health and physical condition by a Du Pont physician.

Du Pont employees receive an annual fit test. Some select employees or contractors will be fit tested twice per calendar year as a precautionary measure. For instance, the contractors at the landfill are fit-tested twice each year due to their potential contact with asbestos at the landfill. For several years, Du Pont Chambers Works employees have received quantitative fit tests using corn oil as the test compound. Although the quantitative fit test is not required by OSHA, it is more comprehensive than a qualitative fit test and can provide additional information that can be more protective to the employee in the event of a need to wear a respirator.

4.5.5 Hazard Communication

Du Pont Chambers Works has a written hazard communication program that was prepared to comply with OSHA's hazardous communication standard (29 CFR 1910.120). The purpose of this standard is to "ensure that the hazards of all chemicals produced or imported by chemical manufacturers or importers are evaluated, and that information concerning their hazards is transmitted to affected employers and employees...". The Du Pont written program is distributed to all employees and is also accessible via personal computers. The individual programs contain material safety data sheets (MSDSs) for the chemicals that are used in the operation areas in which employees work. All together, there are approximately 4000 MSDSs for the estimated 4000 products that are manufactured or used at the facility. In addition, to ensure full participation and a level of proficiency on the part of employees, the "Hazard Communication Program" has been placed on interactive video. New employees actively participate with the information on screen and must achieve a 75% score on a test to demonstrate proficiency.

The "Hazards Communication Program" is also distributed to the supervisor of each group of contractors who comes to perform work at the Chambers Works. The appropriate MSDSs are attached for the operation area in which they will perform work. It is the responsibility of the supervisor to assure that his/her people receive copies of the "Hazards Communication Program" and that each of them is appropriately educated on the content.

MSDSs provided to employees working at the incinerator and landfill will depend on wastes going to these waste management units. Waste analysis will be performed for each waste stream (see Sections 2.1.4.1 and 2.2.3 for the incinerator and landfill, respectively), and based on analytical results and known constituents in the waste stream, the employees will be provided with the appropriate MSDSs.

In October 1988, OSHA reviewed the Du Pont Chambers Works "Hazards Communication Program". OSHA found that the document met the regulations as stated in 29 CFR 1910.1200.

4.5.6 Emergency Response Capabilities

The Du Pont Chambers Works has an "Emergency and Disaster Manual" for the different operation areas throughout the plant. The emergency response manual that presently addresses the existing incinerators and landfill is entitled "Chemical Waste/Salvage/Landfill Area, Building Numbers 1079/1115." This manual meets the emergency response requirements as outlined in 29 CFR 1910.120, paragraph (l). Du Pont officials have stated that this emergency response manual will be expanded to address the new incinerator and landfill. For additional information on the Du Pont Chambers Works emergency response capability, see Section 2.5.3.3, Detection and Warning, and Section 2.5.3.4, Evacuation.

The Du Pont Chambers Works facility also has an active Transportation Emergency Response (TERP) Team. It is comprised of nine Du Pont employees, all of whom are trained to respond to incidents requiring Level A personal protection. The TERP Team can respond with four different vehicles. One of the vehicles has a cellular phone and a data link to access Du Pont Company MSDSs, CAMEO (Computer Aided Monitoring of Emergency Operations) software for prediction of plume movement of an airborne chemical contaminant, and a chemical information data base called HAZLINE. The only responses which the TERP Team are not trained to handle are radioactive materials incidents, explosives, and polychlorinated biphenyl releases. The TERP Team is well trained to deal with most hazardous chemical spills/releases and possesses a good deal of collective experience in spill response to respond to mishaps within the Du Pont Chambers Works facility. For additional information on the TERP Team, see Section 2.5.3.7, Response System and Operations.

4.6 SOCIOECONOMIC CHARACTERISTICS

Projected changes in current socioeconomic characteristics caused by the proposed incinerator and landfill projects will have minimal impacts. Changes will include:

- Additional acreage in industrial use;
- Increased numbers of workers at the site during construction and operation;
- Increased project expenditures for labor and materials during construction and operation;
- Increased consumption of electricity and water during construction and operation;
- Increased tax revenues; and
- Increased traffic.

This section describes the type and magnitude of changes likely to occur in Salem County, Carneys Point, Penns Grove, and Pennsville as a result of the expansion projects.

4.6.1 Demographic Changes

The construction workforce will be largely temporary, and will not substantially influence the demography of the area. The workforce will be made up of heavy equipment operators, surveyors, supervisors, drillers, basic laborers, welders, and design engineers. Typically, for other Chambers Works projects, workers have been drawn from the surrounding area. However, while it is likely that some of the workforce for the proposed incinerator and landfill expansion projects will be drawn from the local labor pool, the number of workers will depend on the contractor selected (through the competitive bid process). As noted earlier in Exhibit 3-56, there were 12,165 contract construction employees located in Salem and New Castle Counties in 1986. While it is likely that some of these workers would be hired for the Chambers Works expansion, for purposes of this analysis, a worst case assumption that all project workers will in-migrate to the area for employment will be used. The in-migrating workforce would be expected to temporarily relocate to communities near the Chambers Works Plant.

The duration of each worker's stay in the site area will vary with schedule tasks. During the incinerator construction phase, there will be a peak in the workforce of 275 persons which will last approximately 9-12 months. The workforce will range from 150-175 workers for the balance of the construction phase (about 18 months). Once construction of the incinerator is complete, approximately 50 operations and maintenance personnel will remain on-site. The landfill will require approximately 25 workers during the 6-9 month construction phases. The maximum number of additional workers on-site is approximately 300. This analysis will focus on impacts from the peak construction workforce since it raises the greatest potential for change.

In order to estimate the demographic impact of these additional workers, a population in-migration model was used to develop a range of impact levels. This model is a simple linear program that estimates the number of people who will relocate to an area for project construction and operation. It estimates in-migration levels on the basis of workforce size, number of local hires expected, percentage of single workers, and family size for married workers moving to the area for jobs. Exhibit 4-25 illustrates the variables and formulas for calculating in-migration estimates. In order to estimate the range of potential demographic changes, two sets of assumptions were developed. The first set of assumptions is designed to provide an upper limit on the number of people expected to in-migrate (worst case). The second set of assumptions is based on expectations about what is most likely to happen given the socioeconomic setting in the area (best case). Exhibit 4-26 presents the inputs and multipliers associated with each case. The various multipliers were chosen on the basis of references listed in the exhibit, which reflect research conducted on community impacts associated with new project developments.

This model was designed to project a range of in-migration estimates within which actual in-migration values will lie. The analysis presented here assumes no mitigative measures are applied to reduce in-migration, and for the worst case it uses projects worker characteristics that tend to overstate in-migration. For example, given the relatively short duration of the construction period, few workers in-migrating to the area are likely to bring their families. However, in order to bound potential impacts, the worst case assumes that 80 percent of the in-migrating workers will bring families.

Project-related populations have been allocated to communities in proportions similar to location preferences of current Du Pont Chambers Works employees. Du Pont conducted a survey of its existing workforce to determine where current employees reside. Over 50 percent of the active existing employees and their families live in Salem County. The balance of the existing workers and families live in New Castle County and other surrounding counties. Of the 50 percent who live in Salem County, 41 percent live in Pennsville, 12

Exhibit 4-25
In-Migration Model

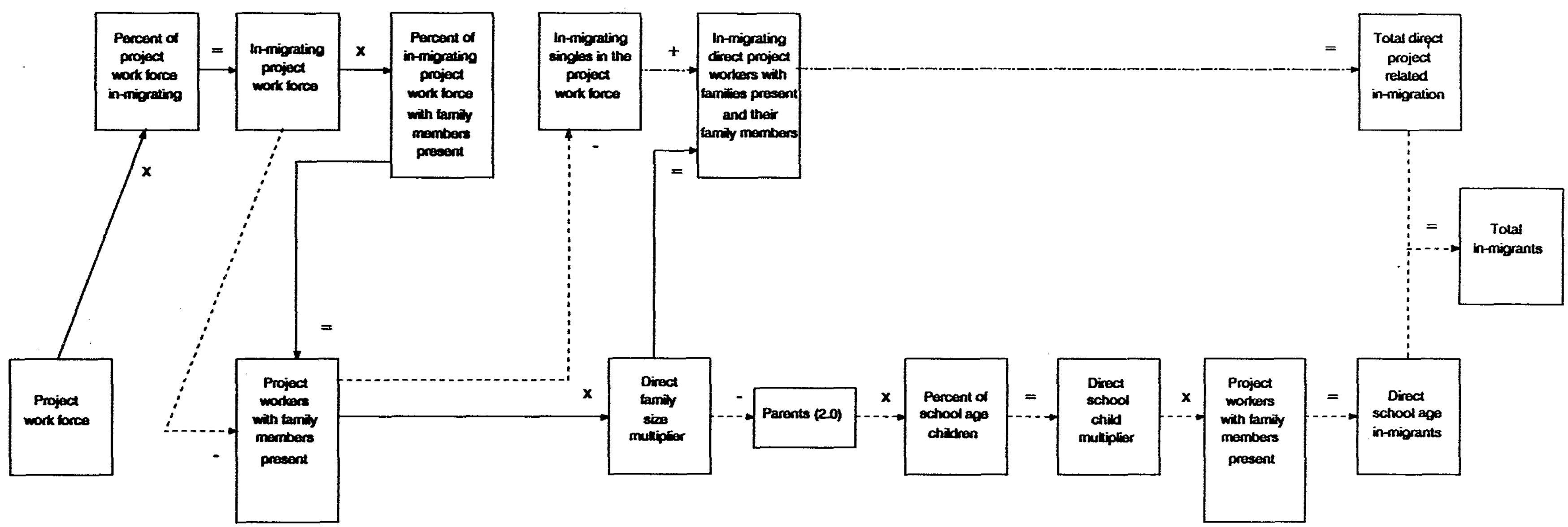


EXHIBIT 4-26

INPUTS AND MULTIPLIERS FOR THE IMMIGRATION MODEL

In-migration Parameters	Best Case	Worst Case
Percent of workforce in-migrating	50.0	100.0
Percent of in-migrating work force bringing families[a]	25.0	80.0
Family Size multipliers[b]	3.3	3.6
Percent of School-Age Children[c]	65.0	65.0

[a]Tennessee Valley Authority, 1980. Yellow Creek Nuclear Plant Socioeconomic Monitoring and Mitigation Report, YCnP-SMR 4, Knoxville, TN and Murdock and Leistritz, 1979, Energy Development In The Western United States, Praeger Special Studies, Prager Scientific, New York, NY. These estimates are also based on the size of the population and employment base in Salem and New Castle Counties which is quite substantial.

[b]The Best Case multiplier is based on U.S. family size multiplier, U.S. Statistical Abstracts; the Worst Case multiplier is based on Construction Worker Profiles derived from the U.S. Department of Energy, 1978. Socioeconomic Impact Assessment: A Methodology Applied to Synthetic Fuels, HCP/62516-01, Washington, DC.

[c]U.S. Department of Commerce, Bureau of the Census, Statistical Abstracts of the United States, 1982-1983, Washington, D.C.

percent live in Carneys Point, and 11 percent live in Penns Grove. Population location models (gravity models) used for allocating in-migrating workers assume that relocation decisions are made in direct proportion to community population size and inverse proportion to distance to work. While the location decisions of current Du Pont employees are generally consistent with these assumptions, workers in-migrating for short-term construction jobs are likely to be more influenced by proximity to work than the long-term Du Pont workforce. For purposes of this analysis, the following estimates shown in Exhibit 4-27 were used to allocate in-migrating workers.

Using the model and assumptions specified above, for a peak workforce of 300 people, total in-migration to the area (including workers and their family members) will range from approximately 240 to 920. The number of school-age children ranges from 30 to 250. These new residents will be distributed as follows based on the assumptions presented in Exhibit 4-27:

JURISDICTION	BEST CASE	WORST CASE
Salem County	144	552
Penns Grove	12	46
Carneys Point	12	46
Pennsville	96	368
Other Twp.	24	92
New Castle County	96	368

Under both the best and worst case projections, the percentage change from the existing population base is quite small. Changes in most of the communities will be less than one percent. The largest projected change occurs in the worst case, where the 368 in-migrants allocated to Pennsville comprise about 2.6 percent of the population base. Research on the relationship between population growth rates and community adjustment problems indicate that where annual growth rates exceed 10 percent, the increase becomes difficult to accommodate.[300] The growth projected here even under the worst case is far below this threshold level.

In addition to the direct project-related jobs, there are likely to be a limited number of indirect jobs created as a result of additional expenditures in the area. Given the limited duration of the construction projects and the size of the population base in Salem, New Castle, and surrounding counties, these indirect jobs are likely to be filled through local hiring. Thus, no significant in-migration is expected to occur as a result of project-induced indirect employment.

EXHIBIT 4-27

POPULATION LOCATION ASSUMPTIONS

JURISDICTION	POPULATION	DISTANCE FROM SITE	IN-MIGRATION PERCENTAGE
Salem County	65,400	N/A	60
Penns Grove	5,300	2 mi	5
Carneys Point	8,530	3 mi	5
Pennsville	13,960	4 mi	40
Other twp.			10
New Castle County	417,800	N/A	40

4.6.2 Economic Impacts

The primary and secondary economic effects are important impacts of the project. In addition to creating new jobs, project purchases of supplies and materials from local firms, and additional expenditures by project workers typically result in increased business activity and employment in local trade and service sectors. As indicated in Section 4.6.1, the peak employment level associated with incinerator and landfill construction is 300.

The total cost of constructing the landfill and incinerator is approximately $100 million[301]. Based on previous experience at Du Pont, project expenditures in the local area are expected to be limited, ranging from 1 to 2 percent of the total cost.[302] Purchases of materials are expected to benefit businesses in the local areas and are likely to create a limited number of indirect jobs (e.g., in retail trade). Similarly, a portion of employee wages paid by the project will be spent in the local area for housing, general goods and services, and entertainment. Not all wages paid as personal income, however, will be captured in the local or even regional economies. Workers without their families present and those who are there for a short duration are likely to spend little of their incomes in the local economy. Conversely, those workers hired from the local area will tend to spend more of their incomes locally.

4.6.3 Housing Impacts

The total number of households projected to migrate into the area using the in-migration model ranges from 150 to 300. The total number of housing units in Salem County in 1980 was 24,165, and in New Castle County there were 148,563 units. Given the size of the local housing market and Salem County's recent experience with a net drop in employment at the Hope Creek and Salem Nuclear plants, the limited amount of in-migration associated with the Du Pont expansion is not expected to affect the local housing market significantly.

4.6.4 Community Service and Utilities

The projection of community service impacts associated with new construction projects is usually an important area of concern in assessing socioeconomic impacts. Changes in the availability and quality of public services are among the most visible impacts that can occur with new developments. The Du Pont expansion, at least in terms of workforce size and local expenditures, is expected to create very limited demand on local infrastructure. The 240 to 920 temporary new residents distributed between Salem and New Castle Counties will not significantly affect services such as police and fire protection, water and sewage treatment, medical services and recreational facilities.

The 1980 school-age population in Salem and New Castle Counties totalled 100,870. The 30 to 250 school-age children expected to temporarily relocate as a result of the Du Pont expansion is 0.03 to 0.3 percent of the existing school-age population base. In Pennsville, where the largest amount of growth is expected, under worst case circumstances, approximately 100 additional school-age children would temporarily move to the area. Since the estimated capacity of the Pennsville Township school district is approximately 3500 students and the 1988 enrollment was 2373, the additional students should not strain current capacity.[303]

In addition to service demands of in-migrating workers and families, new project developments usually place heavier demands on local services. The Du Pont expansion will require additional water (500 GPM during construction) and additional electricity (10,000 KVA during operations) [see Section 2.6]. Instead on relying on nearby communities to provide such services, Du Pont draws its water from the Salem Canal, and the plant has its own wastewater treatment facilities. Du Pont also has its own on-site police and fire service. Thus, project demands on local services will be minimal. Electricity demands will be met by Atlantic Electric which currently serves Salem County.

4.6.5 Land Use Impacts

An additional 42 acres of land will be put to industrial use. However, this land has been previously disturbed and is already zoned "heavy industrial." Isolated wetlands, comprising approximately a quarter of an acre, exist within the boundaries of the proposed landfill (see Section 3.4.1.2). Thus, some wetlands areas may be displaced by these projects. Since there is no productive activity (e.g., agricultural activity), economic losses are not expected as a result of incinerator and landfill construction.

A concern that frequently arises from residents living near proposed landfill and incinerator sites is the issue of property value impacts. A literature search on the issue of property value impacts associated with a well-run hazardous waste landfill site has not yielded any studies specifically targeted to this type of facility. However, there have been numerous studies on property value impacts associated with municipal solid waste landfills, hazardous waste contaminated sites, radon contaminated residential areas, and nuclear facilities. In all of the cases evaluated, for both well-run facilities and contaminated sites, property owners perceived that their housing values would be negatively affected. In studies where the facilities posed no health hazard, however, there was little measurable impact on property values.[304]

Studies of property values on or near contaminated sites have shown more statistically significant negative impacts. A study of property values in Pleasant Plains, New Jersey was conducted in 1982. This town experienced ground water contamination problems as a result of a nearby hazardous waste site. The empirical evidence drawn from the sample of sales in Pleasant Plains indicated that housing values were not affected <u>prior</u> to the contamination episode but they were negatively affected after the contamination was discovered. Another site analyzed in this study showed a relatively insignificant impact on property values close to the site of contamination. The analysts attribute this difference in findings to the varying magnitude of the contamination problem at the two sites. The latter was associated with minor contamination found in a few wells, located on the same property as the hazardous waste facility.[305]

An analysis of the effects on property values of radon contamination at Montclair, West Orange, and Glen Ridge Radium sites in New Jersey was conducted recently. This study indicated that high radon readings appear to influence property values. Through estimation of a linear regression equation, a statistical relationship was found between the ratio of market value to assessed value of properties when high radon levels were present. The estimated property value loss for contaminated properties relative to uncontaminated properties on each site appeared to be between 9 percent and 17 percent of market value. Uncontaminated properties on the Montclair site also appeared to have depressed property values of about 9 percent relative to off-site properties, although this inference was only weakly supported by the data.[306]

The existing Du Pont facilities (including the landfill and the impoundments) have caused significant contamination at the site which is known to both the State of New Jersey and local residents. The fact that the site has been contaminated and that the Du Pont Chambers Works plant is an existing operation, the project expansion is expected to have minimal impact on residential property values. Any actual effect on property values related to the Du Pont operation should already be accounted for in nearby residential property values and should not be further affected by the expansion.

4.6.6 Fiscal Impacts

The purpose of fiscal impact analysis is to project the changes in costs and revenues of governmental units which are likely to occur in response to project development. Much like the economic effects created by new projects, fiscal changes occur from both direct and indirect sources. The direct effects include additional tax revenue produced by the plant and the added public service costs directly attributable to the plant and its workers. The indirect effects include tax revenue from workers' residences and the revenues and costs associated with the creation of indirect jobs.

Perhaps the most important fiscal impact likely to result from the construction of the landfill and incinerator at Du Pont Chambers Works, is the increase in fees to be paid to Carneys Point Township. In New Jersey, a gross receipts tax is imposed on the owner/operator of all major hazardous waste facilities. "The fee is equal to 5 percent of the gross receipts from all charges imposed during the preceding calendar year upon any person for the treatment, storage or disposal of hazardous waste at the facility. Payment of the tax is due to the chief fiscal officer of the municipality wherein the facility is located."[307] Du Pont will pay this 5 percent fee to Carneys Point Township for incinerating waste from outside the plant. A general estimate of gross receipts expected from the incinerator is $20 million per year. Thus, based on this estimate, Carneys Point Township would receive approximately $1 million per year in additional revenue. The Township received $1,203,785 gross receipts tax from Du Pont for WWTP revenues for fiscal year 1988 (refer to Section 3.5.6).

There may be some limited increase in the cost of providing services to the in-migrants that will be temporarily relocating to communities in Salem and New Castle Counties, particularly in Pennsville. These slight increases, however, will be offset somewhat by increased tax revenues from these residents. Thus, the net fiscal impact from new residents is expected to be quite small.

4.6.7 Traffic Impacts

Exhibit 4-28 shows the principal roads off-site that could potentially be affected by increased traffic generated from the Chambers Works expansion. The specific routes used to transport wastes to the facility are identified in Exhibit 4-28 and are as follows:

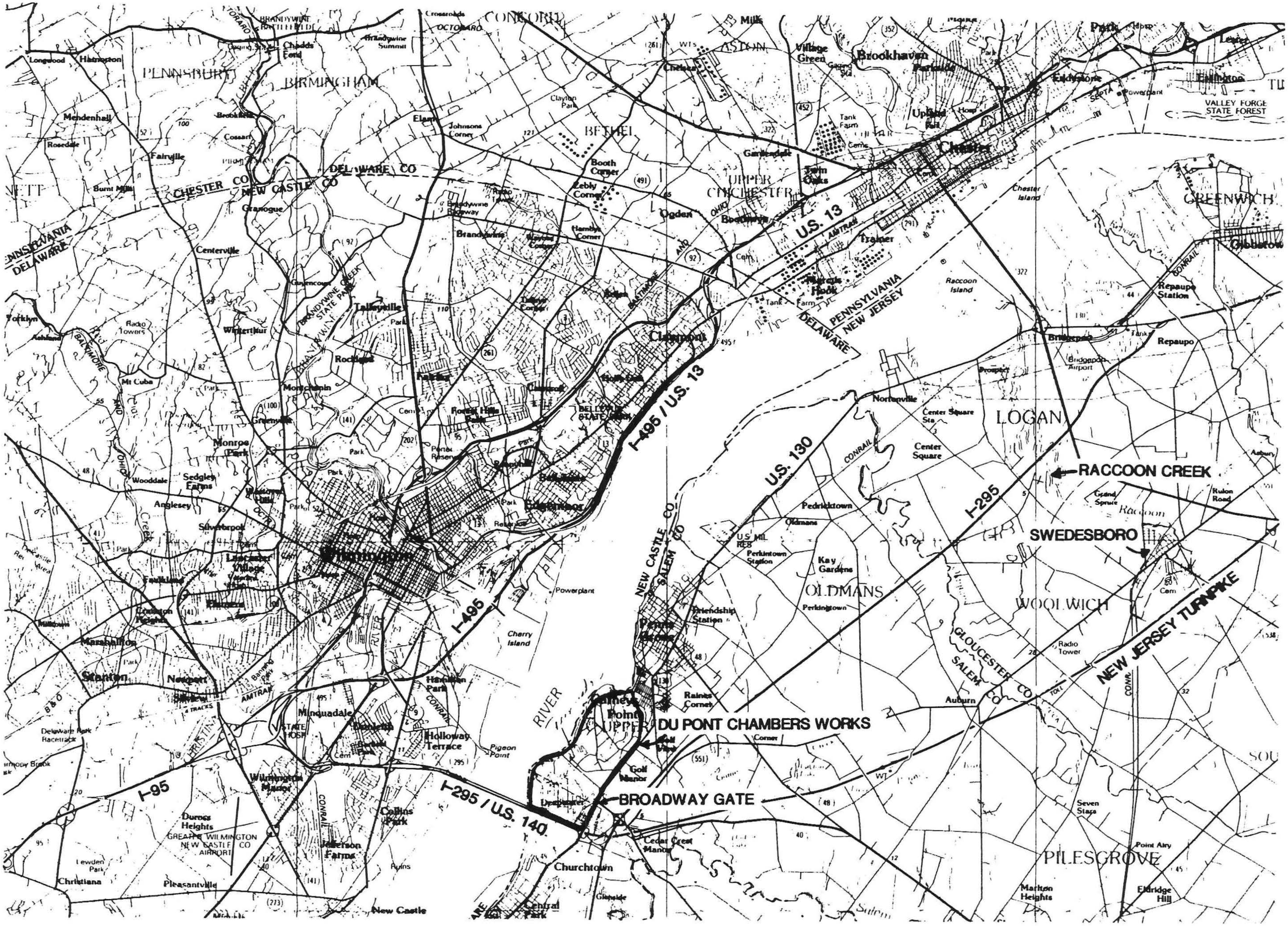
- Route #1. South on I-295 from Raccoon Creek to N.J. Route 140; N.J. Route 140 west into the Broadway Gate;
- Route #2. South on the New Jersey Turnpike from Swedesboro, NJ to N.J. Route 140; N.J. Route 140 west into the Broadway Gate;
- Route #3. North on I-95 from Churchman Road in Delaware to I-295; I-295 east over the Delaware Memorial Bridge to the Delaware/New Jersey Border; I-295 from the border to U.S. 130 South. North on 130 into the Broadway Gate;
- Route #4. South on I-495 from U.S. 13 to I-295; I-295 east over the Delaware Memorial Bridge to the Delaware/New Jersey Border; I-295 from the border to U.S. 130 South. North on 130 into the Broadway Gate; and
- Route #5. South on U.S. 130 from Gloucester County to the Broadway Gate.

Only those routes located within a ten mile radius of the Chambers Works have been analyzed in this study. An impact radius of ten miles has been chosen to ensure that the analysis accurately addresses the concerns of communities, both in New Jersey and in Delaware, which may experience transportation related impacts (e.g., traffic congestion and an increase in truck accidents) as a result of the Chambers Works expansion.

Each of the five routes has been broken down into segments for the purposes of this analysis. Route segments are designated based upon changes in accident and traffic flow characteristics along the routes and are defined in Exhibit 4-29.

EXHIBIT 4-28

OFF-SITE ROADS POTENTIALLY IMPACTED BY EXPANSION PROJECT



Source: U.S. Geological Survey, 1:100,000-scale planimetric map for Wilmington, Delaware-New Jersey-Pennsylvania-Maryland, 1984.

EXHIBIT 4-29

DEFINITION OF ROUTE SEGMENTS

SEGMENT	LENGTH	FROM	TO
DELAWARE			
I 95	2.90 miles	Churchman Rd.	I 295
I 295	4.38	I 95	NJ State Line
I 495	2.90	U.S. 13	I 295
NEW JERSEY			
I 295 a	9.53	Racoon Creek	U.S. 140
1 295 b	0.95	DE State Line	U.S. 130
NJ Turnpike	9.27	Swedesboro, NJ	U.S. 140
US 130 a	0.59	I295	Broadway Gate
US 130 b	8.30	Oldmans Creek	Broadway Gate
US 130 c	1.70	High Hill Road	Oldmans Creek
US 140 a	0.47	I 295	Broadway Gate
US 140 b	0.31	NJ Turnpike	I 295

All vehicle traffic, including truck traffic, arrives through the Broadway gate, which is a 41-foot wide, three lane roadway.[308] Currently, 290 trucks pass through the gate per day on average, and 250 trucks arrive between 7:00 a.m. and 7:00 p.m.[309] A breakdown of the traffic arriving at Chambers Works shows that of the incoming trucks:[310]

- 30% arrive from 130 South (over the Delaware Memorial Bridge);
- 20% arrive from 130 North; and
- 50% arrive from 140.

The general characteristics of each of these roads are as follows:[311]

- U.S. Route 130 -- A major north-south arterial extending northward from Lower Penns Neck Township (in Salem County) and intersecting with I-295 in Logan Township (in Gloucester County) and southward to where it intersects with I-295 and U.S. Route 40 in the vicinity
- Route #1. South on I-295 from Raccoon Creek to N.J. Route 140; N.J. Route 140 west into the Broadway Gate; of the Delaware Memorial Bridge. In the vicinity of the Chambers Works, U.S. Route 130 is a 40 foot wide, two lane highway with eight foot shoulders on either side of the road. It does not have restricted access in this area.
- N.J. Route 140 -- An east-west roadway which connects U.S. Route 130 to the west with I-295 and Salem County Route 540 to the east. The roadway is a 32-foot wide, two lane roadway with eight foot wide shoulders on each side of the roadway. It does not have restricted access in the vicinity of Chambers Works.

When the incinerator is operating there will be a high average of eight additional trucks per day, Monday through Friday, entering the Chambers Works.[312,313,314] Of these trucks:[315]

- Three will be arriving from U.S. 130 South (two carrying Du Pont wastes, 1 carrying non-Du Pont wastes);
- Four trucks arriving on NJ Route 140 (one carrying Du Pont wastes and three carrying non-Du Pont wastes); and
- One truck carrying non-Du Pont wastes from 130 North (traveling south from Pennsylvania or New Jersey).

Shipments are accepted 24 hours per day, 7 days per week on each of these routes; however, 75% of the shipments are expected to arrive between 8:00 a.m. and 4:00 p.m.[316] In addition, 50 additional people with personal vehicles are expected on these roads after startup. No increase in off-site traffic is expected due to landfill operations.[317]

As discussed in Section 2.4, all wastes arrive by tank truck or box trailer. Although a rail car unloading facility exists, no wastes are to arrive by rail.[318,319] Wastes are also not expected by either barge or ship.[320]

4.6.7.1 Volume/Capacity. Traffic and classification counts were obtained for each of the five routes detailed above for the years 1984 through 1987 (the latest year for which complete data were available from the New Jersey and Delaware Departments of Transportation). The average daily traffic flows (ADTs) for each of these routes are listed in Exhibit 4-30. ADTs are expressed in terms of both "all vehicles" (i.e., including passenger cars, trucks, buses, etc.) and "truck traffic" (excluding pick-up trucks). All vehicular ADTs were obtained from the New Jersey Department of Transportation's Bureau of Data Sources[321] and the Delaware Department of Transportation, Northern District.[322] Truck ADTs were estimated using data from the Federal Highway Administration.[323]

Also shown in Exhibit 4-30 are the maximum expected increases in ADT for all vehicle traffic and truck traffic due to the Chambers Works expansion. The increase in all vehicle ADT (i.e., 50 passenger vehicles plus 1 to 4 trucks depending upon the route) is a conservative estimate. The number of passenger vehicles is categorized by route due to the scarcity of information on the direction from which these vehicles are coming, instead the total increase (50)has been assumed for each of the routes. Increases in truck ADT by route are based upon estimates discussed in Section 4.6.7. The resulting change in traffic flow ranges between 0.10% to 1.30%. These increases are negligible.

In addition, incinerator activities would not generate such an increase in traffic such that roadway capacity would be an issue. All of the off-plant roadways in the vicinity of the Chambers Works facility have sufficient capacity to accommodate the traffic that would be generated by these activities. According to a traffic study performed by Orth, Rodgers, Thompson & Associates, Inc. in April of 1988, the principal potential traffic constraint at the facility, namely the entry gates at peak commute hours, will not be affected by the incinerator operations.[324] Orth, Rodgers, Thompson & Associates, Inc. performed a volume/capacity analysis for the intersection of U.S. Route 130, NJ Route 140, and the Broadway Gate during the morning, midday, and evening hours. The results were as follows:

EXHIBIT 4-30

VEHICLE AND TRUCK TRAFFIC FLOW

Segment	Length	All Vehicle ADT	Truck ADT	Increased Traffic Flow Vehicle/Truck
ROUTE #1				
NJ I 295 a	9.53	20,200	3,353	54/4
NJ US 140 a	0.47	8,200	377	54/4
	10.00			
ROUTE #2				
NJ Tpke	9.22	31,290	5,194	54/4
NJ US 140 b	0.31	6,700	308	54/4
NJ US 140 a	0.47	8,200	377	54/4
	10.00			
ROUTE #3				
Del I 95	4.08	69,085	12,504	53/3
Del I 295	4.38	84,500	15,295	53/3
NJ 295 b	0.95	61,600	10,226	53/3
NJ US 130 a	0.59	16,900	777	53/3
	10.00			
ROUTE #4				
Del 495	4.08	28,516	5,161	53/3
Del I 295	4.38	84,500	15,295	53/3
NJ 295 b	0.95	61,600	10,226	53/3
NJ US 130 a	0.59	16,900	777	53/3
	10.00			
ROUTE #5				
NJ US 130 b	8.30	8,200	377	51/1
NJ US 130 c	1.70	4,900	225	51/1
	10.00			

Sources: 1) Telephone conversations with Jim Panzitta, New Jersey Department of Transportation, Bureau of Data Resources, 1/24/89 and 2/15/89.
2) Telephone conversation with Bill Derrickson, Delaware Department of Transportation, Northern District, January 24, 1989.

> Based upon the volume of traffic [presently] passing through the intersection of U.S. Route 130 with N.J. Route 140 and the Broadway Gate during peak hours, this additional truck traffic would have little traffic impact upon the traffic conditions at this intersection. In fact, because not all of this truck traffic would arrive or depart during any one peak hour, but would be spread out over the entire day, the construction of the incinerator would have no traffic impact on the intersection.[325]

All vehicles are expected to comply with normal highway loadings. No improvement of public roads is required. New access roads are to be constructed in the immediate incinerator and landfill boundary limits. Access roads are to be designed for HS 20-44 AASHTO highway loadings (80,000 lb. gross vehicle weight). No other new plant roads are required.[326]

4.6.7.2 Safety. Data on traffic accidents involving trucks were obtained for each of the five routes for the years 1984 through 1987 (the latest year for which data were available from the New Jersey and Delaware Departments of Transportation).[327,328] The average annual accident rate for each of these roads is listed in Exhibit 4-31 along with projected accident rates. Current accident rates were calculated using the following equation:

$$P_c = \frac{TACC}{TADT \times 365}$$

where: P_c = Current accident probability
TACC = Average annual number of truck accidents
TADT = Average daily traffic flow for trucks

Projected accident rates were calculated using:

$$P_p = \frac{TACC + (INC \times P_c \times 2)}{(TADT + INC) \times 365}$$

where: P_p = Projected accident probability
P_c = Current accident probability
INC = Maximum increased truck traffic (varies from 1 to 4)
TACC = Average annual number of truck accidents
TADT = Average daily traffic flow for trucks

The factor of two in the equation has been added as an additional measure of safety, resulting in a conservative estimate of projected accident probability.

As one can see from Exhibit 4-31, the resulting increase in accident probability is very slight, ranging from 0.02% to 1.28%. The slight change in accident probability is primarily a result of the negligible increase in traffic flow, and therefore, resulting number of accidents.

EXHIBIT 4-31

ACCIDENT RATE DATA

Segment	Length	Truck ADT	Truck Accidents	Accident Probability	Maximum Increased Traffic	Increased ADT	Maximum Increased Accidents	Accident Probability	Change in Acc Prob
ROUTE #1									
NJ I 295 a	9.53	3,353	13	1.06E-05	4	3,357	13.0310	1.06E-05	0.119%
NJ US 140 a	0.47	377	1	7.26E-06	4	381	1.0212	7.34E-06	1.049%
	10.00								
ROUTE #2									
NJ Tpke	9.22	5,194	22	1.16E-05	4	5,198	22.0339	1.16E-05	0.077%
NJ US 140 b	0.31	308	3	2.67E-05	4	312	3.0779	2.70E-05	1.281%
NJ US 140 a	0.47	377	1	7.26E-06	4	381	1.0212	7.34E-06	1.049%
	10.00								
ROUTE #3									
Del I 95	4.08	12,504	31	6.79E-06	3	12,507	31.0149	6.79E-06	0.024%
Del I 295	4.38	15,295	57	1.02E-05	3	15,298	57.0224	1.02E-05	0.020%
NJ 295 b	0.95	10,226	5	1.34E-06	3	10,229	5.0029	1.34E-06	0.029%
NJ US 130 a	0.59	777	5	1.76E-05	3	780	5.0386	1.77E-05	0.384%
	10.00								
ROUTE #4									
Del 495	4.08	5,161	3	1.59E-06	3	5,161	3.0035	1.59E-06	0.116%
Del I 295	4.38	15,295	57	1.02E-05	3	15,295	57.0224	1.02E-05	0.039%
NJ 295 b	0.95	10,226	5	1.34E-06	3	10,226	5.0029	1.34E-06	0.059%
NJ US 130 a	0.59	777	5	1.76E-05	3	777	5.0386	1.78E-05	0.772%
	10.00								
ROUTE #5									
NJ US 130 b	8.30	377	15	1.09E-04	1	377	15.0795	1.10E-04	0.530%
NJ US 130 c	1.70	225	1	1.22E-05	1	225	1.0089	1.23E-05	0.887%
	10.00								

Impacts associated with an accident involving hazardous waste being transported to Chambers Works are discussed in Section 5. This section deals with both minor and major spills.

4.6.8 Historical and Archaeological Resources

As described in Section 3.6, no known cultural or historic resources exist at the proposed landfill and incinerator sites. Therefore, no direct impacts on recorded archaeological sites or historical locations and structures are anticipated as a result of the proposed projects. The principal cultural resources that might be disturbed during project construction are those resources that are not recorded, but which may be located where construction activities take place. Given the previous uses of the site (see Section 3.4.1), it is highly unlikely that such resources would be found.

4.6.9 Aesthetic Impacts

Potential project facilities affecting aesthetic conditions include the incinerator stack (213 feet high) and the landfill, which will be 100 feet above grade when its capacity is reached and it is closed. Construction activities will involve excavating, grading, and transporting equipment and supplies. Increased dust, storage piles, and construction traffic will likely be seen by motorists crossing the Delaware Memorial Bridge. Similarly, both the incinerator and landfill, when they are complete, will be visible to motorists crossing the Bridge. Given, the substantial number of buildings and stacks already at Chambers Works, these new facilities will not present a significant visual intrusion.

Along the eastern boundary of the site there is a natural aesthetic barrier of woodland which obscures the view of Chambers Works during all seasons. Thus, motorists driving along Route 130 and nearby residents will not see either the construction activities or the closed landfill and incinerator. Some residents further away from Chambers Works will be able to see the incinerator and closed landfill from a distance. However, both units will be part of an existing industrial landscape. In addition, the landfill will then be covered by grass.

4.7 ACOUSTIC ENVIRONMENT

Three areas typical of the environment surrounding the Du Pont Chambers Works were identified in Section 3.7.2 according to their respective ambient noise:

> At Harrison and Jackson Streets in Deepwater, measured noise was found to have an equivalent continuous noise level (L_{eq}) of approximately 59 dB(A) and a day/night sound level (L_{dn}) of 78 decibels. This is the residential

area nearest to the site proposed for the incinerator. There is the greatest potential for increased noise impacts on this environment.

Along State Route 130 it is unlikely there will be any impact from the noise of construction or operation of the incinerator, because the L_{dn} along this road is 80 decibels and the L_{eq} is 76 decibels. This represents a high noise level to which the noise from the site is unlikely to contribute.

In Carneys Point at Division and J Street, an L_{dn} of 60 dB(A) and L_{eq} of 57 dB(A) was measured. Because the noise levels at the Carneys Point location are lower than those in Deepwater, it is appropriate to consider the impacts of noise at this location as well as at Deepwater, even though this location is 8600 feet from the proposed incinerator.

In this section, noises from operations and from construction activities are presented as they relate to the New Jersey Daytime Noise Limits of 65 dB(A), the New Jersey Nighttime Noise Limits of 50 dB(A), and the EPA and Housing and Urban Development goal of a 55 dB(A) L_{dn} for a residential environment. Whether the noise will raise the ambient sound level in the residential neighborhood will also be addressed.

4.7.1 Impact of Incinerator and Landfill Construction

Major sources of noise during the construction phase are heavy equipment operations on site and additional vehicular traffic traversing the roads in the area of the proposed projects. For this impact analysis, it is presumed that the incinerator construction and the preparation of the landfill will take place simultaneously.

Several assumptions were made to determine the increase in vehicular traffic and resultant noise impacts. Baseline traffic data from which projections were calculated are from the New Jersey Department of Transportation[329]. Data from Route 130 in the Pennsville area were used because it is closest to the site. Average daily traffic count in this area is 16,900 vehicles. Of this, approximately 18 percent is composed of truck traffic[330]. Therefore, a 20 percent figure was used to calculate the average daily truck traffic on Route 130. The average daily truck traffic is 3380 vehicles, and the average car traffic is 13,520 vehicles. It was also assumed that during construction 240 personal vehicles (automobiles) would be driven to and from the site daily and that 309 construction vehicles (trucks) would be used per day to haul soil during filling operations and to conduct other activities (refer to Section 2.6.2).

The impact of the additional 309 trucks on the daily equivalent continuous noise level was calculated as follows:

$$D_L = 10 \log ((T_1+T_2)/T_1)$$

where D_L = the change in sound level

T_1 = the baseline number of trucks
T_2 = the incremental number of trucks.

The calculation is based on addition of noise sources (trucks) to the daily noise. Overall sound levels are calculated as

$$L = L_i + D_L,$$

where L_i is the initial sound level. In this situation, T_1 = 3380, T_2 = 309, and D_L = 0.4 decibels. This change in sound level is not perceptible.

If it is assumed that only two-thirds of the daily truck traffic passes during the construction shift, the number of trucks used as the basis from which to calculate the noise increment attributable to the construction activity is lowered. The increment under this assumption is

$$D_L = 10 \log (2662/2553) = 0.6 \text{ dB},$$

which is still not a perceptible increment.

The additional automobile traffic attributable to the construction is also negligible. The change in level resulting from automobiles is

$$D_L = 10 \log (13{,}760/13{,}520) = 0.1 \text{ dB}.$$

The majority of highway noise is produced by contact between truck tires and the roadway and exhaust noise during truck acceleration; therefore, the only noise increments that are of concern are those that result from the increased truck traffic. The impact of additional trucks moving on the highway to and from the site will be imperceptible.

4.7.1.1 Heavy Equipment Operations. To determine impacts from the operation of heavy equipment during construction, it was assumed that there would be three construction machines operating simultaneously. Simultaneous operation means that the machines function under maximum load generating maximum noise at the same instant. For the worst case assumption, a self-propelled scraper, for which noise levels are 91 dB(A) at 50 ft, was used[331]. At 2600 ft, the noise level at the nearest residence would be 57 dB(A). Large bulldozers produce the same noise levels. For simultaneous operation of three machines, the level at 2600 ft would be 62 decibels. This would have the effect of raising the ambient level during operation of the machines from 59 dB(A) at Harrison and Jackson Streets to 64 dB(A), an increase of almost 5 decibels. However, structures are located between the incinerator construction site (i.e., the construction site nearest to residential areas) and the nearest residences. These structures include the consolidated warehouse, the three new large above-ground tanks at the Du Pont WWTP, and the B landfill, which rises twenty feet above grade. These structures would function as noise barriers, and therefore increases in ambient sound levels at Harrison and Jackson Streets would be significantly less than 5 decibels (i.e., imperceptible).

Noise from only the construction equipment operating at the site (i.e., three simultaneously operating machines) could reach 52 decibels at Division and J Streets in Carneys Point. Adding this to the ambient noise would raise the noise level at this location by as much as 1 decibel, which would not be perceptible. On certain occasions, if the ambient noise at this location is low and there are high peak levels of noise produced by the equipment, the increase might be audible.

4.7.2 Impact of Incinerator Operations

Two sources of noise from the incinerator could cause impacts: noise generated by the induced-draft fans and radiated from the top of the stack, and noise emitted at ground level from the fan casings and from the combustion inside the kiln. Because this is a custom designed installation, there are no similar incinerators on which measurements can be made to quantify noise levels.

4.7.2.1 Noise Emitted from the Kiln. The noise levels from the kiln will be less than 85 dB(A) at 3 ft. This level represents a criterion for occupational safety programs and provides little guidance with regard to issues of noise emissions from the kiln. Because the levels are given in terms of A-weighting, there may be high levels of low frequency sound from the burners that propagate into nearby residences. Exhibit 4-32 shows the A-weighting factors from 10 Hz to 16 kHz. At the low frequencies A-weighting reduces the weighted sound level by as much as 70 decibels. Therefore, if a sound spectrum is dominated by low frequency infrasound (10 Hz to 30 Hz), the level at 30 Hz (with average weighting of -50 dB) and below may be as high as 125 dB (75 dB + 50 dB) without contributing to the A-weighted sound level at the kiln.

Noise levels of 85 dB(A) at 3 ft equate to 26 dB(A) at 2600 ft. If the noise emanating from the kiln is all in the mid-to-high frequency range, then it will be imperceptible at the nearest residence. However, if the noise has a predominant low frequency component, as is typical for combustion, then it could create impacts. Predominant sound output from an oil-fired casting furnace has been found to be between 6 and 10 Hz, and sound levels produced by the burner were 104 dB at a distance of 3 meters[332].

Noise levels of 50 to 80 dB with a spectrum between 5 Hz and 100 Hz have resulted in complaints. Furthermore, studies of wall rattle produced by aircraft noise indicate a threshold occurring between 80 and 110 dB. Window rattle occurs at noise levels approximately 5 dB lower. Specific studies show that at 10 Hz window vibration occurs for sound levels between 50 and 60 decibels.[333]

EXHIBIT 4-32

A-WEIGHTING CHARACTERISTIC

Frequency (Hz)	Relative Response (dB)
10	-70.4
20	-50.5
31.5	-39.4
63	-26.2
125	-16.1
250	-8.6
500	-3.2
1000	0.0
2000	+1.2
4000	+1.0
8000	-1.1
16000	-6.6

Sound levels of 91 dB at the incinerator would produce a level of 50 decibels at the residences. Exhibit 4-32 shows that 91 dB at 10 Hz would have an A-weighted sound level of only 20.6 dB. At 20 Hz it would have a weighted sound level of 40.5 dB(A).

The New Jersey Department of Environmental Protection allows daytime levels of 96 dB at 31.5 Hz. A similar level of sound at 10 to 20 Hz at the incinerator could produce rattling of windows at the nearby residences. Therefore, if it is determined that low frequency noise is generated in the kiln, noise emissions will have to be mitigated.

4.7.2.2 Noise Emitted from the Stack. In an installation such as the one proposed, the most common source of noise is generated by the induced draft fans and radiated from the top of the stack. Exhibit 4-33, Line 1 shows the sound power level data for the Robinson Industries RB1216 fans that are proposed for the incinerator. Note that at 250 Hz there is a prominent peak in the octave band data, which represents a tonal component in the noise. Tones such as this will be clearly audible in the surrounding environment. Noise levels from the stack extrapolated to the nearest residence in Deepwater are shown on Line 3 of the Exhibit 4-33. The 250 Hz component is at 64 dB at this distance. Overall A-weighted levels at 2600 ft for the two fans are 57 dB(A) which is 7 dB above the New Jersey Nighttime Noise limit and is 8 dB below the New Jersey Daytime limit. These limits are shown on Lines 4 and 5. Note that between 250 Hz and 2000 Hz the noise emitted from the stack exceeds the New Jersey Nighttime limits. Although the noise levels are within the New Jersey Daytime limits, at 250 Hz the difference is only 3 decibels.

Another source of potential noise is transmission of acoustic energy through the stack. Because the stack is constructed of a fiberglass reinforced plastic (FRP) liner with a steel cage, there is insufficient mass in the wall to reduce transmission of noise through the stack wall. This noise will then be radiated into the surrounding area. To mitigate noise radiation from the top of the stack and across the stack walls it is necessary that appropriate mufflers be installed between the fans and the stack. If the fans are not treated, the noise from the top of the stack will reach 57 dB(A) at the nearest Deepwater residence and raise the 59 dB(A) ambient level to 61 dB(A), an increase of 2 decibels. This normally might not be noticeable; however, because there is a predominant tone at 250 Hz, there will be a noticeable change in the ambient acoustic environment in the Deepwater area.

4.7.2.3 Noise Radiated from the Fan Casing. Line 8 in Exhibit 4-33 shows that the noise radiated from the fan casing to the residences is 27 dB(A) with a maximum octave-band level at 63 Hz of 36 dB. With these levels, fan casing noise has no impact on the acoustic environment of the residences.

EXHIBIT 4-33

FAN SOUND EMISSION CALCULATIONS (dB)

Frequency (Hz)	63	125	250	500	1000	2000	4000	8000	A-wt
1. Fan sound power	122	125	128	118	113	108	104	101	121
2. Sound power two fans	125	128	131	121	116	111	107	104	124
3. Stack noise @ 2600 ft	58	61	64	54	49	44	40	37	57*
4. NJ Night limit	71	61	53	48	45	42	40	38	50
5. NJ Day limit	82	74	67	63	60	57	55	53	65
6. Far field casing @ 3ft	100	98	98	86	77	71	62	56	91
7. Total casing noise @ 3ft	103	101	101	89	80	74	65	59	94
8. Total casing @ 2600 ft	36	34	34	22	13	7	-	-	27

* Underlined noise levels exceed NJ night time limits.

4.7.2.4 Noise from Increased Truck Traffic. After the incinerator is constructed and operating, there will be an additional 8 trucks per day arriving at the incinerator site from off-site. This increase in truck traffic will yield a change in sound level of 0 dB, and therefore, will have no impact on ambient noise levels.

4.7.2.5 Impacts of Landfill Operations. Operations will remain unchanged except sludge will be hauled to Carneys Point and not the C landfill and that 10 trucks will move ash from the incinerator to the landfill. Using 85 dB(A) at 50 feet as the noise from one truck, one vehicle could produce 51 dB(A) at the Deepwater residences. Three trucks operating simultaneously generating this noise will produce 56 dB(A) at the residences which, added to the 59 dB(A) ambient noise level, results in a noise level at the site of 61 dB(A), 2 dB above the existing ambient noise level. An increase of 2 dB in a broad band environmental noise would not normally be noticeable.

4.8 ADHERENCE TO THE NEW JERSEY HAZARDOUS WASTE FACILITIES SITING OBJECTIVES

According to the definitions provided in Subchapter 13 of the New Jersey Solid and Hazardous Waste Management Regulations (NJAC 7:26-13) and adopted by the New Jersey Major Hazardous Waste Facilities Siting Act (NJSA 13:1E-49 et seq.), the proposed incinerator and landfill project at the Du Pont Chambers Works hazardous waste operations does not qualify as a new major commercial hazardous waste facility. Therefore, the minimum standards for siting a new major commercial hazardous waste facility do **not** apply.

The New Jersey Hazardous Waste Facilities Siting Act (NJSA 13:1E-49 et seq.) defines a "new" major hazardous waste facility as "any major hazardous waste facility, other than an existing major hazardous waste facility" (NJSA 13:1E-51(1)). The Act defines an "existing" major hazardous waste facility as "any major hazardous waste facility which was legally in operation or upon which construction had legally commenced prior to the effective date of this Act (September 10, 1981; NJSA 13:1E-51(1)). Moreover, a hazardous waste facility is considered "major" if it is a commercial facility which the Act defines as one that "accepts waste from more than one generator for storage, treatment, or disposal at a site, other than the site where the hazardous waste was generated," (NJSA 13:1E-51(1)) and if it "has a total capacity to treat, store, or dispose of more than 250,000 gallons of hazardous waste" (NJSA 13:1E-51(1)).

In applying these definitions to the proposed expansion of the Chambers Works facility, it is clear that Du Pont was operating the hazardous waste management component of the plant when the Major Hazardous Waste Facilities Siting Act became effective, that the facility was then accepting wastes from off-site sources, and that the facility's capacity was greater than 250,000 gallons per day. According to Du Pont, the capacity of the Chambers Works wastewater treatment unit was 24,637,466 gallons per day in September of 1981, and the capacity of the "C" landfill was 1,221,000 cubic yards. As a result, both NJDEP and the Hazardous Waste Facilities Siting Commission agree that for the purposes of the Act, Chambers Works is an existing major commercial hazardous waste management facility.

Though the minimum standards for the siting of new major commercial hazardous waste facilities do **not** apply to the proposed expansion, the environmental characteristics of the proposed expansion sites and details of the proposed expansions have been compared with the seven siting objectives (NJAC 7:26-13.1 et seq.), and are described below. This comparison illustrates the extent to which the proposed design would meet new facility requirements.

First Objective: NJAC 7:26-13.7, Protect the Population of the State

Section 7:26-13.7 of the NJAC defines siting criteria that are intended to protect New Jersey residents. This section reads as follows:

(a) For the purpose of protecting the population of the State:

1. No land emplacement or impoundment type of new major commercial hazardous waste facility shall be sited within 2000 feet of any structure which is routinely occupied by the same person or persons for than 12 hours per day, or by the same person or persons under the age of 18 for more than two hours per day;

2. No new major commercial hazardous waste facility other than land emplacement or impoundment type facilities shall be sited within one-half mile of any structure which is routinely occupied by the same person or persons for more than 12 hours per day, or by the same person or persons under the age of 18 for more than two hours per day; and

3. No new major commercial hazardous waste facility shall be sited in any area within a 20-mile radius of a nuclear fission plant at which spent nuclear fuel rods are stored on-site.

4. The measurement of distances required in (a) 1 and (2) above shall be taken from structures which are legally occupied, in accordance with the Municipal Land Use Law, NJSA 40:55D-1 et seq. and any ordinance adopted by the municipality pursuant thereto, six months prior to the Commission's formally proposing to designate the site.

(b) No new major commercial hazardous waste facility shall be sited in any area so as to cause an unreasonable risk of harm to the health, safety, and welfare of the population. In determining whether such risk would be presented, the department and the commission shall take into consideration, at every step of the siting process, the following factors:

1. The density of population in proximity to the facility;

2. The size and type of the facility;

3. The type of waste expected to be present at the facility;

4. The transportation means and routes available to evacuate the population at risk in a maximum credible accident, including both spills and fires;

5. The size and types of other hazardous waste facilities and facilities that handle hazardous materials in the adjacent area;

6. The availability of fire, police, and other emergency management personnel and medical facilities in the area.

First Objective Comparison

Both the landfill and the incinerator meet the distance requirements to safeguard the health of the public. The landfill, which is a land emplacement waste management unit, is located more than 2000 ft. from residential structures, and the incinerator is more than one-half mile from any residence.

However, because Chambers Works is positioned 14 miles from the Salem Nuclear Plant, 6 miles short of the required 20 mile radius from nuclear fission plants, the incinerator and landfill, if designated a new major hazardous waste facility, could not be sited at the selected locations.

Based on the analyses presented throughout this section, the proposed expansion will not present an unreasonable risk to the health, safety, and welfare of the local residents. The incinerator and landfill have been designated to minimize the release of hazardous constituents to the environment and prevent accidental releases. Numerous administrative controls will also be in place to prevent emergencies and to respond to any accidental releases. Refer to Section 2 for discussions on wastes to be accepted, facility designs, environmental controls, emergency prevention measures, and response capabilities.

<u>Second Objective: NJAC 7:26-13.8, Ensure Structural Stability</u>

Section 7:26-13.8 of the NJAC lays out the siting criteria that are designed to ensure the structural stability of new major commercial hazardous waste facilities. This section reads as follows:

(a) For the purpose of ensuring structural stability of new major commercial hazardous waste facilities:

1. No new major commercial hazardous waste facility shall be sited in a riverine flood hazard area delineated by the Department pursuant to the State Flood Hazard Area Control Act, NJSA 58:16A-50 <u>et seq.</u>, or the 100-year flood hazard area identified under the flood insurance studies prepared for the Federal Emergency Management Agency (FEMA), or in other areas shown to be within the area subject to inundation by the 100-year flood of a non-delineated stream as determined pursuant to NJSA 58:16A-55.2.

2. No type of new major commercial hazardous waste facility other than a land emplacement or impoundment type of facility shall be sited in:

   i. A coastal flood hazard area identified by FEMA or delineated by the Department or, if not delineated, at elevations less than 12 feet above mean sea level in the coastal floodplain, unless it can be demonstrated to the satisfaction of the Department that the facility design will prevent the physical transport of any hazardous wastes by the 100-year coastal flood event;

   ii. Areas underlain by cavernous limestone, cavernous dolomite, or cavernous marble; and

   iii. Areas overlying past or present subsurface mining activities.

3. No land emplacement or impoundment type of new major commercial hazardous waste facility shall be sited in:

   i. A coastal flood hazard area identified by FEMA or delineated by the Department or, if not delineated, at elevations less than 12 feet above mean sea level in the coast floodplain;

   ii. Areas underlain by limestone, dolomite, or marble; or

   iii. Areas overlying past or present subsurface mining activities.

<u>Second Objective Comparison</u>

Both the proposed incinerator and landfill locations are within a coastal flood area identified by FEMA (not a riverine flood hazard area) at a mean sea level elevation below +12 feet. However, the proposed incinerator will be constructed on top of a compacted structural fill having a design top-of-fill elevation of +12.5 feet (Chambers Works datum (CWD)).[334] In addition, Du Pont proposes to remove hazardous waste drums from the 100 year floodplain when flood conditions are imminent. This will prevent the physical transport of any hazardous wastes by the 100 year coastal flood event (NJAC 7:26-13.8 (a) 2.i).

The proposed landfill will be above grade and contained by a perimeter dike. This dike will have a minimum top elevation of +17 feet (CWD), and the 100-year flood event elevation for the Delaware River at Chambers Works at mean tide is +12.3 ft (CWD) (+9.0 ft USC&GS datum). The design also includes riprap on the dike walls to minimize the effects of erosion. In addition, the landfill will be protected by an existing sea wall constructed of cement and fill that generally extends to elevations greater than +10.0 ft (CWD).

Both these designs meet the intent of the second objective and should reduce any risk associated with siting the landfill and incinerator at the proposed locations.

Criteria related to stratigraphy and past mining activities are not applicable since those conditions of concern do not exist at the Chambers Works location.

Third Objective: NJAC 7:26-13.9, Protect Surface Water

The intention of Section 7:26-13.9 of the NJAC is to protect surface water in the State. This section reads as follows:

(a) For the purpose of protecting surface water, no new major commercial hazardous waste facility shall be sited within:

1. The upstream portion of the watershed draining to an on-stream reservoir;
2. Those watershed areas that drain directly into an off-stream reservoir;
3. The watersheds for waters classified by the Department as FW-1 or FW-2 Trout Production Waters in the Surface Water Quality Standards (NJAC 7:9-4).

Third Objective Comparison

This objective is met at the selected locations. The locations do not constitute the upstream portion of the watershed draining to an on-stream reservoir, a watershed area that drains directly into an off-stream reservoir, or the water sheds for waters classified by the Department as FW-1 or FW-2 Trout Production Waters.

Fourth Objective: NJAC 7:26-13.10, Protect Environmentally Sensitive Areas

Section 7:26-13.10 of the NJAC concerns environmentally sensitive areas in the state. This section reads as follows:

(a) For the purpose of protecting environmentally sensitive areas, no new major commercial hazardous waste facility shall be sited in or on:

1. Wetland areas inundated by surface or ground water with a frequency to support, under normal circumstances, a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction;

2. Areas where the placement of the facility would adversely affect a habitat of an endangered or threatened wildlife or vegetative species as defined by the New Jersey Endangered and Non-Game Species Conservation Act, NJSA 23:2-1 et seq., or the Federal Endangered Species Act of 1973, PL 93-205, unless a habitat adequate to assure the survival of the species within the region surrounding or on the site is preserved.

   i. These areas preserved as habitats shall be appropriately managed in accordance with a plan approved by the Endangered and Non-Game Species Project within the Division of Fish, Game, and Wildlife.

3. Areas designated as wild, scenic, recreational, or developed recreational rivers, pursuant to the National Wild and Scenic Rivers Act, 16 USCA 1271 et seq., or the New Jersey Wild and Scenic River Act, NJSA 13:8-34 et seq.;

4. Lands in municipally approved farmland preservation programs or on lands which have been dedicated to agricultural use by the purchase of their development rights pursuant to the provisions of the Agricultural Retention and Development Act, PL 1983, c. 33 or equivalent independent county or municipal programs, provided that such designation and dedication was officially adopted by municipal ordinance and the development rights have been purchased at least six months prior to the commission's proposing the site or an applicant submitting to the Department and the municipality as letter stating the intention to apply for registration and engineering design approval;

5. The Pinelands Area as established by NJSA 13:18A-11a of the Pinelands Protection Act, NJSA 13:18A-1 et seq.

6. Within 6.25 miles (10 kilometers) of any mandatory Federal Class I Prevention of Significant Deterioration of Air Quality area.

Fourth Objective Comparison

The criteria contained in the fourth objective are met at these locations. Even though construction of the proposed landfill would involve the filling of a few small isolated wetland areas, the impacts are expected to be limited and minimal. The several small wetland areas that must be filled have been classified by the New Jersey Bureau of Wetlands as being of moderate value and constitute an area that only totals less than 0.25 acre of the entire proposed site. In addition, no endangered or threatened species of wildlife are known to inhabit the Du Pont Chambers Works property. Although Bald eagles winter approximately 0.5 mile southwest of Chambers Works, and Peregrine falcons have been known to nest on the Delaware Memorial Bridge, there is adequate preserved habitat to assure their survival within the region surrounding the site.

The proposed siting of the landfill and incinerator will not impact wild, scenic, recreational, or developed recreational rivers, nor will the project pose a threat to special agricultural lands, pineland areas, or Federal Class I Air Quality areas.

Fifth Objective: NJAC 7:26-13.11, Ensure Safe Transportation

Section 7:26-13.11 of the NJAC deals with transportation issues. This section reads as follows:

(a) For the purpose of ensuring the safe transportation of hazardous waste from generators to new major commercial hazardous waste facilities:

1. Hazardous waste should be transported on Interstate, State, or county highways or other roads which are well-maintained, well-constructed, free of obstructions, and with a high degree of visibility.

2. The Department and Commission should consider requiring private, direct access roads from those specified in (a)(1) above to the facility; and

3. No hazardous waste shall be transported on roads where weight restrictions for the road or any bridge on the road will be exceeded in the selected route of travel, unless engineering upgrades, undertaken and financed by the facility operators, are provided which conform to all appropriate Federal, State, county and local laws and regulations.

Fifth Objective Comparison

Siting of the proposed incinerator and landfill at the Chambers Works location would not be impeded by the fifth siting objective. Hazardous waste would be transported on Interstate, State, and county highways and roads which are well maintained, well-constructed, free of obstruction, and have a high degree of visibility. In addition, private, direct access exists and is already being used for the transport of waste to the existing commercial hazardous wastewater treatment plant and no improvement to public or private access roads is required. Furthermore, all vehicles are expected to conform to normal highway loading[335] requirements.

Chambers Works is located less than one mile from Interstate 295 (I-295) and the New Jersey Turnpike, requiring minimum movement on county and/or local roadways. It is expected that most of the hazardous wastes from off-site sources will be delivered by trucks using either I-295 or the Turnpike. Trucks exiting these roads may enter Chambers Works from either U.S. Route 130 or N.J. Route 140.[336,337] Some of the trucks are expected to use US 130 to the north of Chambers Works' Broadway gate. U.S. Route 130 is a 40-foot wide, two-lane highway with eight-foot shoulders on either side of the road. N.J. Route 140 is an east-west roadway which connects U.S. Route 130 to the west with I-295 and Salem County Route 540 to the east. It is a 32-foot wide, two-lane roadway with eight-foot wide shoulders on each side.

For additional information regarding roads and access, refer to Section 2.4, Waste Transportation and Section 3, Environmental Setting.

Sixth Objective: NJAC 7:26-13.12, Protect Ground Water

Section 7:26-13.12 of the NJAC was written to ensure that the state's ground water resources are protected. This section reads as follows:

(a) For the purposes of protecting ground water:

1. New major commercial hazardous waste facilities may only be sited in areas where, prior to facility construction, the flow of ground water in the uppermost saturated unit is predominantly parallel to or upwards toward the water table and the predominant ground water flow direction is toward a nearby surface water body without any intermediate withdrawals from the uppermost saturated zone for public or private water supply and there is no significant recharge to deep aquifers; and

2. All new major commercial hazardous waste facilities shall be prohibited in areas where the depth to the seasonally high water table in the uppermost saturated unit will rise to within one foot of the ground surface; and

3. Land emplacement and impoundment type of new major commercial hazardous waste facilities shall be prohibited in the following areas:

   i. In areas where the ground water travel time within the uppermost saturated unit from the outermost edge of the containment structure to the site boundary, or to a surface water body or wetland within the site boundary, is less than ten years;

   ii. In areas within one mile of a water supply well or well field producing over 100,000 gallons per day, unless it can be demonstrated to the satisfaction of the Department or Commission, as appropriate, that natural hydrologic barriers isolate the site from the aquifer being pumped;

   iii. In the case of partially in-ground facilities, in areas where, prior to facility construction, the depth to the seasonally high water table in the uppermost saturated unit will rise to within five feet of the bottom of the containment structure; and

   iv. In the case of wholly aboveground facilities, in areas where, prior to facility construction, the depth to the seasonally high water table in the uppermost saturated unit will rise to within one foot of the ground surface.

<u>Sixth Objective Comparison</u>

Both the incinerator and the landfill proposed sites meet the intent of the sixth objective.

Although the ground water travel time within the uppermost saturated unit from the outermost edge of the landfill to the site boundary and to a surface water body and wetlands within the site boundary is less than ten years, other siting objectives are met. In addition, engineered features of the proposed landfill and incinerator will ensure that the intent of all siting objectives are achieved. Based on site stratigraphy, the flow of ground water in the uppermost saturated unit appears to be predominantly parallel to the water table and toward surface water bodies without any intermediate withdrawals for public or private water supply. There is also no significant recharge to a deep aquifer. There is a hydrologic barrier (represented by an unconformity) that separates the upper saturated zones from the Potomac-Raritan-Magathy aquifer from which much of the potable ground water is pumped. If ground water pumping associated with corrective action activities at Chambers Works is affecting parallel flow in the area of the proposed landfill, impacts would not increase recharge to the potable ground water supply. Furthermore, Woodward-Clyde Consultants claims that the seasonally high water table does not rise within one foot of the ground surface.[338]

Engineered features of the landfill (e.g., double liner system and leachate collection system) are designed to prevent hazardous waste constituents from coming into contact with the ground water. In addition, a leak detection system and ground water monitoring wells will be installed to detect system failure, and a ground water interceptor well system will be in place to withdraw any contaminated ground water before contaminants can reach a surface water body or a drinking water aquifer.

Engineered features at the incinerator will contain any spill of hazardous material from flowing onto the ground surface and coming into contact with ground water. The incinerator complex will be constructed on an asphalt/ concrete pad with spill containment wells.

Seventh Objective: NJAC 7:26-13.13, Protect Air Quality

Section 7:26-13.13 of the NJAC is concerned with air quality. This section reads as follows:

(a) For the purpose of protecting the air quality of the state:

1. No new major commercial hazardous waste facility shall be sited in a non-attainment area unless the facility demonstrates the emission offsets will be obtained prior to operation, pursuant to the requirements of the Department's air pollution control regulation entitled Control and Prohibition of Air Pollution from New or Altered Sources Affecting Ambient Air Quality in Non-Attainment Areas, NJSA 7:27-18 et seq., subject to the following more stringent requirements:

   i. The annual significant emission increase for volatile organic substances shall be 10 tons per year.

   ii. The annual significant emission increase for total suspended particulate matter shall be 25 tons per year.

   iii. The minimum offset ratio as required by Table 2 in NJAC 7:27-18.4(b) for volatile organic substances (VOS) shall be at least 2:1 and the offsets shall be obtained at a distance not to exceed 50 miles from the proposed new facility; and

   iv. The minimum offset ratio, as required by Table 2 in NJAC 7:27-18.4(b) for total suspended particulate matter (TSP) is as follows:

Distance of TSP Offsets from Facility (miles)	Minimum Offset Ratio
0.0 - 0.5	1.0:1
0.5 - 1.0	1.5:1
1.0 - 2.0	2.0:1

Seventh Objective Discussion

The Chambers Works area is in attainment of all ambient air quality standards for all criteria pollutants except ozone. Therefore, if the proposed expansions were designated as a new major commercial hazardous waste facility, Du Pont would be required to secure offsets to the expected increase in VOS emissions (precursors to ozone) prior to commencing operation of the incinerator. As described in Section 4.2, Air Quality, the expected rate of VOS emissions associated with the proposed incinerator is 10.2 tons per year which exceeds the 10 tons per year criterion. The minimum offset ratio required by the siting criteria is 2:1, which means that if 10.2 tons per year of VOS were emitted during incinerator operations, an offsetting reduction in VOS emissions of twice that amount (20.4 tons per year) would be required. Such offsets must be obtained from sources within 50 miles of the proposed incinerator site.

NOTES

1. Letter from M.P. Polakovic, Chief Engineer, NJDEP Air Quality Engineering and Technology, to G. Jordan, Rollins Environmental Services, General Manager, May 8, 1987.

2. RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

3. Letter from Mr. P. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont De Nemours & Co. to Mr. T. McAdams, Radian Corporation, March 31, 1988.

4. Memo and Computer Hardcopy from S. Boyle, Asst. Director, NJ Hazardous Waste Facilities Siting Commission, to Mr. Charles Miller, March 24, 1988.

5. RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

6. Ibid.

7. Ibid.

8. Ibid.

9. Ibid., Section 4, Attachment B.

10. EPA, 1986 - Permit Writer's Guide to Test Burn Data, EPA/625/G-86-012, 1986.

11. Richard D. Scheffe, "VOC/NO_x Point Source Screening Tables," U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1988.

12. Telephone conversation with Mr. Richard D. Scheffe, U.S. EPA, February 15, 1989.

13. RCRA Part B Permit Application, Volume VIII - Air Permit Application, "Chambers Works Rotary Kiln Hazardous Waste Incinerator and New Secure Landfill," prepared for E.I. Du Pont de Nemours & Company, Deepwater, NJ, 1989.

14. Letter from M.P. Polakovic, Chief Engineer, NJDEP Air Quality Engineering and Technology, to G. Jordan, Rollins Environmental Services, General Manager, May 8, 1987.

15. Kelley, K.E., "Comparison of Metals Emission Data from Hazardous Waste Facilities," Presented at the 78th Air Pollution Control Association Meeting, Paper No. 85-72.8, June 1985.

16. Letter from Mr. P. Costello, Sr. Consultant, Environmental Affairs, E.I. Du Pont De Nemours & Co. to Mr. T. McAdams, Radian Corporation, March 31, 1988.

17. Memo and Computer Hardcopy from S. Boyle, Asst. Director, NJ Hazardous Waste Facilities Siting Commission, to Mr. Charles Miller, March 24, 1988.

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SECTION 5

UNAVOIDABLE ADVERSE IMPACTS AND MITIGATIVE MEASURES

Section 5 details the unavoidable impacts associated with the proposed incinerator and landfill expansion activities that have adverse effects. Mitigative measures that are effective in minimizing or reducing the adverse impacts are also described.

5.1 CONSTRUCTION IMPACTS

Due to the nature of construction activities, which have significant highs and lows during the course of a job, the impacts have been divided into those which are temporary versus those which are permanent.

5.1.1 Temporary Impacts

Temporary impacts are those caused by the construction of the proposed incinerator and landfill and include any impacts due to heavy equipment and other vehicles involved in construction activities. Fugitive dust, sediment discharges, and noise are the three main areas of potential impact from construction activities. **There are expected to be no socioeconomic impacts associated with the construction workforce.** A maximum of 300 additional workers will be hired by the construction contractors at any one time to build the proposed units. This labor force will be obtained from the local area and from other areas. The number of workers hired from the local area depends on the contractor selected. However, impacts on local unemployment and impacts associated with workers coming into the area will be negligible.

5.1.1.1 Air Emissions Impacts of Construction. With the implementation of fugitive dust control and mitigation measures during construction activities, fugitive dust concentrations resulting from construction activities are not expected to exceed Federal or State ambient air quality standards for particulate material.

5.1.1.2 Sediment Discharges Impacts of Construction. Increased sediment loading to surface waters is not expected to occur during the construction of the incinerator and landfill. Good construction practices (e.g., covering piles, wetting surfaces) will be followed, and soil erosion and sediment controls should prevent increased sediment loading, thus the impact of any increased loading should be minor and short-term.

5.1.1.3 Acoustic Environment Impacts of Construction. Construction of the proposed incinerator and landfill expansion will produce noise, but any increase in ambient sound levels off-site should be imperceptible. Use of heavy machinery during construction will be the primary source of noise. However, residences are too far away, Du Pont structures will act as noise barriers, or existing noise levels off-site are sufficiently high that the increase in noise will be imperceptible (refer to Section 4.7.1).

5.1.2 Permanent Impacts

Permanent impacts of construction are those due to the completed incinerator and landfill. They do not include the impacts due to short-term construction activities, maintenance, and/or operation of the completed incinerator and landfill.

5.1.2.1 Ecological Impacts. As discussed in Section 4.3, the ecological impacts due to constructing the proposed incinerator and landfill are limited to habitat loss. Approximately 0.25 acre or less of wetland aquatic habitat will be lost due to construction of the landfill. Approximately 40 acres of terrestrial wildlife habitat will be lost as a result of construction of the landfill, the truck wash station, and associated roads, with another 15 acres used for the incinerator and associated structures. However, the value of the terrestrial habitat potentially lost is low since the sites have already been disturbed by past industrial activities. Also, the land is already zoned as a "heavy industrial" area, therefore, the construction of the proposed incinerator and landfill should not affect any nearby residential property values.

5.1.2.2 Other Permanent Impacts. No other significant permanent impacts were identified as resulting from the construction of the proposed incinerator and landfill. Neither the construction activities nor the incinerator stack (213 feet high) and landfill (100 feet high after closure) will be visible from Route 130 due to an existing natural woodland barrier. Some residents further away from Chambers Works will be able to see the closed landfill and incinerator from a distance. However, both units will be part of an existing industrial landscape. In addition, the landfill will be covered by grass. The incinerator and landfill will also be visible to motorists crossing the Delaware Memorial Bridge. Given the substantial number of buildings and stacks already at Chambers Works, however, these facilities will not present a significant visual intrusion.

5.2 IMPACTS UNDER NORMAL OPERATIONS

This subsection provides details on the impacts of daily operation of the incinerator and landfill under normal conditions upon the environment, nearby residents, and workers on the site.

5.2.1 Water Quality Impacts

Surface Water Quality Impacts. No adverse impacts to surface water quality are expected from routine operation of either the incinerator or landfill. The incinerator complex has been designed to prevent stormwater run-on and runoff and to contain all spills through the use of spill containment curbs. Wastewater generated by the incinerator's air pollution control system (i.e., the only wastewater generated in the incinerator system), all rain that falls onto the complex, and any liquid spill material will be conveyed to the WWTP. Expected quantities that will be generated will represent an extremely small percentage of the 40 million gallons treated and discharged each day from the WWTP. Contaminants in the incinerator stack emissions may reach area surface waters by deposition, but contaminant concentrations are expected to be very low and are not expected to affect water quality adversely.

Discharges from landfilling activities also will be controlled, including leachate generated by stormwater infiltrating through the wastes and wash-water runoff from the truck wash station. Both of these wastes will be collected and pumped to the WWTP for processing. Quantities also will represent only an extremely small percentage of the flow processed daily at the WWTP. Run-on will be prevented by the perimeter containment dike. The quality of area surface waters could be affected by subsurface leakage from the landfill and exfiltration of contaminated ground water, but various controls will be installed at the landfill to prevent ground-water contamination (see below).

Although both units will be located within the 100-year floodplain, floodwaters should not impact either unit. The incinerator's waste storage building will be constructed on fill material that will be raised to the 100-year flood event elevation (i.e., to 12.3 ft CWD). The landfill will include a perimeter clay containment/starter dike that will have a minimum top elevation at 17 ft CWD, which is 4.7 ft above the 100-year flood event elevation. The dike also will include rip-rap protection that will have a top elevation at 14.5 ft CWD, which is 2.0 ft above the 100-year flood event elevation. Therefore, floodwaters are not expected to wash away wastes in the landfill or waste drums from the incinerator's waste storage area.

Ground-Water Quality Impacts. **The proposed incinerator complex and landfill have been designed to protect ground water, and therefore, no adverse impacts to ground water are anticipated.** The incinerator complex will consist of an impermeable concrete pad surrounded by curbing to contain liquid spills. Therefore, spills will not be able to percolate to ground water. Particulate contaminants from stack emissions will be deposited on the ground, but concentrations of these contaminants are considered insignificant and would not be expected to percolate down to the drinking water aquifer (Potomac-Raritan-Magothy) system in any concentration that would pose a health risk.

The landfill design includes various control features to prevent the release of hazardous waste constituents to the subsurface environment. These features include a complex liner system, a leak collection system, and a leak detection system. The landfill also includes a ground-water monitoring system to detect contaminant releases from the structure should any of the controls fail, and a well system to intercept any contaminated ground water. Leachate and any intercepted ground water will be pumped to the Chambers Works WWTP for processing.

5.2.2 Air Quality Impacts

The air quality impacts of air pollutant emissions from the proposed Chambers Works incinerator are not expected to be significant based on evaluation of emissions estimates and air quality modeling results. Ambient air quality modeling of the incinerator emissions was conducted by ENSR and ICF Technology. The modeled ambient air concentrations of criteria pollutants, metals, organic compounds, and acid gases from the incinerator were found to be well within regulatory standards and guidelines. The expected emissions from both the incinerator and landfill were evaluated by ICF Technology and found to be well within existing and proposed standards and guidelines.

The air quality impacts of air pollutant emissions from the proposed Chambers Works landfill are not expected to be significant based on evaluation of air quality monitoring data from the existing landfill operation, and evaluation of waste characterization data and proposed landfill operating procedures provided by Du Pont. Ambient air quality modeling of emissions of particulate and organic compounds from the landfill was not conducted. However, based on the comparison of the results of modeling fugitive emissions of organic compounds from the incinerator waste storage and handling system with fugitive emissions expected from the landfill, ambient air concentrations of organic compounds are expected to be well within regulatory standards and guidelines. Based on monitoring data for fugitive particulate emissions from the existing Chambers Works landfill, the ambient air concentrations of particulate material (including metals) are expected to be well within regulatory standards and guidelines.

Control of particulate and organic emissions is dependent on proper control of the types of wastes disposed in the landfill, as well as proper operating methods. It is expected that Du Pont will operate the landfill using procedures designed to minimize air emissions and impacts, as documented in the Draft Part B Application on the landfill operating procedures.

The air pollution control systems applied to the incinerator are expected to be in compliance with Federal and State emission control regulations and guidelines, subject to verification during the required incinerator trial burn. The removal efficiency of the control system for acid gases (specifically hydrogen chloride and hydrogen fluoride) is expected to minimize the impacts of acid gas emissions and to comply with Federal and State regulations. The control efficiency for particulate material (including metals) is expected to be greater than regulatory standards and guidelines.

5.2.3 Ecology Impacts

No impacts on aquatic and terrestrial systems associated with the landfill and incinerator operations are expected. The landfill design features and operating controls are adequate to prevent migration of chemicals from the landfill. The design of the incinerator and its operating controls are also sufficient to prevent chemical releases from spills and other operational incidents. In addition, emission concentrations at the incinerator will not be large enough to cause adverse impacts.

5.2.4 Public Health Impacts

The goal of the public health assessment (Section 4.4) is to determine whether emissions associated with the proposed Chambers Works expansion pose a risk to human health. This screening assessment is based on guidelines recommended by the U.S. Environmental Protection Agency and the NJDEP Division of Environmental Quality and concentrates on the emissions expected from the operation of the proposed hazardous waste incinerator. The landfill will not have continuous point-source emissions and is expected to have essentially no fugitive emissions (based upon operating experience with the present landfill). Therefore, no public health impacts were assessed for airborne emissions from the proposed landfill. Exposure scenarios and assumptions were selected to identify the most likely significant exposure pathways and reflect maximum plausible risk and thus provide conservative health risk estimates. **This conservative (protective) analysis indicates that the incinerator emissions will have no significant impact on public health.** The assumptions and methodology of the approach used to reach this conclusion are summarized below.

Various sources of uncertainty are inherent to risk assessments. These uncertainties are compensated for by using conservative assumptions that tend to overestimate risks. The assumption used here can provide an estimate of the upper bound of risk, however, actual risks could be considerably lower.

Sixteen chemicals were selected for detailed evaluation based on projected emissions, guidance from NJDEP and potential for health risk (Section 4.5.3). For each chemical the health effects that have been associated with short-term (acute) and long-term (chronic) exposure were summarized. Health effects criteria recommended by EPA were used to estimate the dose-response relationship for these chemicals for oral and inhalation exposure.

Two exposure pathways identified as complete are likely to be significant. These are direct inhalation of airborne chemicals and incidental ingestion of soil. For each of these pathways potential chemical intakes were estimated for the most exposed individual (MEI), that is the person residing at the maximum impact point, assuming plausible maximum exposure scenarios. The MEI risk was derived by combining potential intakes and health criteria.

The results of this assessment showed that all non-carcinogens had hazard indices several orders of magnitude less than 1 and therefore, below the threshold for potential concern. The highest risks for carcinogens was an upper bound limit for polychlorinated-p-dioxin and polychlorinated dibenzofuran compounds (PCDDs/PCDFs) of 1×10^{-7} (i.e., 0.1 cases per million), given lifetime exposure of the MEI at the maximum impact point. (Refer to Section 4.4.1). The maximum risks for hexavalent chromium, cadmium, and arsenic are 3×10^{-7}, 4×10^{-7}, and 6×10^{-7}, respectively. Risks estimated for all other chemicals were about 10 to 10,000 times lower.

5.2.5 Worker Health and Safety Impacts

No significant worker health and safety impacts were identified as resulting from the operation of the proposed incinerator and landfill expansion. Operations will be covered under the plant-wide health and safety program, and this program, together with proposed designs and other administrative controls, is sufficiently comprehensive in scope to protect worker health and safety.

5.2.6 Socioeconomic Impacts

The impacts to the communities immediately surrounding Chambers Works due to the increase in traffic caused by the proposed incinerator and landfill are negligible. As was discussed in Section 4.6.7, the increase in traffic flow along routes extending 10 miles from the facility gates range from 0.10% to 1.30%. This change in traffic flow results in an estimated increase in accidents ranging from 0.02% to 1.28%. Both of these increases are minor and present negligible impacts to the surrounding area.

5.2.7 Acoustic Environment Impacts

Operation of the proposed incinerator will produce noise in the surrounding area. Noise emissions from the induced draft fans used between the scrubber and the stack will be the primary source of this noise. The path of transmission between this source and the potential receiving locations, however, is readily amenable to noise reduction techniques. Without the implementation of noise mitigation measures, noise impacts are predicted for the Deepwater area when the incinerator begins operation. As shown in Section 4.8.2, the noise levels from the stack will exceed the New Jersey night-time noise limits. Furthermore, the noise will raise the ambient level in Deepwater by 2 dB during the day, which, although it might normally not be noticeable, may at times be annoying because there is a pure-tone component at approximately 250 Hz.

The major source of operational noise are the two Robinson Industries RB 1216 induced draft fans located between the scrubber and the stack. Exhibit 5-1 is a summary of the noise impacts of incinerator operation. The two fans produce a linear sound power level of 134 dB. This sound power, radiated from the top of the stack, would produce an A-weighted sound level of 57 dB at a distance of 2600 feet at the residences at Harrison and Jackson Streets in Deepwater. Consequently, plant emissions would exceed the New Jersey night-time code by 7 dB. Furthermore, the sound level equals or exceeds the New Jersey night-time noise limits in six bands. Reducing this noise using a muffler inserted in the stack would be inappropriate, because the stack is constructed of fiber reinforced plastic with a steel shell. Sound would be transmitted through the stack wall as well as from the stack discharge. A more appropriate treatment would be to insert a duct muffler between the fans and the stack. Exhibit 5-1 illustrates the attenuation of such a muffler, and line 4 shows that noise levels can potentially be reduced to 29 dB(A) at the Deepwater location. This level is far below the ambient level and well within the New Jersey night-time noise

EXHIBIT 5-1

ACOUSTIC IMPACTS OF INCINERATOR OPERATION

	Octave Band Center Frequency (Hz)									
(In dB)	63	125	250	500	1000	2000	2400	8000	A-wt	Lin
1. Sound Power Two ID Fans	125	128	131	121	116	111	107	104	124	134
2. Stack Noise at 2600 Feet	58	61	64	54	49	44	40	37	57	67
3. Potential Muffler Attenuation	-12	-20	-29	-39	-41	-41	-38	-26		
4. Stack Noise 2600 Feet with Muffler	46	41	35	15	8	3	2	11	29	47
5. New Jersey Night-time Limits	71	61	53	48	45	42	40	38	50	

Notes: Sound pressure levels (dB re 20 μPa)

Line 2-levels that exceed NJ night-time limits are underlined

A-wt - A-weighted sound pressure level
Lin - linear sound power level

limits. In addition, the level of the 250 Hz tone would be reduced below the ambient level and would be masked by ambient sources.

Low frequency infrasound generated by the combustion process at the rotary kiln could result in adverse impacts. The designer of the kiln should document noise levels generated by the combustion process in the kiln. These octave-band levels should not exceed 94 dB in any octave bands below 31.5 Hz at 50 feet from the kiln. This will assure that low frequency sound does not cause window and wall rattle in the nearby residences and does not exceed the New Jersey night-time limits in Deepwater. Additionally, the manufacturer of the kiln should provide information on methods to mitigate that noise that exceeds this specified level.

5.3 IMPACTS OF ABNORMAL OCCURRENCES

This subsection addresses impacts of abnormal occurrences involving the incinerator and landfill. For the purpose of this discussion, abnormal occurrence is defined as a hazardous incident caused by human error, system/ equipment malfunction, physical phenomenon, and/or natural hazard (e.g., lightning, flood, earthquake, etc.) that are out of the ordinary and that are unlikely to occur. The discussion below will be divided into two categories: foreseeable occurrences and credible worst case occurrences. Impact, for the purpose of Section 5.3, is defined as the ultimate result of a hazardous abnormal occurrence following the application of preventative and mitigative measures.

5.3.1 Foreseeable Occurrences and Their Impacts

Section 5.3.1 addresses foreseeable occurrences, while credible worst case accidents are discussed in Section 5.3.2. Foreseeable occurrence, for the purpose of this section, is defined as an upset that has been identified as being representative of the types of accidents that are most likely to occur, given the operations to be conducted and site characteristics. This is not to say that foreseeable accidents are likely to occur; these accidents are conceivable and more likely to occur than the credible worst case accidents addressed in Section 5.3.2. Nine foreseeable occurrences have been identified and are listed below. Their impacts are discussed in following sections.

- Inappropriate waste fed into the incinerator
- Small spill associated with storage operations
- Small spill associated with handling operations
- Minor fire associated with storage and handling operations
- Small on-site transportation spill
- Small off-site transportation spill
- Floods and hurricanes
- Earthquake
- Leak in landfill containment liner.

5.3.1.1 General Impacts Applicable to Most Occurrences. There are some impacts that generally occur with most of the foreseeable occurrences that were identified. These general impacts are discussed below, while more specific impacts applicable to only certain occurrences are addressed in Section 5.3.1.2. This section discusses the expected effectiveness of existing and proposed engineering controls and administrative procedures in preventing foreseeable occurrences and then discusses their effectiveness in responding to such occurrences.

Evaluation of Controls and Procedures for Preventing Foreseeable Occurrences. Impacts of foreseeable occurrences at the landfill and incinerator are expected to be minimal considering the expected effectiveness of Du Pont's existing and proposed administrative procedures, operational procedures, and engineering controls in preventing occurrences. Existing procedures and controls are included in this discussion because they are already in place plant-wide and, therefore, will also apply to the proposed incinerator and landfill. Proposed procedures and controls, on the other hand, are specific to the proposed landfill and incinerator.

Du Pont has included its proposed incinerator and landfill accident prevention program numerous state-of-the-art engineering controls and administrative/operational procedures for preventing accidents at both the incinerator and the landfill. The success of the accident prevention program is dependent on both the engineering controls and administrative/operational procedures working effectively together. The expected effectiveness of these accident prevention measures is discussed below. Prevention refers to keeping accidents from occurring as opposed to reducing their impact when and if they occur. A spill containment dike, for example, does not prevent liquid from escaping from a container, is thus not considered a preventative measure even though it confines the spill. A containment dike is considered a response/ mitigation measure.

Proposed Incinerator

The accident prevention measures for the proposed incinerator, container storage and handling area, tank farm, and truck unloading area are comprehensive and thorough. Engineering controls envisioned at the incinerator are expected to be effective in preventing spills, leaks, fugitive emissions, fires, and explosions from occurring. The incinerator will have the following in-place engineering controls to prevent spills and leaks effectively:

- Tanks designed to ANSI, ASME, ASTM, and Du Pont standards and specifications and in compliance with RCRA requirements (refer to Section 2.1.2.2);
- Tanks equipped with level indicators and high level shut-off switches (refer to Sections 2.1.2.2 and 2.5.3.2);
- Electrically heated tanks to prevent freezable waste from freezing and damaging the tank (refer to Section 2.1.2.2);

- Automatic closing valves (which respond to high level switches in tanks) in feedlines, and flow indicators (refer to Sections 2.1.2.2 and 2.5.3.2); and

- Vent systems that direct emissions from tanks and tank trucks to either the incinerator, when operating, or carbon adsorbers (refer to Sections 2.1.2.2 and 2.5.3.2).

The incinerator facility will be equipped with the following in-place engineering controls to prevent fires and explosions:

- Tanks and tank trucks blanketed with non-flammable nitrogen gas (refer to Sections 2.1.2.2 and 2.5.3.2);

- Tanks equipped with pressure venting valves (i.e., conservation vents), anti-static fill lines and lightning arrestors (refer to Sections 2.1.2.2 and 2.5.3.2.);

- Vent systems that collect flammable vapors and route them to either the incinerator or carbon adsorbers (refer to Sections 2.1.2.2 and 2.5.3.2);

- Electronic equipment associated with waste storage and handling operations complying with the requirements for the National Electrical Code, Class 1, Division 2, Group D classification (refer to Section 2.5.3.2);

- Double block valves and bleed lines that prevent accidental introduction of materials into the kiln (refer to Section 2.5.3.2);

- Negative pressure within the kiln to remove continually any accumulations of gases and to prevent the buildup of explosive concentrations (refer to Section 2.5.3.2);

- Pressure and temperature indicators and automatic controls for the kiln and afterburner chamber, including waste feed cutoffs (refer to Section 2.5.3.2); and

- Emergency pressure relief vent in the afterburner discharge duct to protect the kiln and afterburner (refer to Section 2.1.3.4).

Administrative and operational procedures that will be in effect at the incinerator together with engineering controls are expected to be effective in preventing spills, leaks, fugitive emissions, fires, and explosions. Accident prevention will be accomplished by incinerator operating personnel following procedures regarding waste acceptance, handling, and storage; safety guidelines; inspection and maintenance program; guidelines presented in the "Discharge Prevention, Containment or Countermeasure Plan;" and the No Smoking policy. Du Pont's comprehensive training program will provide incinerator personnel with training in these areas. Administrative/operational procedures and training are detailed in Sections 2.1, 2.5, and 4.5.

Despite the expected effectiveness of the above procedures and engineering controls in preventing foreseeable occurrences, accidents may still occur. These accidents can result from human error, system/equipment malfunction, natural hazard, and/or physical phenomenon (e.g., static spark igniting flammable vapors). Failure of an engineering control or administrative/operational procedure, however, does not necessarily mean that an accident will occur. Examples of foreseeable occurrences include:

- Leaking drums due to corrosion or damage
- Spills from overturned or punctured drums
- Feedline rupture due to puncture, rapid pressurization, or corrosion
- Leaks from damaged or partially closed valves
- Spills from overfilled containers
- Fires involving spilled wastes.

When such accidents occur, response systems, equipment, and procedures will lessen or eliminate potential adverse impacts on people, property, and the environment. Accident response is addressed later in this section.

If accident prevention measures fail, the impacts would affect incinerator personnel and the incinerator. Because of the incinerator's isolated location, it is unlikely that other parts of the Chambers Works plant would be affected. **Off-site (i.e., beyond the plant property) impacts would be extremely unlikely and minimal at best.** Impacts, as mentioned earlier, will be lessened or eliminated by in-place response equipment, systems, and procedures; therefore, impacts should be relatively minor (e.g., minor damage to equipment, requiring repair or replacement; slightly injured, exposed, or contaminated personnel; temporary shut-down of operations, etc.). Depending upon the accident circumstances, there is always the possibility of personnel receiving moderate to serious injuries that would require on-site or off-site medical treatment, but cases of this type would be uncommon. Impacts will be discussed in greater detail later in this section.

<u>Proposed Landfill</u>

The proposed landfill, given its design and the nature of the wastes to be accepted, will likely experience only two foreseeable occurrences: 1) leachate leaking into the ground water, and 2) flood waters entering the landfill over the containment dike. Spills are not expected because free liquids will not be disposed of in the proposed landfill, and fires and explosions are not expected because the wastes to be landfilled are non-combustible (refer to Section 2.2.1 for acceptable/non-acceptable wastes at the landfill). Leachate leaking into the ground water is very unlikely to occur under normal circumstances because of the extensive leak prevention components that have been incorporated into the design of the landfill (refer to Sections 2.2.2.2 and 2.2.2.3). Leachate leaking into the ground water could occur under abnormal circumstances such as an earthquake; however, a damaging earthquake in the Deepwater area is very unlikely. Flood waters reaching levels whereby they could affect the landfill are also unlikely.

The containment system for the proposed landfill is expected to be effective in preventing wastes and leachate from impacting the environment. As described in Section 2.2.2, the landfill containment system, which will meet RCRA and NJDEP requirements, will include a double liner, leachate collection and detection system, a ground-water monitoring system and an interceptor well system, a containment dike that will be continuously raised as the cells are filled, and other run-on/runoff controls. The associated truck wash station will also have runoff containment structures and a large sump to collect contaminated wash water.

Proposed administrative and operational procedures at the landfill together with engineering controls are expected to be effective in preventing environmental contamination and fires (e.g., ignitable wastes will not be accepted). Landfill personnel will follow operational procedures regarding waste acceptance and landfilling, safety guidelines, inspection and sampling program, and guidelines presented in the "Discharge Prevention, Containment or Countermeasure Plan" and "Contingency Plan for Secure Landfill" to prevent accidental releases. Du Pont's comprehensive training program will provide training in these areas to landfill personnel. (Administrative/operational procedures and training are detailed in Sections 2.2, and 2.5).

Despite the expected effectiveness of the above procedures and engineering controls in preventing foreseeable occurrences, problems may still occur. Leachate leaking into the ground water could be caused by a leak in the liner system and failure of the leachate collection and detection system. Such failures would be highly unlikely under normal conditions but could become more likely in the event that the systems were stressed by the effects of an earthquake. However, a ground-water pumping system would also be in place for ground-water withdrawal and treatment. Flood waters could also enter the landfill and carry away wastes, however, a flood of sufficient magnitude to rise above the containment dike is highly unlikely.

If preventive measures fail, impacts of foreseeable occurrences at the landfill could affect the environment, particularly ground water. Impacts are discussed later in this section and also in Section 5.3.1.2.

<u>Evaluation of Controls and Procedures for Responding to Foreseeable Occurrences</u>. When accident prevention measures fail to prevent foreseeable occurrences, response systems must be in-place to lessen or eliminate adverse impacts. Impacts of foreseeable occurrences are expected to be minimal due to the expected effectiveness of Du Pont's existing and proposed response procedures, systems, and equipment.

Du Pont has included in their proposed accident prevention plans numerous state-of-the-art response systems, equipment, and procedures for the proposed incinerator and landfill. The success of the response program is dependent upon response equipment and procedures working in combination. The expected effectiveness of these response measures is discussed below.

Proposed Incinerator

The proposed accident response measures for the incinerator are comprehensive and meet or exceed Federal and State regulations. Engineering controls that will be in place at the incinerator are expected to be effective in lessening or eliminating adverse impacts of spills, leaks, and fires. The incinerator will have the following in-place engineering controls to control spills, leaks, and fires effectively:

- Level alarms for tanks and sumps that are monitored in the Central Control Room 24 hours a day (refer to Section 2.5.3.3);

- Smoke detectors in the Office Building and in the Instrument Equipment Room of the ECR Building (refer to Section 2.5.3.3);

- Alarm boxes for transmitting an alarm to the plant's Emergency Control Center and audible evacuation/fire alarm system and public address system (see Section 2.5.3.3);

- Automatic sprinkler systems protecting the front wall of the kiln, container storage area, container handling/feed area, truck unloading area, lab, shop, and office building and monitor nozzles to protect the tank farm (refer to Section 2.5.3.5).

- Automatic Halon systems for protecting electrical equipment in the Central Control Room, Instrument Equipment Room, and Analyzer Room (refer to Section 2.5.3.5);

- Water supply system (i.e., tank, pumps, lines) to supply sufficient quantities of water to sprinkler systems and manual fire suppression systems (refer to Section 2.5.3.3);

- Hydrants/hose boxes and fire extinguishers at strategic locations (refer to Section 2.5.3.5);

- Spill containment structures at or in the tank farm, truck unloading area, container storage and handling area, kiln, afterburner/wet deslagger area, gas scrubbing area, and the fluoride unloading area and fire suppression water collection sumps to capture contaminated runoff (refer to Section 2.1.2.2); and

- Safety shower and eyewash stations throughout the incinerator area.

Response systems that will be utilized in conjunction with in-place response equipment include response groups and the "Systematic Approach for Emergency Response" (SAFER) computer system for modeling accidental releases to the air. Chambers Works has an existing emergency response system that has effectively provided protection to the entire plant for many years. This same system will also provide protection to the incinerator. The response organization is composed of the following groups:

- Fire department (refer to Sections 2.5.3.6 and 2.5.3.7);
- TERP Team (refer to Sections 2.5.3.6 and 2.5.3.7);
- Fire brigade (refer to Section 2.5.3.7);
- Medical department/ambulance service (refer to Sections 2.5.3.6, 2.5.3.7, 2.5.6, and 4.5.4); and
- Protection Division (refer to Section 2.5.1).

These response groups are well trained, well equipped, and fully capable of handling most or all of the foreseeable occurrences at the incinerator. In cases where additional assistance is required, Chambers Works can call upon the emergency response resources (i.e., fire department, ambulance, police) of nearby municipalities (refer to Section 3.5.5).

The SAFER system (see Section 2.5.3.3) will be a valuable tool in projecting plume trajectories and concentration levels resulting from air releases. Although it should not be required to respond to foreseeable abnormal occurrences, it will be especially useful in the event of a major release. SAFER is discussed in greater detail in Section 5.3.2, Credible Accident Scenarios.

Proposed operational and response procedures at the incinerator facility together with in-place response equipment and systems are expected to be effective in lessening the impacts of foreseeable abnormal occurrences on personnel, property, and the environment. Operational and response procedures and programs will address protection of workers as well as remedial actions. More specifically, procedures and programs will address and include:

- Reporting of emergencies (refer to Section 2.5.3.3);
- Evacuation (refer to Section 2.5.3.4);
- Response training (refer to Sections 2.5.5, 2.5.6, 4.5.1, and 4.5.2);
- Respiratory protection (refer to Section 4.5.4);
- "Discharge Prevention, Containment or Countermeasure Plan" (see Section 2.5.3.1);
- "Discharge Cleanup and Removal Plan" (see Section 2.5.3.1);
- "Chambers Works Spill Control Safety Guidelines" (see Section 2.5.3.1);
- "Emergency and Disaster Manual" (refer to Section 4.5.6);
- Material Safety Data Sheets (refer to Section 4.5.5); and
- Hazard Communication Program (refer to Section 4.5.5).

Despite the expected effectiveness of the above response procedures, systems, and equipment in lessening impacts of foreseeable occurrences, adverse impacts may still result. Adverse impacts may be caused by equipment malfunction, delayed reporting of emergencies, delayed or improper response actions, adverse weather conditions, hazards overwhelming response equipment and efforts, etc. Impacts of foreseeable occurrences would be expected to affect incinerator personnel, the incinerator, and the environment. Because of the incinerator's isolated location, it is unlikely that other parts of the plant would be affected. Off-plant impacts would also be extremely unlikely and minimal at best. Impacts to the incinerator and workers could vary widely depending upon the incident circumstances. A spill in the container storage area, for example, would cause minor damage to property but could cause minimal to serious injuries depending upon the hazardous characteristics of the spilled waste, the present health condition of the worker, and the degree of worker exposure prior to medical treatment. A small fire in the drum handling/incinerator feed area could cause minor to moderate damage to property and minor to serious injuries to personnel depending upon the severity of the fire and degree of worker exposure to the products of combustion prior to medical treatment. **In all cases of foreseeable abnormal occurrences, the impacts to the environment, if any, are expected to be minimal.**

<u>Proposed Landfill</u>

The proposed accident response measures for the landfill are practical, thorough, and meet or exceed Federal and State regulations. Proposed engineering controls at the landfill are expected to be not only effective in responding to abnormal occurrences but very effective in preventing them.

As mentioned earlier, the only foreseeable abnormal occurrences affecting the landfill would be liner failure and flood waters washing away wastes. Although neither occurrence is very likely, engineering controls will be in place to lessen adverse impacts. There will be a leak detection system to signal the presence of leachate leaking through the liner and appearing in the leachate collection system below the upper liner (see Sections 2.2.2.3 and 2.2.2.4). This will enable Chambers Works to take prompt remedial action. Should leachate leak beyond the leak detection system, there will be ground water monitoring wells in place to detect contamination and a ground-water well interceptor system to withdraw contaminated ground water. The landfill's containment dike, which is above the 100-year flood level, should keep high flood waters from the Delaware River from entering the landfill. If flood waters do enter the landfill and completely cover the surface, then engineering controls will become ineffective. As mentioned before, this is unlikely to occur.

If prevention measures fail, impacts of a foreseeable occurrence at the landfill could affect the environment, particularly ground water. Contaminants leaking into the ground water could impact the regional drinking water aquifer system, and flood waters carrying away wastes could impact a downstream area of the Delaware River Basin. Impacts caused by a leaking containment system will be lessened due to the proposed ground water monitoring program (see Section 2.2.2.5) and an interceptor well system. This monitoring program should detect leaks soon after occurrence, so that remedial action can be taken in a timely manner to prevent further contamination. The interceptor well system will be able to pump contaminated ground water, preventing it from moving off the site.

Transportation Accidents

Spills occurring during the transport of wastes do not lend themselves to this section's discussion of general impacts applicable to most foreseeable abnormal occurrences. Transportation spills are, therefore, addressed separately in the next section.

5.3.1.2 Impacts of Specific Occurrences. Section 5.3.1.2 discusses the following specific impacts associated with certain occurrences:

- Inappropriate waste fed into the incinerator
- Small spill associated with storage operations
- Small spill associated with handling operations
- Minor fire associated with storage and handling operations
- Small on-site transportation spill
- Small off-site transportation spill

For each of the above occurrences, the following topics are discussed (as applicable):

- Description of occurrence

- Probability of occurrence - in qualitative terms

- Evaluation of existing engineering controls and administrative procedures for preventing the occurrence

- Evaluation of existing engineering controls, equipment, personnel, and procedures for responding to occurrence

- Potential impacts beyond or despite response efforts (based on the adequacy of preventative measures and response capabilities)

Inappropriate Waste Fed into the Incinerator

Release Scenario. Emissions of air contaminants from the incinerator stack could increase above normal levels if an inappropriate waste stream as fed to the incinerator. The credible scenarios which could cause this include improper labeling of waste drums and operator error. Examples of operator error include unloading the wrong drum into the incinerator, or connecting a pipe to the wrong storage tank for the purposes of unloading the contents into the incinerator. Based on information provided by Du Pont concerning waste acceptance and analysis procedures and operator training programs for the proposed incinerator, either scenario is considered unlikely.

Based on the description of the incinerator, waste streams, and emissions data provided by Du Pont and ENSR, the worst case situation chosen for this analysis assumes the loading of an excessive amount of chlorinated compounds into the incinerator. Emissions data provided by ENSR indicate that the uncontrolled hydrogen chloride (HCl) emission rate is 3,600 pounds/hour under normal incinerator operating conditions. Assuming that all the HCl emissions are generated from methylene chloride, approximately 4,200 pounds per hour of methylene chloride would be required. This would represent the maximum feed rate of methylene chloride to the incinerator.

ICF Technology examined a scenario where the feed rate of methylene chloride was twice that expected under normal incinerator operating conditions. In such a situation the uncontrolled emission rate of HCl would be 7,214 pounds per hour (910 grams/second). The increase in loading of HCl into the scrubber would considerably decrease the efficiency of the scrubber. The HCl control efficiency claimed by Du Pont during normal operation is 99.9 percent. During this situation where the uncontrolled HCl emission rate is doubled, it is conservatively estimated that the scrubber efficiency drops to 70 percent. This corresponds to a controlled emission rate of HCl of 2,164 pounds per hour (273 grams/second).

Although it is possible for an inappropriate waste to be fed to the incinerator in the short term, the situation is not expected to persist for a long period. The continuous HCl emission monitoring system would alert the incinerator operators to the increased HCl emission rate. Thus the situation would likely be addressed within no more than a few minutes either by diverting the inappropriate waste from the incinerator feed or by shutting down the incinerator.

Modeled Ambient Air Concentrations. This situation was modeled using INPUFF Version 2.3, an EPA approved model for modeling semi-instantaneous (short-term) or continuous point sources at a maximum of 100 receptor locations[1]. Required inputs to the model include the emission rate of the pollutant in grams/second, wind speed and direction, exhaust gas velocity, and release duration. The HCl emission rate used for this analysis is 273 grams/second. Wind speed was assumed to be 9.2 miles per hour (site specific mean wind speed). The wind was assumed to be blowing towards the East. However, the actual wind direction is not important since the concentrations are being estimated directly downwind from the incinerator stack along the centerline of the plume and these concentrations would remain steady regardless of which direction the wind blows during the one hour modeling duration. In addition, it is assumed that there will not be any fluctuations in the wind speed and direction during this one-hour period. All the other model inputs used in assessing the impacts of the high HCl emission rate are included in Exhibit 5-2.

For this modeling analysis, the receptors were placed at ground level along the centerline of the plume starting from a distance of 200 meters up to 6 kilometers downwind from the stack (Ambient concentrations within 200 meters of the stack are negligible). The maximum concentration of HCl was estimated to be 1.0×10^{-4} grams per cubic meter, and it would occur at a point 2.2 kilometers directly downwind. The wind was assumed to be blowing towards the east. However, the actual wind direction is not important since the concentrations directly downwind from the incinerator stack along the centerline of the plume are being modeled and these concentrations are the same regardless of which direction the wind blows during the one-hour modeling duration. In

EXHIBIT 5-2

MODELING PARAMETERS FOR INPUFF MODEL - SHORT TERM AMBIENT AIR CONCENTRATIONS
INAPPROPRIATE INCINERATOR WASTE FEED

Stack Height - 213 feet

Stack Diameter - 5.5 feet

Exhaust Gas Rate - 48,534 acfm

Exhaust Gas Temperature - 158 degrees F

Wind Speed - 9.2 miles per hour

Wind Direction - towards the East[1]

Stability Class - F

Release Duration - 600 seconds (10 minutes)

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[1] The actual direction is not important here because the concentrations are being estimated along the centerline of the plume and these would be the same irrespective of the wind direction.

addition, it is assumed that there will not be any fluctuations in the wind speed and direction during this one-hour period.

The estimated concentration is very low and does not pose any significant health threats based on comparison with permissible short term concentration levels.[2] The short-term concentration of HCl which is considered immediately dangerous to life and health (IDLH) is 100 ppm (0.151 grams per cubic meter). **The analysis therefore indicates that an incorrect waste feed scenario such as this would not pose any significant health threats off-site.**

Small Spill Associated with Storage Operations. Despite the expected effectiveness of administrative/operational procedures and engineering controls in preventing spills during storage operations, occasional small spills should be expected. Spills may be the result of human error, container failure, and/or equipment malfunction. Foreseeable spill occurrences during storage operations include:

- Leaking drums due to cracks, corrosion, or unforeseen reactions between contents and drum;
- Spills from overturned or overfilled drums;
- Spills from drums that have been punctured or otherwise damaged; and
- Leaks from damaged, malfunctioning, or partially closed valves.

For the purposes of this analysis, ICF Technology considered a small spill to be a spill of less than 100 gallons. The likelihood of small spills occurring during storage operations is relatively low despite the volume of wastes that will be stored. This is attributed to the spill prevention measures that will be in effect. On occasions when small spills do occur, the resulting impacts should be minimal due to the comprehensiveness of the response measures that will be applied.

Du Pont has included several engineering controls in its incinerator design and proposes to establish comprehensive administrative/operational procedures (refer to Section 5.3.1.1) that will, in combination, prevent spills. The most likely area for spills to occur will be the container storage area, due to the number of containers (i.e., drums) that will be stored there. Spill prevention, therefore, is critical in the container storage area, although it will also be important at the tank farm.

The storage areas will have numerous engineering controls (refer to Section 5.3.1.1) in place to respond to both small and large spills. Response organizations (refer to Section 5.3.1.1) will also be available to mitigate spills quickly and effectively. When spills occur, response procedures (refer to Section 5.3.1.1) will be initiated by incinerator personnel and emergency responders to lessen the impact of spills. Should a small spill occur outdoors (i.e., at the tank farm), the SAFER system (see Section 2.5.3.3) can be utilized to project plume paths and concentrations, assuming that the spill is of sufficient size and volatility to form a vapor cloud.

To better understand responses to small spills, a hypothetical spill is presented. Assume that a forklift punctures a 55-gallon drum of liquid waste in the container storage area. The spilled liquid will flow down the sloped concrete floor and into the collection trench for that particular area. Eventually, the liquid will flow down through the trench to a 450 gallon capacity sump.[3] As the sump fills, a level indicator will trigger an alarm at the Central Control Room which will prompt an investigation of the problem.[4] The bulk of the spill will have been contained within the trench and sump. Response personnel, wearing appropriate personal protective gear, would then plug the leak or place the damaged drum into an overpack drum and spread absorbent material on residual liquid on the floor. The waste within the trench would then be hosed down into the sump, and either routed to and treated at the Waste Water Treatment Plant or pumped from the sump into a suitable container for eventual incineration.

The sump would be repeatedly flushed with water, as necessary, to recover all of the hazardous waste, and any absorbent used during the spill cleanup would then be collected and placed in a recovery drum. Finally, an appropriate cleaning solvent would be applied to the spill area which, too, would be absorbed and placed into the recovery drum for later incineration or disposal.[5] Spill responders would then decontaminate themselves and their equipment. Anyone injured or exposed to the spilled waste would utilize a safety shower/eyewash station, if applicable, and would be evaluated and treated by the Chambers Works Medical Department (refer to Sections 2.5.6 and 4.5).

Despite the expected effectiveness of the above described response procedures, systems, and equipment in lessening the impacts of small storage-related spills, adverse impacts may still result. These impacts may be caused by delayed reporting of the spill to the Emergency Control Center, delayed or improper response actions, adverse weather conditions (if spill is at the tank farm), or other factors. Impacts of small spills would be expected to affect incinerator facility personnel, the involved storage area, and possibly the environment (if spill is at the tank farm). Due to the isolated location of the incinerator, it is unlikely that other areas of Chambers Works would be impacted. Small spills are not expected to impact off-plant locations.

Impacts to incinerator personnel should be insignificant if personnel follow spill emergency procedures such as immediately evacuating the affected area (see Section 2.5.3.4). Impacts to personnel exposed to spilled waste could range from slight to serious injuries, depending upon the hazardous characteristics of the spilled waste, the condition of the worker's health, and the degree of exposure prior to medical treatment. Impacts to the storage area would be temporary (e.g., brief shut down of normal operations) and minimal. Impacts to the environment from airborne contaminants would also be expected to be minimal, as air currents should disperse the vapors and reduce concentrations to safe levels.

Small Spill Associated with Handling Operations. As is the case with the storage operations previously discussed, occasional small spills can be expected during handling operations, despite the expected effectiveness of administrative/operational procedures and engineering controls in preventing spills. Spills during handling operations may be the result of human error, container failure, and/or equipment malfunction. Foreseeable spill occurrences during handling operations may include:

- Spills from overturned or overfilled drums;
- Spills from drums that have been punctured or otherwise damaged;
- Leaks from damaged or partially closed valves;
- Spills from malfunctioning or damaged pumps;
- Feedline rupture due to rapid pressurization, corrosion, or puncture; and
- Leaking drums due to corrosion, cracks, or unforeseen reactions between contents.

For the purposes of this analysis, ICF Technology considered a small spill to be a spill of less than 100 gallons. The likelihood of small spills occurring during handling operations is greater than that for storage operations, due the frequent opening and closing of valves and drum bungs or covers and the frequent transfer of wastes from container to container. The frequency of spills, however, should still be low due to the spill prevention measures that will be in effect. On occasions when small spills do occur, the resulting impacts should be minimal due to the comprehensiveness of the response measures that will be applied.

Refer to the previous discussion on small spills associated with storage operations for information concerning spill prevention and response measures. It should be noted, however, that the most likely locations for spills associated with handling operations will be the truck unloading area, fluoride waste unloading area, tank farm "pump alley," and drum handling area (i.e., liquid removal station, sampling area, drum deheading/resealing area, and repackaging area).

To get a better understanding of responses to small spills, a hypothetical spill is considered. Assume that a break occurs in the transfer hose that is being used to unload a tanker truck in the truck unloading area. The spilled liquid will flow down the sloped concrete floor to trenches. The liquid in each trench would then flow to a 6,700-gallon capacity sump.[6] The unloading operators or response personnel would shut down the unloading equipment, thereby stopping the spill source. The bulk of the spill will have been contained within the trenches and sumps. Response personnel, wearing appropriate personal protective gear, would then ensure that the transfer hose was no longer leaking waste, and they would spread absorbent material on residual liquid on the floor.

While cleanup was underway, the overhead vent system would be collecting vapors and routing them to the kiln (if operating) or to carbon adsorbers. The waste within the trenches would be hosed into the associated sumps, and the liquid in the sumps would either be routed to and treated at the Waste Water Treatment Plant or pumped from the sump to a suitable container for eventual incineration.[7] The remainder of the cleanup would be similar to that described in the hypothetical spill response for the small spill associated with storage operations. Anyone injured or exposed to the spilled waste would utilize a safety shower/eye wash station, if applicable, and would be evaluated and treated by the Chambers Works Medical Department (refer to Sections 2.5.6 and 4.5).

Despite the expected effectiveness of response procedures, systems, and equipment in lessening the impacts of small spills during handling operations, adverse impacts may still result. These impacts may be caused by delayed reporting of the spill to the Emergency Control Center, delayed or improper response actions, adverse weather conditions (if spill occurs outdoors), or other factors. Impacts of small spills would be expected to affect incinerator facility personnel, the involved waste handling area, and possibly the environment (if the spill occurs outdoors). Due to the incinerator facility's isolated location, it is unlikely that other areas of Chambers Works would be impacted. Furthermore, small spills are not expected to impact off-plant locations.

Impacts from small spills during waste handling operations should be similar to those for storage-related spills. That being the case, refer to the previous discussion on impacts for small spills associated with storage operations. In addition, it should be noted that impacts on the environment from airborne vapors released from the truck unloading area should be minimized due to the vapor collection system that serves this area.

Minor Fire Associated with Storage and Handling Operations. Small fires are possible in storage and waste handling areas, despite the expected effectiveness of fire prevention procedures and engineering controls. Fires may be the result of human error, system/equipment malfunction, physical phenomenon (e.g., static or frictional spark igniting flammable vapors), natural hazard (e.g., lightning striking a feedline containing flammable wastes). Although fires are rarely expected, the most likely fire scenario would involve a spilled flammable waste coming in contact with an ignition source. The likelihood of fires occurring during storage and waste handling operations is very low due to the fire and spill prevention measures that will be in effect at the incinerator.

Du Pont has included several engineering controls in the incinerator facility's design (refer to Section 5.3.1.1) and will establish comprehensive administrative/operational procedures (see Section 5.3.1.1) that will, in combination, prevent fires. The most likely area for a fire to occur is the drum handling area (i.e., liquid removal station, sampling area, drum deheading/resealing area, and repackaging area), due to the type of operations that will occur there. These operations will bring flammable wastes out into the open (where ignition could occur) and will involve waste transfer from container to container, thus increasing the chance of spills that could possibly ignite.

The incinerator waste storage and handling areas will be protected by various fire suppression systems and equipment (refer to Section 5.3.1.2). For example, any fire occurring within the container storage area, drum handling area, or truck unloading area is expected to be controlled or completely extinguished by automatic sprinkler systems. In addition, manually operated fire suppression equipment (i.e., monitor nozzles and portable fire extinguishers) is available at the tank farm and other waste storage and handling areas. The plant Fire Department and the plant Fire Brigade will also be available to suppress fires quickly and effectively. When fires occur, fire response procedures (see Section 5.3.1.1) will be put into effect by incinerator personnel and emergency responders to lessen their impact.

A hypothetical fire is presented to illustrate the response to small fires. Assume that an open drum in the drum deheading/resealing area is knocked over and spilled flammable wastes ignite as the metal drum strikes another nearby metal drum (i.e., frictional sparking). At this point, workers may attempt to suppress the fire with fire extinguishers. If not, or if their efforts are unsuccessful, the fire will directly or indirectly activate the sprinkler system which will prevent the fire from spreading and will, in most cases, extinguish the fire. If the fire is still burning when the Fire Department and local Fire Brigade arrive, it will be extinguished.

Upon leaving the area or prior to attempting to extinguish the fire, incinerator workers will activate the fire/evacuation alarm to warn all workers to evacuate to the Office (i.e., the primary rally point) and will report the fire to the Emergency Control Center by means of a fire alarm box or telephone. Runoff from water and foam (if used) will flow down the sloped floor into a trench which drains into a 450-gallon sump.[8] Should the sump fill before its contents can be pumped out, the runoff will flow into an attached fire water overflow sump and be routed to the WWTP through a dedicated line.[9] If the sprinkler system has activated, Fire Department personnel will shut it off as soon as the fire is under control in order to reduce runoff. The cleanup of the area would be accomplished in the same manner as that described for the hypothetical spills discussed above. Anyone injured or exposed to the products of combustion would utilize a safety shower/eye wash station, if applicable, and would be evaluated and treated by the Chambers Works Medical Department (refer to Sections 2.5.6 and 4.5).

Despite the expected effectiveness of the response procedures, systems, and equipment mentioned above in lessening the impacts of small fires, adverse impacts may still result. These impacts may be caused by delayed reporting of the fire to the Emergency Control Center, delayed or improper response actions, adverse weather conditions (if fire is outdoors), or other factors. Impacts of small fires would be expected to affect incinerator facility personnel, the involved waste storage or handling area, and possibly the environment. Due to the incinerator's isolated location, it is unlikely that other areas of the plant would be impacted. Furthermore, off-plant locations are not expected to be impacted.

Impacts to incinerator personnel are expected to be insignificant if they follow fire emergency procedures such as immediately evacuating the affected area. Incinerator workers will never be expected to use fire extinguishers, rather, they will operate fire extinguishers at their own discretion. Impacts to incinerator personnel who were exposed to flames or products of combustion could range from minor (e.g., mild smoke inhalation, first degree burns, etc.) to major (e.g., severe smoke/toxic gas inhalation, second or third degree burns, etc.), depending upon the intensity of the fire, the toxicity of released smoke and gases, and the degree of exposure prior to medical treatment. Impacts to the storage or handling area could range from minor (e.g., slight heat, smoke, and/or water damage) to moderate (e.g., significant heat, smoke, and/or water damage that is repairable). A small fire should not cause major damage to a large area, although it is entirely possible that containers or equipment in the immediate fire area could be heavily damaged or destroyed. Fire damage and subsequent cleanup/repair could also shut down normal operations for a couple hours or even a few days. Impacts to the environment from airborne contaminants should be minimal, as air currents should effectively disperse the contaminants. There are expected be no environmental impacts due to fire water runoff, as in-place contaminant structures (i.e., dikes, curbs, sumps, trenches, etc.) should effectively contain all runoff.

Small On-Site Transportation Spill. Based on the existing and potential truck accident probabilities and traffic volumes traveling to the incinerator and landfill presented in Section 4.6.7, it is likely that a small spill will occur at least once in the operational lifetime of the incinerator and landfill. Depending on the chemical(s) being transported the health effects on the driver and other unprotected people in the area potentially affected by the vapor cloud could range from minor to severe. Spills which occur on-site will be responded to by Chambers Works' TERP Team and/or other Chambers Works response teams. Sections 2.5.3.6 and 2.5.3.7 discuss the response equipment and systems available at Chambers Works.

A concern with many spills of hazardous materials is the potentially toxic vapor cloud that is formed from the evaporating liquid. A credible spill of 15 gallons of methylene chloride was chosen to model the impacts of a typical transportation accident release. A volume of 15 gallons was chosen based on historical accident data from the US Department of Transportation's Hazardous Materials Information System (HMIS). HMIS is a national data base containing information from hazardous materials incidents reports submitted to the DOT from 1974 to the present and applies to any quantity of hazardous material discharged during transport. A survey of the releases occurring in New York and Delaware during 1985, 1986, and 1987 showed that more than fifty percent of the releases reported were less than 40 gallons in size.[**] Fifty percent of these releases

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[**] Although the HMIS database includes releases during on/off loading, these were not used in determining the average size of a credible release during transportation. Impacts due to chemical handling activities are discussed in Section 5.3.1.2.4. Incidents involving gasoline, kerosene, and LP gas were excluded since these commodities are not accepted by the proposed

were caused by defective or loose fittings, valves, or closure; the remaining causes of these releases included external punctures, internal pressure, corrosion or rust, improper loading, body or side failures, and weld failures. The average size of all releases less than or equal to 40 gallons over this three year period was 13.5 gallons. For these reasons, a volume of 15 gallons was chosen as a typical release size.

Methylene chloride was chosen as the chemical to be modeled for several reasons. Methylene chloride is one of the ten largest Du Pont-generated waste streams to be incinerated. Of these, methylene chloride is the most volatile and is likely to generate a larger vapor cloud upon release than the other waste streams. Six of these waste streams are solids, sludges, or tars, none of which are expected to contain significant amounts of volatile material; two of the streams are filtrates; and the remaining stream is waste paint. Methylene chloride is also a potential carcinogen[10] and has a relatively low Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) and short term exposure limit (STEL) concentration. Therefore, modeling methylene chloride is a conservative choice.

The spill area and resulting vapor dispersion of a 15 gallon spill of methylene chloride was calculated using the methodology from Technical Guidance for Hazards Analysis (EPA December 1987)[11] and assuming an unconfined spill; the evaporation rate was calculated using the Clancey equation given in Loss Prevention in the Process Industries by F.P. Lees.[12] The mean wind speed for the Chambers Works area (4.09 m/s),[13] atmospheric stability class F, and the STEL concentration for methylene chloride (500 ppm) were used in these calculations. An F stability class is the most conservative stability class yielding the largest vapor cloud areas with maximum concentration. The STEL is published by the American Conference of Governmental Industrial Hygienists and is a 15 minute time-weighted average exposure which should not be exceeded at any time during a work day.

The area potentially affected by the vapor cloud is defined as an area within which the airborne concentration of a chemical involved in an accidental release would exceed a specified level of concern (in this case the STEL concentration of methylene chloride). This area is a circle of radius equal to the downwind distance of concern with the potential release site located at the center. In the case of the on-site transportation spill, the modeled downwind distance of concern is 21.4 meters (70.2 feet). The area potentially affected by the credible spill would not encompass any residential areas. Since the downwind distance of concern is only 70.2 feet it is unlikely that any major disruption in normal operations at Chambers Works would result.

Small Off-Site Transportation Spill. Based on existing and potential truck accident probabilities and traffic volumes traveling to the incinerator and landfill (See Section 4.6.7), it is likely that a spill during transport of

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Chambers Works incinerator and landfill. Since a large quantity of these chemicals are transported, their release statistics would bias the release statistics of other hazardous materials.

wastes to Chambers Works will occur at least once in the operational lifetime of the incinerator and landfill. Depending on the chemical(s) being transported, the health effects on the driver and other unprotected people in the area potentially affected could range from minor to severe.

As with the small on-site transportation spill previously discussed, a credible spill of 15 gallons of methylene chloride was chosen to model the impacts of a typical transportation accident release . The downwind distance of concern from this spill is 70.2 feet. Since this distance is relatively short, the impact to any residential area is likely to be small and will not go beyond the immediate area of the roadway.

Spills which occur off-site will be responded to by Chambers Works' TERP Team as well as by local emergency responders (see Section 3.5.5). The TERP Team will respond to releases occurring within 300 miles of Chambers Works. Section 2.5.3.6 and 2.5.3.7 discuss the response equipment and systems available from Chambers Works.

5.3.2 Impacts Under Maximum Credible Accident Scenarios

Subsection 5.3.2 addresses impacts of maximum credible accidents involving the proposed incinerator. **Maximum credible accident, is defined as an abnormal occurrence that presents a worst case situation and is conceivable although not likely to occur** over the incinerator's operational life-time. In order to identify and discuss the impacts of maximum credible accidents, the accidents are presented in terms of three worst case scenarios:

- Incinerator venting to the atmosphere,
- Large spill and fire involving the Tank Farm, and
- Large off-site transportation spill.

For each of the above accident scenarios, the following topics will be discussed (as applicable):

- Description of scenario
- Probability of scenario occurring - in qualitative terms
- Evaluation of existing preventive measures
- Evaluation of existing response systems, equipment, personnel, and procedures
- Potential impacts beyond/despite response efforts (based on the adequacy of preventative measures and response capabilities)

5.3.2.1 Incinerator Venting to the Atmosphere through Emergency Relief Valve

Release Scenario. The proposed Chambers Works incinerator will be equipped with an emergency relief valve, designed to bypass the incinerator air pollution control system (APCS) and vent the incinerator emissions to the atmosphere. The relief valve is designed to activate automatically only in the event of an extreme high pressure in the kiln or afterburner. Emissions of air pollutants from the kiln and afterburner will not be controlled by the APCS in the event the emergency vent is activated, and the resulting emissions of air pollutants is considered a worst-case accident scenario.

The proposed incinerator will incorporate several safety features to minimize the probability of the emergency relief valve opening. The kiln and afterburner are equipped with temperature and pressure sensors and transmitters, and automatic combustion controls. These controls will normally prevent the development of high pressure conditions in the kiln or afterburner. In the event that a high pressure condition does develop in the afterburner, the incinerator is equipped with waste feed interlocks that will, under most conditions, cut off the waste feeds to the kiln and afterburner without causing the emergency relief valve to open. The relief valve will open only if an extreme high pressure condition develops at a rapid rate, for example because of an explosion in the kiln. The probability of a high pressure event occurring that the incinerator control system could not respond to without opening the relief valve is very low.

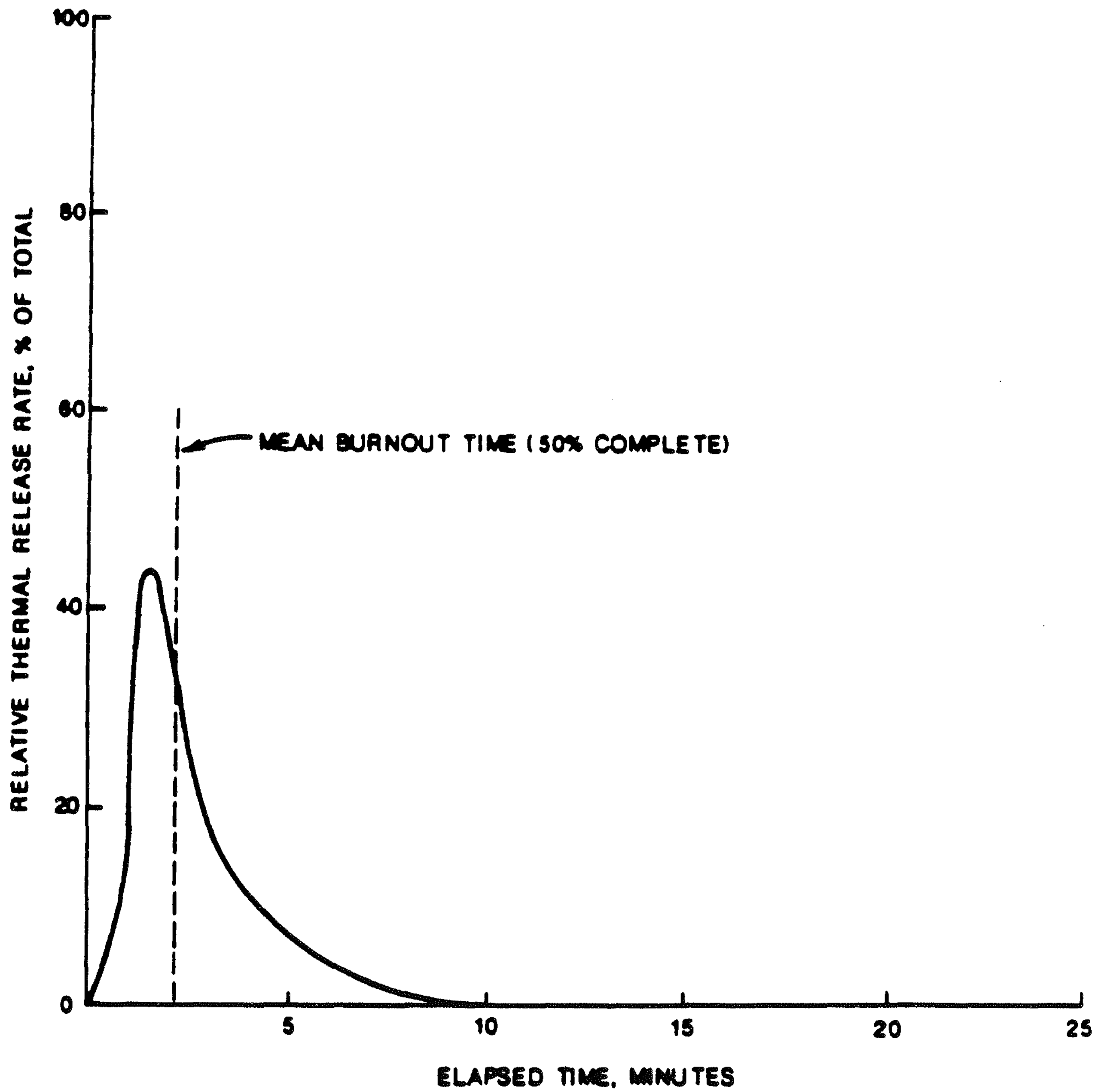
In the event the relief valve does open, the relief valve, kiln and afterburner pressure sensors, and waste feed mechanisms are all equipped with an interlock system that will shut off all waste feed to the incinerator in the event that the relief valve is activated. Therefore, uncontrolled emissions from the incinerator will be limited to that resulting from the burnout of solid waste in the kiln at the time the relief valve is activated. ENSR assumed in their analysis of the relief valve emissions that 1,000 pounds of solid waste would be in the kiln at the time of activation. and that this waste would burn for 20 minutes. ENSR assumed that no liquid waste would be combusted in the kiln or afterburner after the relief valve opened as liquid waste feed would be cut off when the valve opened.

The assumption that only solid waste would remain in the kiln after the relief valve opens is reasonable, based on the operation of the interlock system. Liquid waste feed pumps would be immediately shut off, and although the interlock system would not function instantaneously, the amount of liquid injected into the kiln and afterburner in the few seconds between the relief valve activation and waste feed cut off is negligible as compared with the amount of solid waste remaining in the kiln. The assumption of 1,000 pounds (two drums) of waste remaining in the kiln is also reasonable, considering the nominal feed rate to the incinerator of 17,500 lb/hr.

Release Rate. ENSR assumed that the emissions from the incinerator after the relief valve opens would be the same as the uncontrolled emissions during normal incinerator operations for the first six seconds, and then would decrease to zero over a period of 20 minutes as the solids remaining in the incinerator burned out. The burnout profile used by ENSR, included as Exhibit 5-3, was derived from data from a "similar" incinerator, based on data provided by Ford, Bacon, and Davis.[14]

EXHIBIT 5-3

TYPICAL BURNOUT CURVE FOR
INCREMENTAL SOLID FEED TO KILN



It is expected that the major portion of the emissions from burnout of the waste will occur in the first few minutes after the valve opens, and that the maximum off-site concentrations resulting from the emissions will be relatively insensitive to the burnout profile, assuming that 1,000 pounds of waste remain in the kiln. In order to be conservative in our assessment of the maximum off-site pollutant concentrations resulting from the relief valve emissions, we have assumed that the emission rates of particulate material and acid gases (except nitrogen oxides and hydrogen fluoride) from the relief valve will be equivalent to the uncontrolled emission rates from the incinerator during normal operation, and that the emissions will persist for 4.3 minutes after the relief valve opens. The duration of the emissions was calculated based on the assumption that the waste remaining in the kiln contains 25 percent (250 pounds) chlorine, and that all of the chlorine is emitted as hydrochloric acid during the release period.

The emission rates used in modeling all other pollutants with the exception of nitrogen oxides (NOx) and hydrogen fluoride (HF) were equivalent to their uncontrolled emission rates during normal incinerator operation. The HF emission rate was adjusted from the uncontrolled emission rate because the major portion of the fluorine-containing waste accepted by the proposed incinerator will be liquid wastes fed to the afterburner.[15] Liquid wastes will not be fed into either the kiln or afterburner after the relief valve opens. ENSR assumed that solid wastes fed to the incinerator would contain only 0.5 percent fluorine. The NOx emission rate was adjusted because NOx emissions are a direct function of temperature, and the combustion temperature of the waste in the kiln is expected to quickly drop quickly below 1,600 degrees F when the waste feed is cut off.

ENSR did not estimate the emissions of organic compounds or carbon monoxide from the relief valve. It is expected that the combustion efficiency of the kiln will be low, as excess oxygen and mixing conditions necessary for complete combustion will not be maintained after the waste feed is discontinued. Therefore emissions of uncombusted and partially combusted organic compounds are expected during the first few minutes after the relief valve is opened. We have assumed that the combustion efficiency decreases by a factor of 10 upon cut off of the waste feed, and that the concentration of CO in the stack gas increases quickly to 1,000 ppm (131 lb/hr), and the concentration of non-methane organic compounds increases to 200 ppm (15 lb/hr).

<u>Modeled Ambient Air Concentrations</u>. The short term ambient air concentrations resulting from emission from the relief valve were modeled using the INPUFF Version 2.3, an EPA-approved model for modeling semi-instantaneous releases. This model can be used to simulate dispersion from semi-instantaneous (short-term) or continuous point sources at a maximum of 100 receptor locations. Emissions from moving point sources can also be simulated using this model. The user can account for variations in wind field by updating the meteorological information after each meteorological time period. Required inputs to the model include the emission rate of each pollutant in grams/second, wind speed and direction, exhaust gas velocity, and release duration. The emission rates used in the air quality modeling are included in Exhibit 5-4. The model inputs used in assessing the impacts of relief valve operation are included in Exhibit 5-5.

EXHIBIT 5-4

SHORT-TERM EMISSIONS FROM INCINERATOR EMERGENCY RELIEF VALVE

Pollutant	Emission Rate		Total Emissions	
	lb/hr	g/s	lbs	grams
Particulate	7,800	983	556.8	252,557
Sulfur Dioxide	1,000	126	71.4	32,397
Hydrogen Chloride	3,600	454	257.0	116,565
Hydrogen Fluoride	70	8.8	5.0	2,266
Phosphorus Pentoxide	202	25.4	14.4	6,541
Carbon Monoxide	131	16.5	9.4	4,242
Non-methane Organics	15	1.9	1.1	486
Total release duration	4.28 minutes - 257 seconds			

EXHIBIT 5-5

MODELING PARAMETERS FOR INPUFF MODEL - SHORT TERM AMBIENT AIR CONCENTRATIONS
INCINERATOR EMERGENCY VENT

Stack Height - 114.1 feet

Stack Diameter - 5.5 feet

Exhaust Gas Rate - 37,308 acfm

Exhaust Gas Temperature - 1800 degrees F

Wind Speed - 9.2 miles per hour

Wind Direction - towards the East*

Stability Class - F

Release Duration - 300 seconds (257 seconds rounded off to 300 seconds)

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* The actual direction is not important here because the concentrations are being estimated along the centerline of the plume and these would be the same irrespective of the wind direction.

ENSR estimated the exhaust rate from the relief valve to be approximately 20 percent of the normal incinerator exhaust rate, as the exhaust fan would not be operating and the force for the exhaust would come only from the natural draft of the incinerator stack. Wind speed was assumed to be 9.2 miles per hour to be consistent with other dispersion estimates made by ICF Technology. The wind was assumed to be blowing towards the east. However, the actual wind direction is not important since the concentrations directly downwind from the incinerator stack along the centerline of the plume are being modeled and these concentrations are the same regardless of which direction the wind blows during the one-hour modeling duration. In addition, it is assumed that there will not be any fluctuations in the wind speed and direction during this one-hour period. As previously discussed, the release duration was estimated based on assuming 1,000 pounds of waste remaining in the incinerator and the emission rate of HCl equivalent to the uncontrolled emission rate of 3,600 lb/hr.

For this modeling analysis, the receptors were placed at ground level along the centerline of the plume (or puff, in this case) starting from a distance of 200 meters up to 6 kilometers downwind from the stack. The maximum concentration (one-hour average) from each of these pollutants was estimated to occur at a point 2.8 kilometers away directly downwind. Exhibit 5-6 shows the results of this modeling analysis. **These concentrations are very low and do not pose any significant health threats, based on comparison with permissible short term concentration levels.**[16] For example, the maximum one-hour concentration of HCl is 5.7 x 10^{-5} grams per cubic meter, whereas the concentration of HCl which is considered immediately dangerous to life and health (IDLH) is 100 ppm (0.151 grams per cubic meter). **Therefore, the emissions from the incinerator emergency relief valve clearly will not pose any serious health threats.**

5.3.2.2 <u>Large Spill and Fire Involving the Tank Farm</u>. This section discusses a maximum credible accident scenario involving a major spill and fire at the incinerator tank farm. The scenario, although credible, is not likely to occur. The purpose of discussing this scenario is to illustrate a worst case type of accident involving storage operations and to identify and discuss the resulting effects following the application of prevention and mitigation measures. The tank farm was chosen for the scenario because it presents the most likely opportunity for a large spill and fire to occur at the incinerator (i.e. there are several large storage tanks ranging in volume from 10,000 to 24,000 gallons).

<u>Scenario Description</u>. The scenario is based upon a series of interrelated events that cause release of a flammable liquid waste and ignition of the pooled liquid. The scenario involves a tank truck unloading 5,000 gallons of a liquid waste that is composed primarily of toluene, a flammable and moderately toxic solvent that is expected to delivered to the incinerator frequently. Prior to unloading the waste, the unloading technicians inadvertently open the wrong valve and activate the pump in the associated line. As the waste begins to flow from the truck, it is pumped at a rate of 100 gpm through the line to the wrong tank, which is already filled to 85% of its design capacity of 10,000 gallons with toluene waste, or alternatively, is open for maintenance but not tagged out of service. The filled tank will receive additional liquid beyond its current level of 8,500 gallons, and assuming the tank's liquid level indicator and high

EXHIBIT 5-6

MODELING RESULTS OF INPUFF MODEL - SHORT TERM AMBIENT AIR CONCENTRATIONS
INCINERATOR EMERGENCY VENT

Pollutant	Maximum 1-hour concentration ($\mu g/m^3$)
Particulate	1.24×10^{-4}
Sulfur Dioxide	1.58×10^{-5}
Hydrogen Chloride	5.70×10^{-5}
Hydrogen Fluoride	1.11×10^{-7}
Phosphorous Pentoxide	3.19×10^{-6}
Carbon Monoxide	2.07×10^{-6}
Non-methane Organics	2.39×10^{-7}

level shut-off switch fail to operate, the tank, located a considerable distance from the unloading area, will eventually become filled and overflow through the roof vent. Alternatively, in the case in which the tank was opened but not tagged out of service, the toluene waste will flow through the opened tank directly into the containment area. The spill rate is equal to the pumping rate of 100 gpm.[17] The spilled toluene collects around the tank within the containment area. The tank involved is assumed to be #2503-01 which is positioned in the center of its own containment dike (i.e., there are no other tanks within the dike).[18]

As the liquid collects within the dike and 480-gallon sump,[19] flammable vapors emanating from the spill surface are ignited by a static spark from an unknown source, and the ensuing fire engulfs the entire spill surface and the still-leaking tank. The fire is spotted by persons in the unloading area and reported to the plant's Emergency Control Center. With everyone's attention now on the fire, coupled with a malfunctioning sump level indicator, the source of the spill (the unloading area) continues to go unnoticed. Eventually, all pumps and equipment at the Tank Farm and Unloading Area are shut down as a precaution and this action causes the overflowing action to slow gradually and then stop. By the time the spill ceases, the volume within the containment dike is 2,000 gallons, and the fire continues to engulf the containment area and the tank.

Probability of Scenario Occurring. The probability of the above scenario occurring is very low, as it is dependent upon human error (i.e., routing waste to wrong tank or failure to tag the tank) and equipment malfunction (i.e., level indicator and high level shut-off switch failure), followed by a physical phenomenon (i.e., static spark causing the fire). Even the spill event itself would have a low probability of occurrence, because of the high level of operational and safety training given to workers and the expected effectiveness and reliability of equipment such as level indicators and high level shut-off switches.

Modeling for Products of Combustion. To study the impacts of the fire described in this scenario, an analysis was performed to estimate the concentrations of toluene combustion products. An EPA-approved computer model, ISCST (UNAMAP Version 6), was used in this analysis. To be consistent with the modeling analysis performed elsewhere in this Environmental and Health Impact Statement, the wind speed was assumed to be 4.09 meters per second[20] (9.2 mph), and concentrations were estimated for various points downwind starting from 50 meters (≈164 feet) and going up to 6,500 meters (≈4 miles).

Prior to performing the modeling, the toluene combustion rate from the spill at the tank farm was estimated to be 2.89 kg/second (31.4 gram moles/second).[21] This was based upon the surface area of the spilled toluene which was calculated to be 35.1 square meters (378 sq. ft.)[22], based on the cross sectional area of the containment dike at the level to which 2,000 gallons of liquid would rise.

Upon complete combustion of toluene, the products formed are carbon dioxide and steam, both of which are harmless in unconfined areas such as the

Tank Farm. For the purpose of this analysis, it was assumed that incomplete combustion (i.e., worst case situation) would occur, along with the following assumptions:

- The combustion of toluene vapors is only 60% complete (i.e., 40% incomplete combustion); and

- 60% of the combusted carbon (in toluene) forms carbon dioxide, and the remaining carbon contributes towards the formation of carbon monoxide.

Based on these assumptions, the products of combustion would be released at the following rates:

- 1477 grams/second of carbon monoxide, and

- 1157 grams/second of toluene or 979.4 grams/second of benzene if all of the toluene vapors were to decompose to benzene.

The modeling results estimate that the maximum concentrations of carbon monoxide, toluene, and benzene occur at or below the point 50 meters (164 ft.) downwind of the fire. These concentrations are 1.1×10^6 $\mu g/m^3$ for carbon monoxide, 8.6×10^5 $\mu g/m^3$ for toluene, 7.3×10^5 $\mu g/m^3$ for benzene, assuming that the partially combusted toluene was converted completely to benzene. If the closest plant property line (i.e., Delaware River shoreline) located 1,200 meters (0.75 mile) from the tank farm, the concentrations of carbon monoxide and toluene at this point would be 784 micrograms per cubic meter ($\mu g/m^3$) and 614 $\mu g/m^3$ respectively. If all of the toluene vapors were to decompose to benzene, the benzene concentration at this point would be 520 $\mu g/m^3$.

Exhibit 5-7 provides data regarding the downwind concentrations of incomplete products of combustion with respect to common short duration exposure limits: Short Term Exposure Limit (STEL) and Immediately Dangerous to Life or Health (IDLH). A STEL is defined as a 15-minute time-weighted average exposure which should not be exceeded at any time during a work day.[23] STEL values are derived and published by the American Conference of Governmental Industrial Hygienists (ACGIH). An IDLH level represents a maximum concentration from which one could escape within 30 minutes without experiencing any escape-impairing or irreversible health effects.[24] IDLH values are derived through the Standards Completion Program, a joint effort of the National Institute for Occupational Safety and Health (NIOSH) and the Occupational Safety and Health Administration (OSHA), and published by both NIOSH and OSHA. Although exposure limits are related to and stated in terms of the work place or work day, the limits can also be applied to non-workplace situations.

From Exhibit 5-7, downwind distances from the tank fire at which concentrations of incomplete combustion products are equal to or above STEL and IDLH values are all within 400 meters (0.25 mile) of the Tank Farm. Plotting this distance on a map would show that STEL and IDLH concentrations, regardless of wind direction, would be well within the property line of Chambers Works. Impacts of these and other downwind concentration data will be discussed later

EXHIBIT 5-7

DOWNWIND DISTANCES FROM TANK FIRE AT WHICH CONCENTRATIONS OF INCOMPLETE COMBUSTION PRODUCTS ARE WITHIN SIGNIFICANT EXPOSURE LIMITS

Product of Combustion	Short Term Exposure Limit (STEL)/Distance from Burning Waste	Immediately Dangerous to Life or Health (IDLH)/ Distance from Burning Waste
Carbon Monoxide	466,000 $\mu g/m^3$ (400 ppm) Between 50-100 meters (164-328 feet)[a]	1,750,000 $\mu g/m^3$ (1500 ppm) <50 meters (164 feet)[a]
Toluene	575,000 $\mu g/m^3$ (150 ppm) Between 50-100 meters (164-328 feet)[a]	7,660,000 $\mu g/m^3$ (2000 ppm) <50 meters (164 feet)[a]
Benzene[b]	16,200 $\mu g/m^3$ (5 ppm) <400 meters (¼ mile)[a]	Not listed[c]

Sources:
[1] Threshold Limit Values and biological Exposure Indices for 1988-1989, American Conference of Governmental Industrial Hygienists.
[2] NIOSH Pocket Guide to Chemical Hazards, U.S. Department of Health and Human Services, 1987.
[3] 29 CFR Part 1910, "Air Contaminants; Final Rule, "Federal Register, Vol. 54, No. 12, January 19, 1989, Table Z-1-A.
[4] 29 CFR 1910. 1028, (1988 edition), "Benzene," Appendix A, I. - Substance Identification, p. 880.

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[a] Distance is well within the property line of Chambers Works.

[b] Benzene is a decomposition product of toluene. The concentrations listed for benzene indicate the resulting concentrations if all of the toluene vapors were to decompose to benzene.

[c] Neither OSHA nor NIOSH currently offer an IDLH value for benzene.

in Section 5.3.2.2. The long term effects of this scenario would not be significant considering the short duration of the event with respect to the standard 70 year period used in modeling long term effects.

Evaluation of Preventative Measures. The primary reason for the low probability of occurrence of this scenario is that comprehensive accident prevention measures will be in place at the Tank Farm and tank truck unloading area, as well as throughout the incinerator. Prevention measures, which include both engineering controls (i.e., systems, equipment, instruments, etc.) and operational/administrative procedures, are expected to be very effective in preventing occurrences such as those described. Regarding spill and fire prevention, the Tank Farm will have the following in-place engineering controls relating directly to the scenario:

- Tanks designed to ANSI, ASME, ASTM, and Du Pont standards and specifications and in compliance with RCRA requirements;
- Tanks equipped with reliable level indicators and high level shut-off switches;
- Reliable automatic closing valves (which respond to high level switches in tanks) in feedlines, and reliable flow indicators;
- Tanks blanketed with non-flammable nitrogen gas;
- Tanks equipped with pressure venting valves (i.e., conservation vents), anti-static fill lines, and grounding connections; and
- Electronic equipment associated with waste storage operations complying with the requirements for the National Electrical Code, Class 1, Division 2, Group D classification.

Administrative and operational procedures relating directly to the scenario will be in effect at the Tank Farm and truck unloading area and in combination with engineering controls are expected to be effective in preventing spills and fires.

Despite the expected effectiveness of the above procedures and engineering controls in preventing the events described in the scenario, these or similar events may still occur. For the purpose of discussing the impacts of a large spill and fire at the incinerator, it will be assumed that the earlier described scenario has occurred.

Evaluation of Response Systems, Equipment, Organizations, and Procedures. Assuming that all of the events in the scenario have occurred, Chambers Works would experience a very serious incident that would require immediate and effective response in order to lessen on-plant and off-plant impacts.

The proposed accident response measures for the Tank Farm are very comprehensive and meet or exceed Federal and State regulations. Engineering controls that will be in place at the Tank Farm should be effective in reducing adverse impacts of the spill and fire and include:

- Alarm boxes for transmitting an alarm to the plant's Emergency Control Center;
- Audible evacuation/fire alarm system and public address system;
- Two in-place, manually operated monitor nozzles designed to provide 500 gpm water at 125 psig and hydrants/hose boxes at strategic locations (refer to Section 2.5.3.5);
- Water supply system (i.e., tank, pumps, lines) to supply sufficient quantities of water to fixed fire monitor nozzles and fire hoses;
- Containment area surrounding the leaking tank that consists of:
    - Sloped concrete floors and 4 foot 3 inch high concrete dike capable of holding the entire contents of the tank (i.e., 10,000 gallons) plus rainwater resulting from a 25-year, 24-hour rainstorm.[25]
    - Sump (equipped with pump) that holds approximately 480 gallons of liquid.
    - Fire suppression water/foam overflow sump with dedicated line to the Waste Water Treatment Plant.
- Safety shower/eyewash stations in and near the Tank Farm.

Response systems and organizations that will be used in conjunction with in-place response equipment includes the response group described in Section 5.3.1.1.

To control and extinguish the fire in the tank farm, firefighters will wear appropriate protective clothing and self-contained breathing apparatus and use special firefighting tactics and equipment. Their initial concerns will be confining the fire to the containment area surrounding the leaking tank, cooling the flame-impinged leaking tank, and cooling tanks subjected to radiant heating in adjacent containment areas. Firefighters will utilize the two fixed monitor nozzles as well as hoselines and portable master stream appliances (i.e., heavy duty nozzles capable of flowing large volumes of water, that can be set in place and operated unmanned) to cool tanks. After these initial concerns are remedied, firefighters will turn their attention to extinguishing the fire. The Chambers Works Fire Department is equipped with several types of fire suppression foam and foam application equipment. Following extinguishment of fire, firefighters will apply additional foam to the spill surface to build-up a thick layer of foam that should effectively suppress toluene vapors.

Water and foam used in extinguishing the fire and in cooling the leaking tank will be collected within the containment dike's fire water overflow sump and routed to the Waste Water Treatment Plant through a dedicated line. The toluene waste, which is slightly lighter than water and virtually insoluble in water, should be floating on the suppression water and just under the foam layer. Therefore, emergency responders will pump off the toluene layer from under the foam and direct it to one or more tanks for subsequent incineration. When the containment dike has been drained as much as possible, emergency responders will hose down the tank and containment dike, allowing runoff to enter the overflow sump connected to the WWTP. Residual toluene will then be absorbed from the sloped floors with sorbent material, and the waste residues will be placed into recovery drums for later incineration. Finally, the excess liquid within the tank that had been overfilled will be off-loaded to another tank or tank truck.

Throughout the incident, anyone injured or exposed to the products of combustion (i.e., heat, smoke, carbon monoxide, toluene vapors) or to liquid toluene waste will use nearby safety shower/eye wash stations, as needed, and will be evaluated and treated by the Chambers Works Medical Department (refer to Sections 2.5.6 and 4.5). Should additional emergency medical personnel and ambulances be required, Chambers Works can call in units from nearby municipalities (refer to Section 3.5.5). Should the plant medical center be overwhelmed by victims or need to be evacuated due to incident-related hazards, patients will be transported to off-plant hospitals (refer to Section 3.5.5.3).

Proposed operational and response procedures at the Tank Farm, together with in-place response equipment and efforts by response organizations/systems, are expected to be effective in reducing the impacts of the spill and fire on personnel, property, and the environment. Operational and response procedures/programs will address protection of workers as well as remedial actions, specifically:

- Reporting of emergencies;
- Evacuation;
- Response training;
- Respiratory protection;
- "Discharge Prevention, Containment or Countermeasure Plan";
- "Discharge Cleanup and Removal Plan";
- "Chambers Works Spill Control Safety Guidelines";
- "Emergency and Disaster Manual"; and
- Material Safety Data Sheets.

The most important issue to address early into the incident is that of ensuring the safety of incinerator workers, other on-plant personnel, and off-plant residents and travelers. As soon as the fire is noticed, personnel will activate the closest indoor and outdoor evacuation alarms and report the fire to the Emergency Communications Center (ECC). The outdoor alarm, which will have a sound output of 95-100 dBA,[26] will warn persons at the incinerator site that an emergency exists, and they will immediately shut down all equipment and proceed to the designated rally point (i.e., Office). If this location is adversely affected by the fire or products of combustion, personnel can use escape air masks stored at the Office to leave the incinerator site. Anyone injured or exposed to contaminants during the evacuation will be transported to the plant's medical center for evaluation and treatment.

While evacuation is taking place at the incinerator site, the ECC will activate the plant-wide alarm to alert all plant personnel that a serious situation has developed. Area control centers throughout Chambers Works will also be activated, and radio communications between control centers will be established. At this same time, security personnel will cordon off the hazardous area and prevent traffic from entering the plant. If other areas of the plant need to be evacuated, personnel will be warned and told to report to designated rally points or other areas of safety. Workers may even be told to evacuate to off-plant areas, if necessary.

When an accident of this magnitude occurs, the ECC will immediately notify the Salem County Office of Emergency Management and New Jersey Department of Environmental Protection. If impacts are expected in their areas, the Delaware River Bridge Authority, and either the New Castle County Emergency Preparedness Office or Delaware Division of Emergency Planning and Operations are contacted (whichever of the latter two agencies is contacted, contacts the other).[27] Should the cloud of smoke, gases, and vapors be headed towards Deepwater points north, the Community Alert System will be activated. For additional information regarding off-plant notifications, see Section 2.5.4.

Impacts of the Large Spill and Fire. Despite the expected effectiveness of the above described response procedures, systems, and equipment in reducing the impacts of the toluene waste spill and fire, adverse impacts may still result. Any adverse impacts, however, should be limited to personnel, operations, property, and the environment within the boundaries of Chambers Works. Impacts to off-plant populations, property, and the environment should be minimal.

There would be several definite impacts and several probable impacts of a large fire. The definite impacts would be the immediate evacuation of the incinerator and the surrounding area and the shut down of all incineration operations for several hours or even days. According to the analysis of the modeling results (included in Exhibit 5-7), concentrations of incomplete combustion products would be equal to or above STEL and IDLH levels within 50 meters (≈164 ft.) of the tank farm for carbon monoxide and toluene and within 400 meters (0.25 mile) of the tank farm if all of the toluene vapors were to decompose to benzene. In case toluene vapors were indeed converted to benzene, Chambers Works would need to evacuate a downwind area of at least 0.25 mile to prevent harmful exposure. They must also keep in mind that the flame-impinged tank presents potential explosion hazards (if not quickly and adequately cooled by water) and, therefore, an area within at least 0.5 mile of the tank should be evacuated as a precaution.[28] The likelihood of an explosion is low if the tank was completely full (i.e., no vapor space). The probability of an explosion increases, however, when the liquid level within the tank drops as the liquid vaporizes. As long as the tank is heated by flames, the liquid level will continue to drop, thus, creating more of a vapor space. Should the pressure within the vapor space exceed that being vented through the roof vent, an explosion could occur. This explosion potential can be greatly reduced by quickly cooling the involved tank and any nearby tanks that are being heated.

The probable impacts affecting Chambers Works would be an expanded evacuation and the resulting shut down of other parts of the plant. For example, if the main processing area of the plant was located directly downwind of the fire, Chambers Works officials may evacuate some or all of this area as a precaution. Another possible impact of the spill and fire would be injuries to fleeing workers and to emergency responders attempting to extinguish the fire and cleanup the spill. The likelihood of injuries occurring to workers or emergency responders should be relatively low assuming that personnel follow safety guidelines and procedures, including wearing appropriate personal protective equipment (see earlier discussion on response measures). If injuries should occur, they may range from minor to severe depending on the circumstances. Due to the many hazards at hand (e.g., toxic carbon monoxide gas, radiant heat, etc.), fatal injuries could occur. Inhalation of carbon monoxide, for example, could cause minor medical problems such as headache and nausea in response to lower concentrations and can cause death in high concentrations.[29] Benzene exposure, for another example, can cause minor short-term problems such as irritated eyes and respiratory tracts and severe problems such as convulsions and loss of consciousness.[30] Firefighters could also receive burns varying between first and third degree. As mentioned earlier, injured/exposed persons will be treated at the plant medical center or transported to off-plant hospitals, as necessary, for treatment.

Other impacts of the spill and fire affecting Chambers Works include property damage and environmental damage. The effects of the fire, for example, will necessitate the repair or replacement of the involved tank, piping, and valves and the repair of any damage that may have been done to the containment area. Environmental contamination may have also occurred due to smoke particles settling on downwind land and water.

Impacts to off-plant areas should be minimal. There should be few if any health and safety hazards to residents and motorists in downwind areas. As stated earlier, the real hazards will affect an area within 0.25 mile to 0.5 mile of the Tank Farm, an area well within the plant boundaries as illustrated by Exhibits 5-8, 5-9 and 5-10. Exhibit 5-8 provides off-plant concentrations of incomplete products of combustion from the toluene spill and fire, including concentrations for eight significant points surrounding Chambers Works. The points were selected due to their population density or traffic volume and their proximity to the proposed incinerator. Points located within a 360 degree radius of the plant are included to account for any possible wind direction. Even at the off-plant point closest to the Tank Farm, the Broadway Gate, the concentrations of carbon monoxide, toluene, and benzene are far below their corresponding STEL and IDLH levels. For example, the carbon monoxide level is approximately 0.67 ppm compared to a STEL value of 400 ppm and an IDLH value of 1500 ppm, and the benzene level (assuming that all partially combusted toluene had decomposed to benzene) is approximately 0.16 ppm compared to a STEL value of 5 ppm.

EXHIBIT 5-8

OFF-PLANT CONCENTRATIONS OF INCOMPLETE PRODUCTS OF COMBUSTION FROM FIRE AT TANK FARM

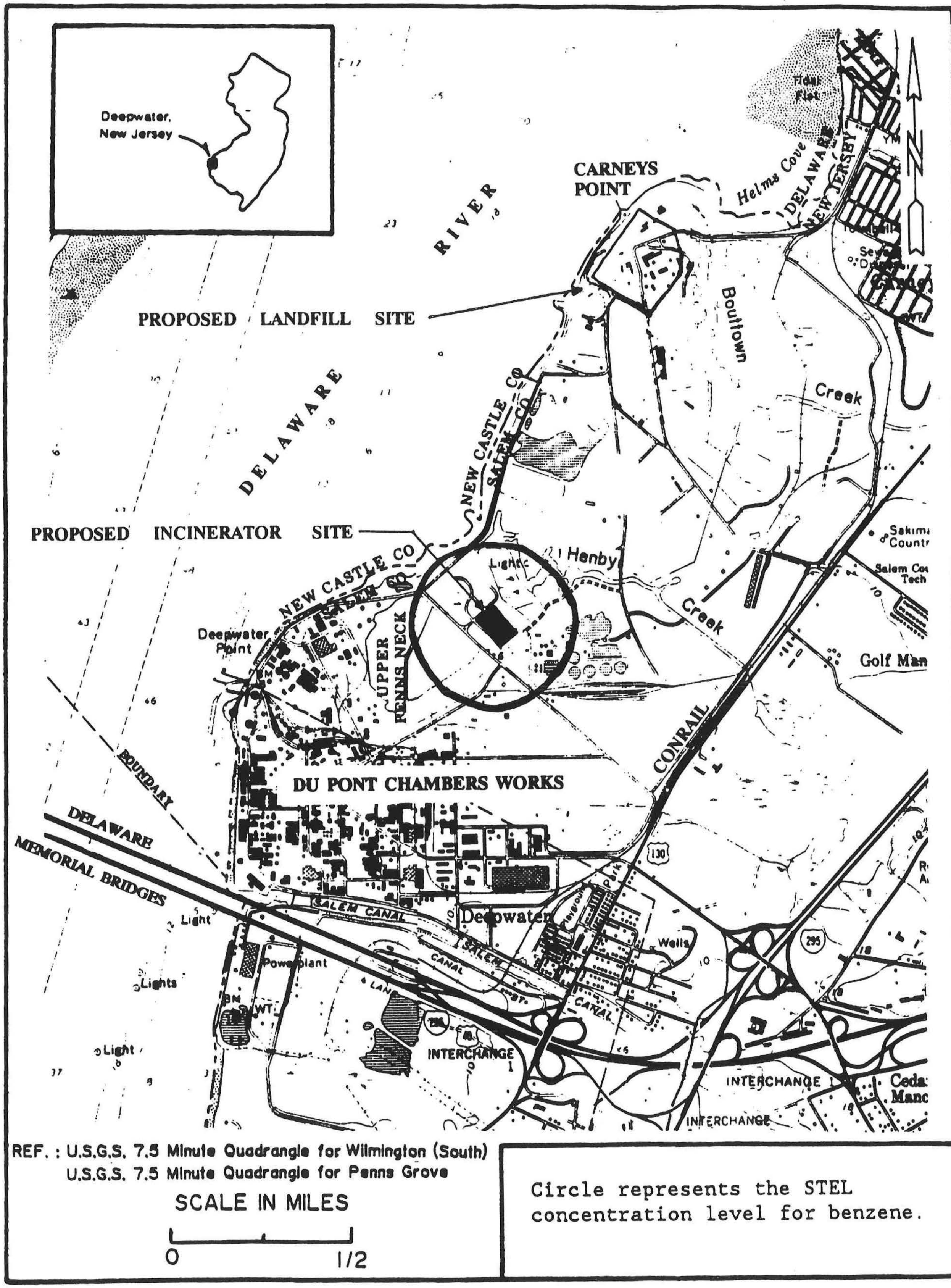
	Location[a]	(Approximate) Distance from Incinerator	Carbon Monoxide Concentration	Toluene Concentration	Benzene[b] Concentration
1.	Southern edge of Carneys Point municipal limits	2200 meters (≈1 1/3 miles)	128 $\mu g/m^3$ (0.11 ppm)	101 $\mu g/m^3$ (0.262 ppm)	85 $\mu g/m^3$ (0.026 ppm)
2.	Broadway Gate entrance to Chambers Works	1200 meters (≈3/4 mile)	784 $\mu g/m^3$ (≈0.673 ppm)	614 $\mu g/m^3$ (≈0.16 ppm)	520 $\mu g/m^3$ (≈0.16 ppm)
3.	Northern edge of community of Deepwater	1400 meters (≈7/8 mile)	495 $\mu g/m^3$ (≈0.425 ppm)	388 $\mu g/m^3$ (≈0.101 ppm)	328 $\mu g/m^3$ (≈0.10 ppm)
4.	Northern edge of community of Pennsville (Churchtown)	3000 meters (≈1 7/8 miles)	61 $\mu g/m^3$ (≈0.052 ppm)	47.8 $\mu g/m^3$ (≈0.020 ppm)	40.5 $\mu g/m^3$ (≈0.020 ppm)
5.	Powerplant south of the Salem Canal	2000 meters (≈1 ¼ miles)	171 $\mu g/m^3$ (≈0.146 ppm)	134 $\mu g/m^3$ (≈0.035 ppm)	113 $\mu g/m^3$ (≈0.035 ppm)
6.	Delaware Memorial Bridge at New Jersey shoreline	1600 meters (≈1 mile)	332 $\mu g/m^3$ (≈0.285 ppm)	260 $\mu g/m^3$ (≈0.068 ppm)	220 $\mu g/m^3$ (0.068 ppm)
7.	Delaware Memorial Bridge at Delaware shoreline	3000 meters (≈1 7/8 miles)	61 $\mu g/m^3$ (≈0.052 ppm)	47.8 $\mu g/m^3$ (≈0.013 ppm)	40.4 $\mu g/m^3$ (≈0.013 ppm)
8.	Pigeon Point (closest land point in Delaware to the proposed Incinerator)	2400 meters (≈1 ½ miles)	99.5 $\mu g/m^3$ (≈0.085 ppm)	77.9 $\mu g/m^3$ (≈0.020 ppm)	65.9 $\mu g/m^3$ (≈0.020 ppm)

[a] The locations cited in the table were selected due to their significance regarding population density or traffic volume and their proximity to the proposed incinerator. The locations are listed in clockwise order, beginning with points north of the proposed incinerator and proceeding clockwise through 360 degrees.

[b] Benzene is a decomposition produce of toluene. The figures indicate the resulting concentrations of benzene if all of the toluene vapors were to decompose to benzene.

EXHIBIT 5-9

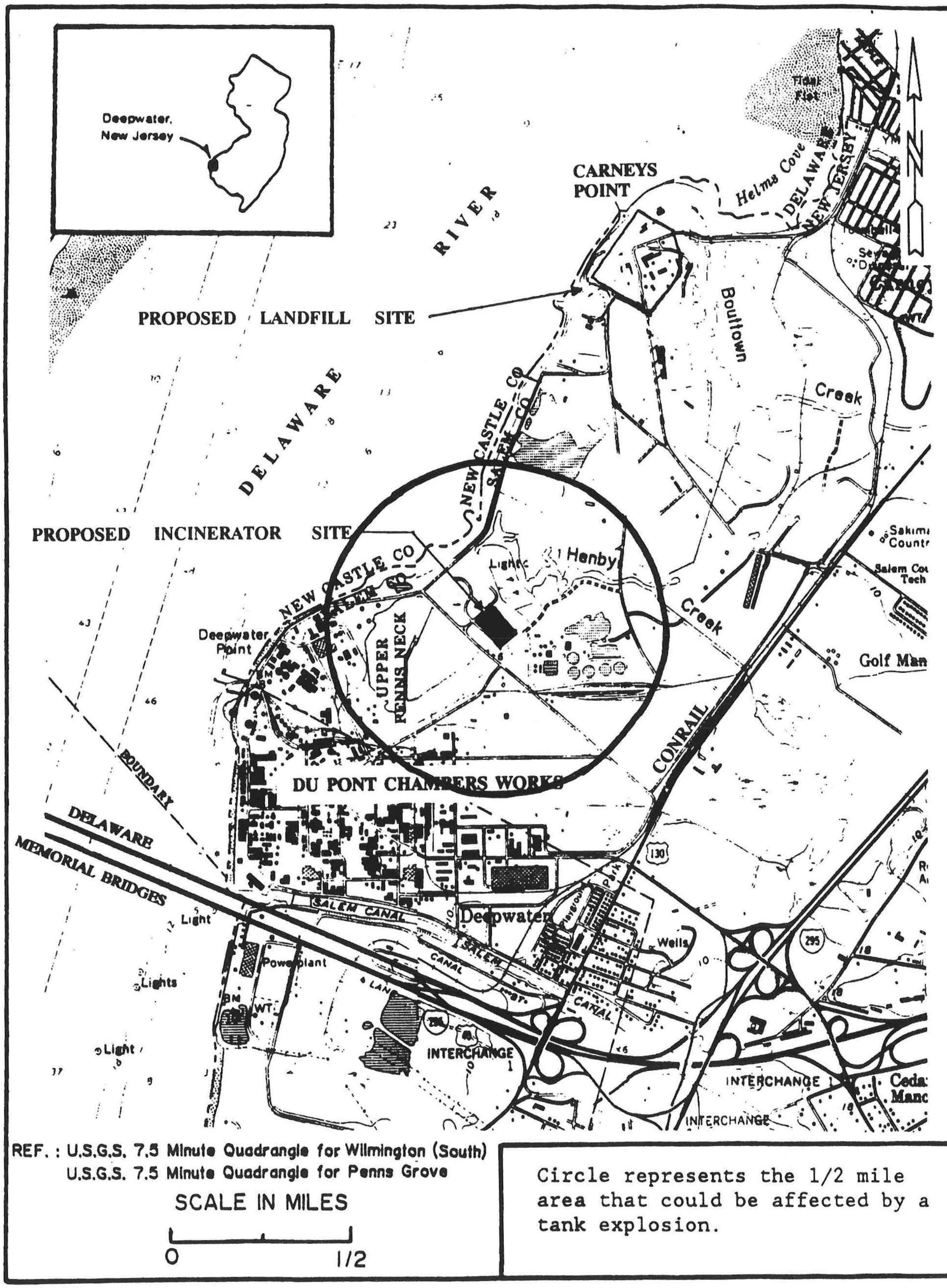
360 DEGREE DOWNWIND AREA POTENTIALLY AFFECTED BY THE SPILL/FIRE AT THE INCINERATOR TANK FARM



Circle represents the STEL concentration level for benzene.

EXHIBIT 5-10

360 DEGREE AREA POTENTIALLY AFFECTED BY A WORST CASE TANK EXPLOSION AT THE INCINERATOR TANK FARM



Circle represents the 1/2 mile area that could be affected by a tank explosion.

Despite the expected minimal impacts to off-plant persons, officials from the local government(s) located downwind of the spill and fire may decide to take protective actions to assure the health and safety of citizens and travelers. These protective actions may involve traffic and crowd control and evacuation or in-place sheltering. Local government capabilities and plans for carrying out protective actions are discussed in Section 3.5.5 and Appendix C. If protective actions are instituted, their impact will be the disruption of both normal movement (i.e., traffic, pedestrians, etc.) and normal business activities for the period of the protective actions.

The governmental jurisdiction located downwind of the fire may initiate air monitoring operations if deemed necessary. Air monitoring capabilities of the states of New Jersey and Delaware are discussed in Section 3.5.5.5.

Another possible impact to off-plant areas will be the settling of air pollutants (primarily smoke particles) upon property and the environment, although air currents may disperse the pollutants to an extent whereby no significant degree of deposition will occur. If air pollutants are deposited upon property and the environment, decontamination operations may have to be initiated. These procedures would probably simple techniques such as hosing down surfaces with water or removing articles. It is not expected that off-site impacts will be significant so as to require more extensive remediation procedures.

5.3.2.3 Large Off-Site Transportation Spill. Based on the existing and potential truck accident probabilities and traffic volumes to the incinerator and landfill presented in Section 4.6.7, a large off-site transportation spill may occur at some point in the operational lifetime of the incinerator and landfill. A large off-site transportation spill is less likely to occur than the credible spill discussed in section 5.3.1.2. Depending on the chemical(s) being transported, the health impacts on the driver and other unprotected people in the area potentially affected by the vapor cloud could range from minor to severe.

The Chambers Works' TERP Team and local emergency responders (see Section 3.5.5) will respond to spills off-site. The TERP Team will respond to releases occurring within 300 miles of Chambers Works. Sections 2.5.3.6 and 2.5.3.7 discuss the response equipment and systems available from Chambers Works. Section 3.5.5 discusses community services including evacuation and sheltering-in-place procedures and emergency medical services that are provided by the surrounding counties and townships.

Emergency response actions involved in a large release are likely to include the use of berms or sorbents and vapor suppression techniques (i.e., water or foam). The clean-up of the spill will involve removal of the mitigation materials and residues. Removal or treatment of contaminated soil and pavement may also be necessary.

A concern with many spills of hazardous materials is the toxic vapor cloud that is formed from the evaporating liquid. A credible worst case spill of 1750 gallons of methylene chloride was chosen to model the impacts of a worst case

transportation spill. Methylene chloride was chosen for the credible worst case spill for reasons presented in the previous discussion of credible spills. The size of the credible worst case spill was determined using the HMIS data base. The average size of the releases greater than 50 gallons over the three year period considered (1985, 1986, and 1987) is 1732 gallons. Sixty-three percent of these releases were due to a vehicular
accident or derailment or an external puncture. All but the largest ninety percent of the releases were less than this value. For these reasons, a volume of 1750 gallons was chosen as the credible worst case release.

The spill area and dispersion of vapor from an unconfined spill of 1750 gallons of methylene chloride was calculated using the methodology from Technical Guidance for Hazards Analysis (EPA December 1987);[31] the evaporation rate was calculated using the Clancey equation given in Loss prevention in the Process Industries by F.P. Lees.[32] The mean wind speed of the Chambers Works area (4.09 m/s),[33] atmospheric stability class F, and the STEL concentration for methylene chloride (500 ppm) were used in these calculations. An F stability class is the most conservative stability class yielding the largest area of concern. The STEL is published by the American Conference of Governmental Industrial Hygienists and is a 15 minute time-weighted average exposure which should not be exceeded at any time during a work day.

The resulting downwind distance of concern was 640 meters (0.4 miles). In the case of the off-site credible worst case transportation spill, the area affected could potentially encompass residential areas such Carneys Point and Penns Grove. The area potentially affected by the vapor cloud is defined as an area within which the airborne concentration of a chemical involved in an accidental release would exceed a specified level of concern (in this case the STEL concentration of methylene chloride). This area is a circle of radius equal to the downwind distance of concern with the potential release site located at the center.

5.4 MITIGATION OF SIGNIFICANT IMPACTS

Two significant impacts have been identified through the impact analyses performed in Sections 5.1, 5.2, and 5.3. One impact was identified by analyzing the maximum credible accident scenario involving the large spill and fire at the Tank Farm; the other significant impact was identified by analyzing the maximum credible accident scenario involving a large off-site transportation spill. Both of these significant impacts can be mitigated, to some extent, through a combined effort by Du Pont and nearby local and state governments. Each significant impact is described below as well as corresponding mitigation actions.

5.4.1 Significant Impact Associated with the Tank Farm Fire

Regarding the Tank Farm spill/fire scenario, although all fire protection will be in accordance with the New Jersey Uniform Construction Code,[34] safety could be improved by adding to the proposed in-place fire suppression equipment. This would ensure that no significant adverse impacts to personnel and property at Chambers Works would occur in the event of a severe fire at the Tank Farm. The concerns center around the proposed installation and operation of the two fixed monitor nozzles referenced in Section 2.5.3.5.

First, there is concern regarding the effectiveness of these two monitors in controlling a fire such as that described in the spill/fire scenario. Current plans call for one monitor to be located on each side of the 14-tank, 2-row configuration, one outside the southeastern corner and the other outside the northwestern corner. While their flow rate and pressure appear to be adequate and their streams capable of delivering water a sufficient distance (the streams will actually overlap towards the middle of the Tank Farm),[35] it does not appear that the streams will **always** be able to cool adequately several tanks being heated simultaneously or any one tank that is being impinged by flames from all sides (i.e., 360 degrees around the circumference of the tank). Although the monitors can be rotated horizontally and adjusted up and down, it appears unlikely that the two water streams could reach all 360 degrees of a tank surface. As explained in the fire scenario discussion, it is vitally important to keep tanks cooled to prevent explosions. Even though firefighters can set up portable master stream devices to supplement the two in-place monitor nozzles, this tactic would be both time consuming and dangerous, exposing firefighters to possible injuries or fatalities and structures and equipment to major damage.

The above problem could be mitigated to some degree by installing additional in-place monitor nozzles along the periphery of the Tank Farm. Such equipment would enable firefighters to direct water more effectively onto tank surfaces so that all flame-impinged areas could be adequately cooled. Additional monitors would also allow several heated tanks to be cooled simultaneously.

A second issue regarding the effectiveness of monitor nozzles is the plans for manual operation of the monitors,[36] necessitating the involvement of firefighters to use them. If the plant fire department and fire brigade were deployed at another on-plant fire when a Tank Farm fire occurred, there would be a delay before any plant or off-plant firefighters could operate the monitor nozzles and hoselines at the Tank Farm. This delay could lead to a catastrophic tank explosion under a worst case scenario. Even under normal circumstances when Chambers Works firefighters can respond immediately to the Tank Farm, the tank(s) can undergo significant heating prior to the time it would take to apply water to them. As before, firefighters and other plant workers (i.e., injuries or fatalities are possible) and property (i.e., major damage to structures and equipment) could be adversely affected.

The above problem could be mitigated to a significant degree by installing automatic water spray or deluge fire suppression systems throughout the Tank Farm. With systems of this type, water can begin cooling tanks and controlling the fire within seconds after ignition of flammable vapors, thus, eliminating or greatly reducing the chance of explosion and fire spread. Installation of automatic suppression systems would also serve as backup to the mounted monitor nozzles in the event of failure of the automatic suppression system(s).

5.4.2 Significant Impact Associated with the Transportation Spill

Local governments may have difficulty handling a large off-site transportation spill. The difficulty lies in their capabilities of monitoring, confining, containing, and cleaning up large spills of hazardous wastes. Their plans and capabilities for protecting the public (i.e., traffic and crowd control, evacuation and sheltering, etc.) and for providing emergency medical care, however, appear adequate (refer to Section 3.5.5 and Appendix C.

The reason for the difficulty local response agencies have in handling large spills is their members' limited knowledge and skills pertaining to spill response, beyond basic hazardous materials skills obtained during required training programs, and their lack of specialized response equipment and chemical protective gear. This situation applies in the cases of both Salem County, New Jersey and New Castle County, Delaware (refer to Appendix C) and is likely to hold true with regard to many other counties and municipalities throughout the region (i.e., New Jersey, Delaware, and Pennsylvania).

The impacts to communities of having inadequate hazardous/materials wastes response capabilities could be significant in cases of large spills of hazardous, volatile substances. For example, not having the capabilities to stop a leak could result in the release of several thousand gallons of hazardous waste, which would impact nearby residents, motorists, property and the environment. Hazardous vapors could cause injuries to unprotected people, ranging from minor to serious depending on the type of waste, concentration levels, and other factors. Protective actions (i.e., traffic control, evacuations, etc.) would disrupt normal business activities and traffic, as well. Nearby property (i.e., residences, businesses, public buildings, etc.) and the environment may also be damaged or contaminated and, therefore, require repair, remediation, or decontamination.

Chambers Works and the state governments of both New Jersey and Delaware have each already established programs to assist local governments in mitigating these problems and resulting impacts. The Chambers Works TERP Team (refer to Sections 2.5.3.6, 2.5.3.7, and 4.5) is available to assist local emergency responders in handling Du Pont tank trucks involved in accidents where the cargo is leaking, spilled, or in need of off-loading. In addition, the NJDEP can send its hazardous materials team to assist local emergency responders in New Jersey (refer to Section 3.5.5.1), and Delaware has its SERT Team to assist local responders in that state (refer to Section 3.5.5.1).

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Appendix A

APPENDIX A

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Appendix B

APPENDIX B

GLOSSARY OF ACOUSTICAL TERMS

Addition (decibel) - (see Decibel addition)

Air-borne sound - Sound which reaches the receiver (listener) by traveling mainly through the air.

Ambient sound\UE - The all-encompassing sound associated with a given environment. This is usually a composite of sounds from many sources, near and far. No particular sound is dominant.

Amplitude - the magnitude of the pressure of a sound wave or a vibrating surface. The amplitude is usually expressed in linear units.

American National Standards Institute (ANSI) - A standards setting body which involves a large number of technical and professional societies. The Acoustical Society of America is responsible for the acoustical standards activity.

ANSI - (see American National Standards Institute)

Average - The "energy" average of a series of discrete levels obtained by taking the sum of the anti-logs of one-tenth of the levels, dividing by the number of discrete levels and taking 10 times the logarithm of the result. This average is used for sound levels, sound pressure levels and sound power levels.

A-weighted sound level (dB(A)) - The sound level which is measured using the A-weighing network of a sound level meter or other acoustical instrument. It can also be computed from octave or 1/3-octave band sound pressure levels that have been adjusted for A-weighing.

A-weighing - A frequency network which reduces the importance of low frequencies in a manner similar to the human hearing mechanism. The network is standardized and is contained in sound level meters and other acoustical instruments.

Background sound - Sound from all sources other than the particular sound that is of interest (e.g., the sound other than that being measured, the sound other than the speech being listened to, etc.).

Bandwidth (Hz) - The width, in hertz, of a filter used in acoustical measurements. The width can be an octave, or larger, a one-third octave, a fixed percentage of the frequency, or a constant number of frequencies.

Day-night sound level (L_{dn}, dB) - The equivalent A-weighted sound level calculated for a 24-hour period with a 10 decibel penalty during nighttime hours. This penalty is to account for the increased sensitivity of people to sound during nighttime hours (2100 hrs to 0700 hrs).

Decibel (dB) - The label used for levels in acoustics. It is 10 times the logarithm of the ratio of the acoustical properties which are being described. The properties must be proportional to power.

Decibel addition - The total of a series of discrete levels obtained by taking the sum of the anti-logs of one-tenth of the levels and taking 10 times the logarithm of the result. This sum is used for sound levels, sound pressure levels and sound power levels.

Equivalent sound level (L_{eq}, dB) - The sound level which describes the energy contained in a fluctuating sound level over a certain period of time. Any time frame may be considered e.g., one minute, one hour, or one day.

Frequency (f, Hz) - The time rate of repetition of a period phenomena, such as a sound wave. The unit of frequency is the hertz (Hz), which corresponds to one cycle per second. The frequency is the reciprocal of the period.

Hertz (Hz) - The unit of frequency. It has been known as cycles per second.

Level (decibel, dB) - A unit used in acoustics in the measurement of physical quantities. It is 10 times of logarithm of the ratio of two variables, the denominator is usually the reference value of the physical quantity, which are related to power in some manner. The most common terms are sound pressure level, sound level and sound power level.

Loudness (sones) - A subjective attribute of sound. A doubling or halving of loudness represents a change of about 10 decibels. The loudness of a sound depends on its sound pressure level and its frequency content.

Noise - Unwanted sound. This term is loosely used for sound. A sound can be noise at times and not at others.

Octave band (OB) - A band of frequencies whose upper frequency limit is two times the lower frequency limit. This is comparable to the octave on a musical instrument.

Octave-band center frequency (Hz) - The frequency used to designate an octave band. The frequency is the geometric mean of the upper and lower frequency limits of the band. The standardized octave bands are centered at 31.5, 63, 125, 250, 500, 1000, 2000, 4000, 8000 and 16 000 Hz.

Octave-band sound pressure level (OB L_P, dB re 20 microPa) - The level in decibels of the sound pressure measured in an octave band.

One-third octave band (1/3 OB) - A band of frequencies whose width is one-third of that of an octave. The upper frequency limit is about 1.26 times the lower frequency limit.

One-third octave-band analyzer - A frequency analyzer used in acoustics whose bandwidth is equal to a one-third octave.

One-third octave-band center frequency (Hz) - The frequency used to designate a one-third octave band. The frequency is the geometric mean of the upper and lower frequency limits of the one-third octave band.

One-third octave-band sound pressure level (1/3-OB L_p, dB re 20 microPa) - The sound pressure level in decibels measured in a one-third octave band.

Percentile - A distribution of numbers, the fraction (or percentage) of the distribution which exceeds the specified value.

Period (sec) - The length of time between repetitions of a periodic phenomena. The period is the reciprocal of frequency. Periods in acoustics are usually in fractions of a second.

Root-mean-square (rms) - The square root of the time-weighted average of the squared value of a time-varying phenomena. It is the "effective" value of the physical quantity. The most commonly known example is ordinary electrical power where the rms value of voltage is about 115 volts whereas the actual voltage varies as a sine wave over one cycle from plus 160 volts to minus 160 volts. Sound pressure levels are measured using rms quantities.

Sound level meter (SLM) - A device built according to national (ANSI) or international (IEC) standards which is used to measure sound. The sound level meter generally contains one or more weighing networks which are designated A, B, C, and Flat. The lettering of the weighing networks denotes, respectively, decreasing emphasis of the low frequency portion of the sound being measured.

Sound pressure level (L_p, dB re 20 microPa) - The level in decibels of a sound pressure as measured. The reference pressure for the logarithmic scale for sound pressure level is 20 micropascal or 20 microPa (2×10^{-5} newton per square meter). The pressure which is measured and the reference pressure are both either rms pressures or peak pressures.

Appendix C

APPENDIX C

EMERGENCY SERVICES

This Appendix provides supplemental data that should be reviewed in conjunction with Section 3.5.5.1, Emergency Services. Data contained in this Appendix are specific to Salem and New Castle Counties and include procedural information and descriptions of personnel training, equipment, and evacuation facility locations pertinent to each.

C.1 EMERGENCY PROCEDURAL TRAINING AND EQUIPMENT

C.1.1 Salem County

Fire departments closest to Chambers Works (i.e., Pennsville, Penns Grove, and Carneys Point) are staffed by volunteers. In addition to fire suppression training, firefighters receive basic hazardous material (hazmat) training. Beginning in January 1989, the State (i.e., Office of Emergency Management, Bureau of Fire Safety, Health Department) will offer a training program as follows:

- Level 1 - Required for all fire department, emergency medical service, law enforcement, and emergency management personnel. Composed of two courses: "First Responder Awareness" (6 hours) and "First Responder Operational" (8 hours)
- Level 2 - Optional, intermediate-level course entitled "Hazmat Technician" (40 hours)
- Level 3 - Optional, advanced-level course entitled "HazMat Specialist" (still under development but is expected to be offered during 1989).

The Du Pont Chambers Works Transportation Emergency Response (TERP) Team also provides training to local fire departments.

Equipment available to the Salem County Fire Departments located nearest to the Chambers Works are listed by station in Table B-1. Salem County emergency medical personnel are required to be trained and State-certified as Emergency Medical Technicians (EMT's). Approximately 5% of the EMT's have undergone optional, additional training to achieve the EMT-Intermediate level, which allows them to perform defibrillation and to administer IV's. In addition, EMTs can also attend a State-offered course entitled "Hazmat EMS," that covers steps needed for protecting both the ambulance and crew from contamination by a chemically-exposed patient.

C.1.2 New Castle County

The Delaware State Fire School, which provides basic and advanced-level firefighting and emergency medical training, also offers hazmat courses. The hazmat courses are optional for firefighters and emergency medical services (EMS) personnel.

During regular firefighting training, students begin to receive hazmat-related training regarding protective gear, flammable liquids fire suppression and spill control, and evacuation. The courses directly pertaining to hazmat incidents include the following:

- Hazardous Materials 1 - six hour course covering: recognition and identification, labeling and placarding, and technical assistance sources.

- Hazardous Materials 2 - twelve hour course covering: inter-agency response, container identification and design, protective gear, decontamination, and five simulations to test response knowledge and management.

Other State hazmat training available to firefighters (and other emergency responders) includes a course entitled "Hazardous Materials Response for First Responders," offered by the Department of Public Safety, Division of Emergency Planning & Operations and periodic courses offered by the Department of Natural Resources & Environmental Control. Equipment available to the New Castle Fire Departments located near the Delaware Memorial Bridge are listed by station in Table B-2.

The Delaware State Police receive two hours of hazmat training during their overall basic training at the Delaware State Police Training Academy in Dover. The hazmat training covers identification, placarding, and use of the DOT Emergency Response Guidebook. State Police officers can also take hazmat courses voluntarily to increase their knowledge beyond that provided in basic training.

C.2 EVACUATION PROCEDURES AND SHELTERS

In both Salem and New Castle Counties, the Emergency Management Coordinator utilizes WDEL-AM and WSTW-FM to broadcast specific messages concerning emergency situations and evacuation advisements. Citizens in both counties will also receive warnings from emergency response personnel speaking through public address systems in response vehicles. Based upon the decision of Command personnel, citizens may be asked to evacuate. If so, citizens in Salem County are asked to proceed to shelters maintained by the Red Cross. These shelters are listed in Table B-3.

Evacuation equipment such as barricades, flashing signs, traffic cones, etc. are provided by municipal, county, and State public works, and highway departments.

EXHIBIT C-1

FIRE DEPARTMENT APPARATUS IN SALEM COUNTY
LOCATED NEAR CHAMBERS WORKS

Pennsville Station #1

4 pumpers
1 "medium-rescue" vehicle
2 ambulances (basic life support)

Pennsville Station #2 (Deepwater)

2 pumpers
1 brush truck
1 "medium-rescue" vehicle

Penns Grove

3 pumpers
1 brush truck
1 rescue boat

Carneys Point

2 1000-gallon per minute pumpers
1 brush truck
1 "light-rescue" vehicle
2 ambulances (basic life support)

EXHIBIT C-2

FIRE DEPARTMENT APPARATUS IN NEW CASTLE COUNTY
LOCATED NEAR THE DELAWARE MEMORIAL BRIDGE

Goodwill Volunteer Fire Department

4 pumpers (3-1250 gpm, 1-1000 gpm)
1 100-ft. aerial ladder
1 ambulance (basic life support)
1 Chief's car (command post)
1 4WD personnel carrier
1 21-ft. Boston Whaler boat
1 14-ft. boat

Holloway Terrace Volunteer Fire Department

2 pumpers (1-1000 gpm, 1-500 gpm)
1 "heavy rescue" squad
1 ambulance (basic life support)
1 4WD unit

EXHIBIT C-3

RED CROSS DISASTER SHELTERS
IN SALEM COUNTY

PENNS GROVE HIGH SCHOOL
Harding Highway
Penns Grove, N.J. 08069

WOODSTOWN HIGH SCHOOL
East Avenue
Woodstown, N.J. 08098

SALEM HIGH SCHOOL
Walnut Street
Salem, N.J. 08079

PENNSVILLE HIGH SCHOOL
S. Broadway
Pennsville, N.J. 08070

SCHALICK HIGH SCHOOL
Elmer-Centerton Road
Elmer, N.J. 08318

ST. JAMES HIGH SCHOOL
Georgetown Road
Carneys Point, M.J. 08069

PENNS GROVE MIDDLE SCHOOL
Shell Road
Penns Grove, N.J. 08069

MARY SHOEMAKER SCHOOL
E. Milbrooke Avenue
Woodstown, N.J. 08098

WOODSTOWN MIDDLE SCHOOL
Lincoln Avenue
Woodstown, N.J. 08098

Y.M.C.A.
Shell Road
Carneys Point, N.J. 08069

PEDRICKTOWN SUPPORT FACILITY
Route 130
Pedricktown, N.J. 08070

FIELD STREET SCHOOL
Field Street
Penns Grove, N.J. 08069

SALEM COUNTY VO-TECH SCHOOL
Woodstown-Salem Road
Woodstown, N.J. 08098

Appendix D

APPENDIX D

GROUND-WATER FLOW MODEL

Du Pont and their consultant, Woodward-Clyde Consultants (WCC), have been developing a ground water flow model for all of Chambers Works. This modeling effort involves the site specific adaptation of the widely used model developed by McDonald and Harbaugh (1984).[1] This model, referred to as MODULAR, is a modular three-dimensional, finite-difference ground-water flow model. The capabilities of the model are as follows:

> The model simulates steady and no-steady flow in an irregularly shaped flow system in which aquifer layers can be confined, unconfined, or a combination of confined and unconfined. Flow from external stresses, such as flow to wells, areal recharge, evapotranspiration, flow to drains, and flow through river beds, can be simulated. Hydraulic conductivities or transmissivities for any layer may differ spatially and be anisotropic (restricted to having the principal direction aligned with the grid axes and the anisotropy ratio between horizontal coordinate directions is fixed in any one layer) and the storage coefficient may be heterogeneous. The model requires input of the ratio of vertical hydraulic conductivity to distance between vertically adjacent block centers. Specified head and specified flux boundaries can be simulated as can a head dependent flux across the model's outer boundary that allows water to be supplied to a boundary block in the modeled area at a rate proportional to the current head difference between a "source" of water outside the modeled area and the boundary block.
>
> The flow region is considered to be subdivided into blocks in which the medium properties are assumed to be uniform. The plan view rectangular discretization results from a grid of mutually perpendicular lines that may be variably spaced. In the vertical direction zones of varying thickness are transformed into a set of parallel "layers." The associated matrix problem is solved using either the SIP (strongly implicit procedure) for SSOR (slice-successive overrelaxation). Mass balances are computed for each time step and as a cumulative volume from each source and type of discharge.[2]

Predictive Modeling

This model is being developed as a predictive tool for compliance and corrective action activities undertaken at other units at the facility. The assumptions of the model have been developed for the area south of Henby Creek through the use of the voluminous stratigraphic data that are available from years of building and well construction activities, as well as from published information. Sections 3.1 and 3.2 describe the breadth of the site-specific information available concerning the hydrogeologic characteristics of the

Chambers Works Property. The hydrogeologic parameters and assumptions developed for the model south of Henby Creek recently have served as the basis for extending the model north of Henby Creek and Secure Landfill "C" to include the area of the proposed secure landfill.

The model has been calibrated for the area south of Henby Creek, including the proposed incinerator unit, through the analysis of interceptor well and well point pumping data and their associated effects (drawdown) at monitoring wells. The model was calibrated for the incinerator area on March 28, 1988 and was then used in a predictive simulation in November, 1988 for well points installed around the "C" basin. For the proposed secure landfill area, the model was calibrated in April 14, 1989 through the use of single well permeability data (slug-test) and borehole stratigraphic information and was used to simulate the effects of a hypothetical interceptor well in the proposed landfill area.

Model Specifics and Development

The modeled region, Chambers Works, has been broken into discrete cells or blocks with a node located at the center of each block. The hydraulic parameters are then defined for each block. Sections 3.1 and 3.2 describe the data analyzed and interpretations of the stratigraphy, and consequently the hydrostratigraphy, that have been made at the Chambers Works Property. It is this data and these conceptual models of the subsurface that serve as the basis for model development.

Generally the sources of information for Du Pont's interpretation of the subsurface have been regional geologic information; geotechnical investigations, associated with construction activities, that have been conducted over the life of the facility; and geotechnical and hydrogeologic investigations that have been conducted by Leggette, Brashears, and Graham (LBG) and WCC over the past 20 years. This represents a large amount of information, however, the majority of this information is for the area south of Henby Creek.

The latest interpretation of the site by Du Pont's consultant, WCC, is that the sediments beneath the site represent a complex system of interbedded sands and clays in which the clay units are discontinuous. This interbedding creates a multi-layered aquifer system above the P-R-M regional system. WCC's latest interpretation of the site is that there are four small surficial aquifer systems above the shallow P-R-M system (described by LBG) which is generally encountered at depths greater than 100 feet (Deep P-R-M wells are encountered at depths often in excess of 400 feet. These four systems are designated "A" through "D," while the shallow and deep P-R-M aquifers of LBG are designated "E" and "F". The subdivisions are similar to LBG's, except that a perched unconfined aquifer (aquifer "A") is recognized and Aquifer D is considered to be a Cretaceous aquifer rather than a glacial aquifer. The following shows a comparison of the subdivisions given to the layered system by both of Du Pont's consultants:

Woodward-Clyde	Leggette, Brashears, & Graham
Aquifer A (Perched Aquifer)	(not recognized)
Aquifer B (Upper Pleistocene)	Shallow Glacial Aquifer
Aquifer C (Lower Pleistocene)	Middle Glacial Aquifer
Aquifer D (Cretaceous Aquifer #1)	Deep Glacial Aquifer
Aquifer E (Cretaceous Aquifer #2)	Shallow Raritan
Aquifer F (Cretaceous Aquifer #3)	Deep Raritan

The hydrogeologic investigations of both WCC and LBG have demonstrated that the upper four aquifers (A through D) are connected to varying degrees, depending on the area of Chambers Works being considered. However, in many areas the confining units between these surficial aquifer systems may be extensive enough that the hydraulic head difference between adjoining layers may be significant. However, because most the interceptor wells and many monitoring wells are screened in more than one system, it can be difficult to delineate hydraulic head differences.

WCC has made site-specific modifications to the model to accommodate the top five (A through E) aquifers of the multi-aquifer system. The model for the site was first developed in 1986 and 1987. The current model is calibrated to a recently obtained water-level data set in association with an improved understanding of the site stratigraphy. The model is designed so continual refinement is possible as greater resolution for these data sets is achieved. The following points provide an overview of the model characteristics, assumptions, and the modifications that WCC has made to the MODULAR model to apply it to the Chambers Works Property (Woodward-Clyde Consultants, 1989[3], provides detailed information):

- The finite difference grid for the site includes 158 nodes X 100 nodes, and the cells within the plant boundaries are 100 ft by 100 ft in the planimetrically;

- Although modeling of transient conditions (e.g., tidal and seasonal variation) is possible, the Chambers Works model is developed for steady-state or equilibrium (mean annual) conditions;

- Aquifer A is modeled as an unconfined aquifer, and B through E are modeled as leaky, confined aquifers (if the water level in a leaky, confined layer fall below the top of the layer, it is automatically modeled as an unconfined layer);

- The clay layers (confining units) are not modeled as independent layers, to simplify the model, therefore, storage within the clay layers is assumed to be negligible (storage considerations are most important for transient analyses);

- In general, the boundary between Layers 1 and 2 (Aquifers A and B) is simulated as a laterally discontinuous clay layer;

- Layers 3 and 4 (Aquifers C and D) are modeled as leaky aquifers separated from layers above and below by laterally extensive confining units with very low hydraulic conductivities;

- Layer 5 (Aquifer E) is modeled to have very little hydraulic connection with the layers above;

- Depending on the specific location of the cell and the resolution of stratigraphic information available, the vertical conductance of the confining units is modeled with values representing little restriction of vertical flow to virtually no vertical conductance;

- The hydraulic features of the model includes the basins, ditches, streams, the Delaware Estuary, and the interceptor wells as sources and sinks;

- Areal head boundaries for Layers 1 and 2 were modeled as constant head boundaries, while the connection of Layers 3 and 4 with the Delaware River is modeled as impermeable;

- The other boundaries are modeled as general head boundaries such that flow may occur across the edge of the modeled area (impermeable boundaries result in overestimated drawdown, while constant head boundaries require specific drawdown information);

- Based on the available data, nine areal zones of differing hydraulic conductivity were defined for Layers 1 and 2, while Layers 3, 4, and 5, because of insufficient data, were not assumed to have areal variation in hydraulic conductivity. Average values for all zones in these layers were derived from the aquifer testing work of LBG and WCC (see Section 3.2 for results of aquifer testing);

- The model includes a river module that is used to compute vertical flux from specified parameters. For the Chambers Works site, it is used for the A, B, and C Basins, Henby Creek, Salem Canal, Process Water Ditch System, and Secure Landfill "C" (the Delaware Estuary is specified as a constant head value of +3.7 ft CWD, and therefore, is not included in the computational module);

- Average areal recharge is specified as 4" per year in the recharge module; and

- The head at the general head boundaries is extrapolated from regional data several thousand feet outside the model area.

The WCC reports entitled Draft In-House Documentation of the Chambers Works Ground-water Flow Model, 1988 and Auxiliary Documentation Report for the Chambers Works Site-Specific Ground-water Flow Model, 1989 provide detailed information concerning the model as well as several simulations.

Model Testing and Calibration

A major calibration of the model occurred on March 28, 1988. Hydraulic parameters were varied during the calibration until a close match between simulated and observed head values was obtained. The observed water levels were associated with the pumping of INT-108, INT-103A, and INT-102A at 305 gpm, 340 gpm, and 370 gpm, respectively. Following the calibration the model was used in a predictive simulation in November, 1988 for well points installed around the "C" basin. WCC concluded following the calibration run and the predictive simulation involving the well points that the model was reasonably well calibrated but that more information was needed to better characterize the Process Water Ditch System and other water bodies, as well as Aquifer A.

Since the 1988 calibration, the model has been extended to include a 100 x 100 discretization for all the area of the Chamber Works Property (including Carneys Point) and a large amount of stratigraphic information has become available for the proposed secure landfill (before February, 1989 the model extended through the proposed landfill area, but the cells were larger). A calibration was conducted on April 14, 1989 to accommodate these new 100 x 100 cells and the new stratigraphic/hydraulic data. In addition to this calibration, a simulation was conducted to model the effects of a proposed interceptor well for the proposed landfill area.

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Appel, C.A. and Reilly, T.E., "Selected Reports that Include Computer Programs Produced by the U.S. Geological Survey for Simulation of Ground-Water Flow and Quality," U.S. Geological Survey Water Resources Investigations Report 87-4271, 1988, 64p.

NOTES

1. McDonald, M.G. and Harbaugh, A.W., "A Modular Three-Dimensional Finite-Difference Ground-Water Flow Model (MODULAR)," U.S. Geological Survey Open-File Report 83-875, 1984, 528p.

2. Appel, C.A. and Reilly, T.E., "Selected Reports that Include Computer Programs Produced by the U.S. Geological Survey for Simulation of Ground-Water Flow and Quality," U.S. Geological Survey Water Resources Investigations Report 87-4271, 1988, 64p.

3. Woodward-Clyde Consultants, "Draft In-house Documentation of the Chambers Works Ground-Water Flow Model, 1988," E.I. Du Pont de Nemours & Company, Chambers Works, Deepwater, NJ, Project Number: 88C2307-1, February 16, 1989b.

Appendix E

APPENDIX E

ANALYSIS OF FUGITIVE VOS EMISSIONS ESTIMATE

ENSR developed estimates of fugitive emissions of volatile organic substances (VOS) from flanged joints and valves using fugitive emission factors developed in-house by Du Pont. These fugitive emission factors give the amount of VOC emitted from a piece of equipment during a given period of time. Du Pont has suggested that the Synthetic Organic Chemicals Manufacturing Industry (SOCMI) emission factors are more appropriate for petroleum refineries than for chemical processing or waste management facilities.[1] Therefore, Du Pont has developed emission factors based on tests conducted at their chemical facilities (as opposed to petroleum refineries), and these factors are claimed to be more representative of their facilities. These emission factors are claimed to be facility-specific and depend on the leak detection and maintenance practices of the facility.

The SOCMI emission factors are based on categorizing fugitive emission sources as "leak" and "no-leak" components. Under this procedure, fugitive emission sources are screened, and sources that indicate screening values greater than or equal to 10,000 parts per million by volume (ppmv) are categorized as leaking components. The sources which indicate a screening value of less than 10,000 ppmv are categorized as non-leaking components. Du Pont's approach consists of categorizing components into three categories based on screening values of less than 1,000 ppmv, between 1,000 and 10,000 ppmv, and greater than 10,000 ppmv. Based on the description given by Du Pont on their approach towards estimating the fugitive emission factors, their emission factors appear to reflect more closely the real conditions that may exist at their facilities than the SOCMI emission factors.[2]

ENSR has developed estimates of the fugitive emissions from all the valves and flanges which are used in the proposed operation based on emission factors provided by Du Pont. The estimate is 3.64 tons per year.[3] A summary of the fugitive emission estimates is given in Exhibit E-1. The fugitive emission estimates do not include any emissions from pumps. ENSR has assumed that, because all pumps are equipped with double seals, fugitive emissions from pumps would be 0 tons per year. This assumption is consistent with industry practice.

Fugitive VOS emissions from valves and flanges are uncontrolled. Other fugitive emissions, such as those emitted from dedrumming operations or truck unloading operations, are directed either through the incinerator or carbon adsorber. Therefore, only the fugitive emissions from valves and flanges have been considered in this assessment. Fugitive VOS emissions from the controlled sources are negligible.

EXHIBIT E-1

FUGITIVE EMISSIONS OF VOS FROM WASTE STORAGE AND HANDLING SYSTEM

Component	VOS Emission Rate (tons per year)
All Flanges	2.1
All Valves	
- liquid service	1.3
- gas service	0.24
Total Emissions	3.64

ICF Technology estimated the highest ground-level concentrations that could prevail at the plant boundary due to the fugitive emissions from valves and flanges under six different atmospheric stability conditions, varying from most unstable to the most stable and assuming the valves and flanges as an area source.[4] The results are tabulated in Exhibit E-2. Exhibit E-3 gives the assumptions used in estimating the concentrations at the plant boundary. The maximum short-term VOS concentration that is estimated to occur at the plant boundary line due to the fugitive emissions is 4.744 $\mu g/m^3$ under the most stable atmospheric conditions. If the VOS emissions from the incinerator stack were also to be considered, the maximum short-term concentration would be 5.912 $\mu g/m^3$. It is important to note that this is a very conservative estimate, since it is assumed that the most stable atmospheric conditions prevail all the time. Section 4.4 discusses the significance of these emissions on the public health and safety.

EXHIBIT E-2

MAXIMUM CONCENTRATIONS OF FUGITIVE VOS AT CHAMBERS WORKS PLANT BOUNDARY[a]

Atmospheric Stability Condition	Concentration of VOS ($\mu g/m^3$)[b] (1-hr average)
A[c]	0.027039
B	0.185247
C	0.481196
D	1.3398
E	2.4511
F[d]	4.7444

[a]Based on revised ERT estimates.

[b]Concentrations from fugitive VOS emissions from flanges and valves only.

[c]Most unstable atmospheric stability condition.

[d]Most stable atmospheric condition.

EXHIBIT E-3

ASSUMPTIONS USED IN THE VOS CONCENTRATION ESTIMATES

Parameter	Assumption
Area Source Dimensions	Square region 500 feet x 500 feet
Plant Boundary Distance	1,250 meters
Mean Wind Speed	4.09 meters per second
Mean Fugitive Emission Source Height	3 feet

NOTES

1. Telephone conversation between Ramesh Kalagnanam, ICF, and Mr. Patrick J. Costello, E.I. Du Pont de Nemours & Company on February 16, 1989.

2. Ibid.

3. Letter from Patrick J. Costello, Sr. Consultant for Environmental Affairs, E.I. Du Pont de Nemours & Company, to Robert Hall, ERT, January 16, 1989.

4. The estimates are based on the procedures outlined in: Turner D.B., "Workbook of Atmospheric Dispersion Estimates," Office Of Air Programs Publications No. AP-26, U.S. Environmental Protection Agency, Research Triangle Park, North Carolina, 1970, pp. 1-84.

Appendix F

APPENDIX F

ESTIMATION OF THE OZONE INCREMENT DUE TO TOTAL VOS AND NO_x EMISSIONS

The screening analysis for the ozone increment due to the volatile organic substances (VOS) emitted from the incinerator stack as well as those emitted as fugitive emissions is carried out based on the method suggested in the Draft Paper, VOC/NO_x Point Source Screening Tables, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, September 1988.

The inputs required for this screening analysis are:

1. Annual emission rate (tons/year) of non methane hydrocarbons (NMHC),

2. Annual emission rate (tons/year) of nitrogen oxides (NO_x), and

3. Area classification based on land use (rural, or urban).

The data for this analysis are as follows:

Annual NMHC emission rate:	10.24 tons/year
Annual NO_x emission rate:	172 tons/year
Area classification:	Rural

The annual NMHC emission rate includes the fugitive emissions which are emitted at a rate of 3.64 tons/year. The assumption that the fugitive emissions can be modeled as part of the incinerator plume is very conservative. This is because the incinerator plume travels a longer distance than the fugitive emission cloud and therefore is in contact with NO_x for a longer period of time.[1]

Table 1 in the Draft Paper referenced above is used to estimate ozone increment as a function of NMHC/NO_x emission rates (annual emission rates). The ratio of NMHC/NO_x annual emission rate is:

10.24/172 = 0.06

Based on the actual NMHC annual emission rate of 10.24 tons/year and the NMHC/NO_x annual emission rate ratio of 0.06, the ozone increment is less than 1.1 parts per hundred million (or, 0.011 parts per million).

NOTES

1. This was confirmed during a telephone conversation between Ramesh Kalagnanam, ICF, and Mr. Richard D. Scheffe, USEPA, on February 15, 1989.

Appendix G

APPENDIX G

RESUMES OF PRINCIPAL AUTHORS

Ms. Deborah K. Shaver is a Vice President of ICF Technology with over 15 years of experience in managing the environmental and safety impacts of the transportation and handling of hazardous materials and wastes. She is a certified hazardous materials manager (C.H.M.M.) at the Masters level. Her work at ICF Technology emphasizes environmental impact assessment, waste management, waste reduction/minimization and related technology, transportation risk assessment, hazardous materials spill response, and regulatory analysis.

Environmental Impact/Siting Studies

- She directed the preparation of the Environmental and Health Impact Study (EHIS) for the New Jersey Hazardous Waste Facilities Siting Commission on the proposed expansion of hazardous waste facilities at the Du Pont Chambers Works plant.

- Directed a Space Launch Feasibility Study to identify and analyze the capacity and capability of Vandenberg AFB (VAFB) to support the increased heavy lift launch requirements of the Air Force. In this study the environmental baseline at VAFB was detailed, competing missions and requirements were identified, various assumptions on likely vehicle configuration, launch rates and capacities were made the impacts identified. These impacts were then assigned weights in terms of the criticality of their impacts upon the baseline environmental, operations, and socio-economics in the vicinity of VAFB and mitigation options were identified.

- Directed an effort to support a major defense contractor in the environmental impacts of siting the new Advanced Launch System (ALS) at various locations in the continental U.S. as well as overseas during the Phase I concept design. This effort included ecological and environmental assessment of siting launch ground support facilities, vehicle assembly operations, and ancillary manufacturing facilities (both materials and vehicle structural members), as well as analysis of novel launch environments at sea and the likely environmental and regulatory impacts.

- Managed an engineering feasibility study, the conceptual design, costing, and siting of a hazardous waste incinerator for STS and other VAFB hazardous wastes. This included the modeling and potential exposure patterns for incinerator emissions as well as designing a waste water treatment facility to handle the scrubber effluent from the air pollution control system. This effort also included a review of the Federal and California State siting and permitting regulations covering high temperature incineration, and the assessment of a detailed waste inventory.

- Performed industrial waste profile surveys and environmental damage case studies for the EPA Office of Solid WAste of the industries excluded form

RCRA under Section 8002, including metals and minerals mining; primary smelting/refining; cement kilns; non-smelting metal processing; and oil, gas and geothermal drilling, development, and production.

- Determined industrial, domestic, natural, and other sources (e.g., power plant combustion processes, industrial boilers, and waste water treatment processes), environmental pathways and fate (e.g., metabolites, decomposition products, etc.) or organic compounds found in drinking water supplies for the Office of Toxic Substances, EPA.

Transportation/Risk Assessment

- Managed development of transportation route risk assessments for highway shipments of nitrogen tetroxide (N204), a hypergolic rocket oxidizer, and liquid cryogenic fluorine (LF2) to satisfy requirements of new DOT exemptions. These routes run from Cedar Chemical Corp. in Mississippi and Allied Chemical in Metropolis, Illinois to Vandenberg AFB, California and Cape Canaveral AFS, Florida.

- Managed development of emergency response plans for over-the-road shipments of N204 and LF2 and assessment of the emergency response capabilities of local agencies to handle releases of these materials along specific highway routes.

- Managed the update of the risk analysis and alternate routing studies for the Air Force in support of obtaining the DOE exemption certifying the selected routes for the transport of N204 and LF2 remain the safest routes practicable. In addition, ICF Technology assessed routes for the transport of Aerozine-50, a hypergolic rocket propellant.

- Directing the risk assessment of alternate routes for the highway transportation of hazardous materials for a private client.

Waste Management/Waste Reduction

- Developed a handbook for small businesses detailing their responsibilities and steps they need to take to comply with the new small quantity generator hazardous waste regulations, as part of EPA's continuing outreach educational program.

- Assessed the processes, waste generation, and waste management practices in various industries which have many small firms (generating between 100 and 1,000 kg/mo of hazardous wastes) that are likely to be impacted by several recent RCRA regulatory initiatives including the SQG regulations, used oil regulations, leaking underground storage tanks, secondary containment requirements, redefinition of solid waste as it affects recycling/reclamation, and the land disposal ban.

- Managed a waste minimization study of several SQG industries to determine whether alternate management technologies, input substitution, source separation, recycling/rescue, and operational practices are feasible and practical for the small businessman. Some of the industries included metal parts manufacturing, gasoline and automotive maintenance stations, retail stores, dry cleaners, photo processors, and paint and ink manufacturers.

- Directed a waste minimization study to provide an extensive process operations analysis of Systems Command launch and ICBM operations and other base operations at Vandenberg AFB. This program evaluated alternate technologies, input materials, operating parameters, existing waste management techniques, and the costs and benefits of implementing recommended waste minimization techniques, Base wide implementation strategies were considered as well as updates or changes to specifications and technical orders (T.O.s). The project included the development of a plan for implementing the recommended alternatives at VAFB.

Risk Assessment/Hazardous Materials Spills Response

- Development of risk models and performance of risk and hazard assessments of transportation and storage of Titan II and other propellants for the USAF.

- Development of decision scenarios for response and mitigation of hypergolic propellant spills for the USAF, and development of system operating criteria for an automated Titan II spill hazardous response and mitigation system.

- Development of decision scenarios for response and mitigation of hypergolic propellant spills for the USAF, and development of system operating criteria for an automated Titan II spill hazard response and mitigation system.

- Development of risk models and performance of risk/cost assessments of various routing alternatives for the rail transport of spent nuclear fuel for the Federal Railroad Administration (FRA).

- Analysis of railroad personnel safety issues, especially hazardous material-related injuries, how and when they occur, and under what circumstances.

- Manager of Environmental Services for the Bureau of Explosives, Association of American Railroad,s providing on-scene emergency response assistance to major rail carriers, providing expert assistance to shippers of explosives and hazardous materials on packaging and shipping requirements, and providing regulatory liaison and support concerning environmental issues.

- Development and implementation of a training program for Bureau of Explosives inspectors on environmental and hazardous materials chemistry.

Mr. Gerard M. Kelly is a Project Manager at ICF Technology with over 15 years of professional experience in the area of environmental management. He has extensive experience in the areas of environmental laws and regulations, environmental impact and health risk assessment, and preparation of NEPA documentation. He managed the preparation of the Environmental and Health Impact Statement (EHIS) for the New Jersey Hazardous Waste Facilities Siting Commission on the proposed expansion of hazardous waste facilities at the Du Pont Chambers Works. He is currently managing ICF Technology's support to the Department of Energy's Office of NEPA Project Assistance, which involves the review of DOE activities to ensure compliance with NEPA and other environmental review requirements. Mr. Kelly recently reviewed NEPA documents for DOE on proposed remedial actions for hazardous and radioactive waste disposal sites, a thermal treatment unit for hazardous and radioactive mixed wastes, and decontamination and decommissioning of DOE facilities. In addition, Mr. Kelly directed a multi-million dollar, multi-year task order contract with U.S. EPA Region V to conduct NEPA-related activities, and has managed the preparation of over a dozen Environmental Impact Statements (EISs). Other EIS/EA projects in which he has participated include: DOE's high-level nuclear waste geologic repository; expansion of a hazardous waste landfill; dredging and disposal of PCB-contaminated sediment; several wastewater collection and treatment facilities in the midwest; two proposed railroads; expansion of a pulp and paper mill; commercial and residential development; and two notices of proposed rulemaking for the Federal Energy Regulatory Commission. He has personally been involved in all elements of an EIS, including scoping/issue identification, impact and risk assessment, responding to review agency and public comments, and conduct of public participation programs.

Other relevant experience includes a risk assessment of a contaminated aquifer; conduct of a site selection and permitting feasibility study for an oil field waste disposal facility; economic impact analyses of proposed land disposal restrictions and alternatives; and preparation of two regional water quality management plans, which involved evaluation of all water pollution sources (existing and projected point, non-point, and intermittent sources), regional wastewater and stormwater collection and treatment alternatives, and water quality impacts. In addition, Mr. Kelly has conducted several environmental compliance audits of industrial facilities, and extensive surveys of DOE facilities to identify environmental problems and public health risks.

Ms. Margaret K. Boryczka is a Project Manager with ICF Technology and has over nine years of experience in managing socioeconomic and environmental impact studies. Her training is in public policy analysis with an emphasis on transportation, regulatory, and economic issues. She has been involved with siting high-level and low-level radioactive waste facilities, managing economic impact assessment activities and analyzing policy issues related to transporting spent nuclear materials. Ms. Boryczka has also been involved in preparing environmental impact statements for the Federal Energy Regulatory Commission, several State agencies, and private clients. In addition, she has prepared testimony for public hearings on sensitive environmental issues and has given numerous presentations at public meetings. Ms. Boryczka conducted the socioeconomic impact analysis of the proposed expansion of hazardous waste facilities at the Du Pont Chambers works.

Ms. Boryczka prepared socioeconomic and transportation portions of environmental assessments for DOE's high-level nuclear waste program, and for a variety of landfill and incinerator projects. These analyses involved evaluating socioeconomic, cultural, aesthetic, and land-use impacts and property value impacts. She also managed an environmental impact analysis dealing with the effect of regulatory changes proposed by the Federal Energy Regulatory Commission on the electric utility industry. Ms. Boryczka's experience also includes:

- Managed project team involved in designing a model for estimating grants-equal-to-tax payments for a federal facility. The model simulated state and local taxes normally applied to industrial developments and offered policy options relevant to taxing a federal facility.

- Designed model for estimating population changes related to large project developments. In addition, developed components for estimating the cost of upgrading community services in response to project-related immigration.

- Provided information to state and local governments through meetings, formal presentations, and small working groups on nuclear waste disposal project. Usually, technical information on models, plans, and data was presented with follow-on discussions.

- Worked with state and local governments in resolving controversial socioeconomic and transportation issues.

Ms. Judi L. Durda has broad biological and toxicological environmental impact assessment experience. Ms. Durda has previously worked on a number of assignments for ICF Technology and as a Wildlife Biologist with the U.S. Fish and Wildlife Service (USFWS). Ms. Durda conducted the ecological impact analysis of the proposed expansion of hazardous waste facilities at the Du Pont Chambers Works and assisted on the public health risk assessment. Her experience includes:

- Analyzing environmental impacts of public and private projects permitted under Sections 404, 402, 401 of the Clean Water Act.
- Reviewing Section 201 wastewater management projects and NPDES permits to evaluate and mitigate impacts to fish and wildlife resources.
- Reviewing Federal Highway Administration projects, and associated Environmental Assessments and Impact Statements to identify and mitigate fish and wildlife impacts.
- Characterizing cancer and noncancer risks associated with municipal incinerators and municipal sludge landfills.
- Developing acceptable exposure limits for air pollutants and other hazardous wastes based upon a critical review of the available toxicological data.
- Assessing natural resource damage at Superfund hazardous waste sites.
- Conducting on-site field investigations and sampling to determine the degree of environmental contamination.

Mr. Robert Lanza is a Senior Chemical Engineer with ICF Technology. He conducted the air quality impacts analysis for the Environmental and Health Impact Statement for the proposed expansion of hazardous waste facilities at the Du Pont Chambers Works and participated in the public health risk assessment. The assessment included evaluation of air emission control system design information for the incinerator, stack and fugitive emission estimates, and air dispersion modeling performed by contractors, and preparation of input parameters for a human exposure and health risk assessment. He has also recently performed surveys of air emissions sources, control systems, and sampling and monitoring programs at Department of Energy (DOE) Defense and Energy facilities in Richland, Washington; Aiken, South Carolina; Largo, Florida; Albuquerque, New Mexico; Golden, Colorado; Bartlesville, Oklahoma; Ames, Iowa; and Princeton, New Jersey as part of a multi-disciplinary environmental survey team. The surveys served to identify and prioritize existing and potential environmental problems in all environmental media throughout the DOE system.

Mr. Lanza has coordinated and reviewed request from DOE survey team members for sampling and analysis of environmental media for three of the DOE sites surveyed. The project involved providing coordination between environmental survey team and sampling and analysis team members and review of preliminary requests and final sampling and analysis plans. The sampling and analysis served to provide data by which to prioritize identified environmental problems. He has also performed comprehensive environmental compliance audits of DOE facilities in Oak Ridge, Tennessee, and Paducah, Kentucky, as part of a multi-disciplinary team, identifying permitted and unpermitted air emission sources, regulatory implications, and control system requirements.

Mr. Lanza prepared an environmental and regulatory impact assessment of emissions from coal- and oil-fired electric utility power plans in Maryland. The study included a regulatory assessment of proposed PM-10 regulations and evaluation of potentially applicable control techniques. He also prepared and reviewed sections of RCRA Part B permit applications for two solvent recovery facilities in Illinois, including preparation of facility descriptions, process descriptions and waste analysis plans, and review of drawings, contingency plans, inspection plans, training plans, and procedures to prevent hazards for both facilities.

He has prepared engineering calculations and dispersion model input parameters for risk assessment of air emissions from a cement kiln burning hazardous waste as an alternate fuel, and development of a test burn and sampling protocol in response to State regulatory requirements, and has also prepared appeals of permit limitations proposed by USEPA for emissions of heavy metals from hazardous waste incinerators for two hazardous waste management firms, in support of the RCRA Part B permitting process.

Mr. Spence Smith is a Lead Geoscientist with ICF Technology. His 6 years of research and field experience have involved the disciplines of hydrogeology, contaminant transport modeling, geophysics, paleohydrology, paleoclimate, geologic hazards, neotectonics, and surficial processes. While with ICF Technology, Mr. Smith has provided technical support for several projects conducted in a variety of hydrogeologic settings and involving the characterization of soil and ground-water contamination. He has utilized a variety of geohydrological and geophysical techniques, including stratigraphic analysis; monitoring well installation, testing, and sampling; terrain conductivity (EM), ground penetrating radar (GPR), seismic refraction and magnetometry surveys; and soil sampling. In addition, he has managed scheduling and oversight of field teams composed of a number of subcontractors. Mr. Smith conducted the hydrogeologic investigations and the water quality impact analysis on the Environmental and Health Impact Statement for the proposed expansion of hazardous waste facilities at the Du Pont Chambers Works.

Mr. Smith has also been involved in the development of screening methodologies designed to help states assess the vulnerability of sites in various hydrogeologic settings to the spread of petroleum contamination and to prioritize these sites for the best allocation of cleanup resources. He has assisted the Department of Energy with the acquisition and review of hydrologic, geologic, and climatologic data necessary for the siting studies for high-level radioactive waste repositories, and he has provided scientific and regulatory support for issues related to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA).

Prior to joining ICF Technology, Mr. Smith was involved in the development of innovative approaches to flood-frequency analysis and determination of the probable maximum flood (PMF) for arid/semiarid river systems. In addition, he has conducted lab and field studies dealing with the evidence for Quaternary seismic events in the Basin and Range Province. Graduate studies included surface and ground-water hydrology and contaminant hydrogeology in conjunction with a traditional geoscience curriculum.

<u>Environmental Impact Analyses</u>

- Conducted environmental feasibility studies for the Air Force and an aerospace concern to investigate siting and system design options for the Advanced Launch System. Delineated geologic and meteorologic hazards and mitigative environmental factors associated with a variety of siting options and system designs.

- Conducted water use and quality analyses for an Environmental Impact Statement for the Federal Energy Regulatory Commission (FERC). The purpose of this work was to determine the effects a change in FERC regulation of nontraditional wholesale power producers would have on environmental quality.

Spence S. Smith (continued)

Site Assessments

- Conducting environmental audits of a variety industrial facilities in the United States and Canada. These investigations are designed to review industrial processes and associated generation, storage, and disposal practices for hazardous waste. In some cases, hydrogeologic investigations, involving well installation, soil and water sampling, and geophysical studies, are required to assess the extent of environmental problems associated with both present and past activities at the sites.

- Conducted hydrogeologic assessments at several sites, with reported petroleum contamination associated with underground storage tanks, in four very different physiographic provinces with very different hydrogeologic settings within the State of Virginia. In conjunction with conventional hydrogeologic techniques, these studies involve geophysical techniques and soil gas analysis.

- Conducted preliminary assessment/site investigation (PA/SI) of a landfill at the Seneca Army Depot for the United States Army Toxic and Hazardous Materials Agency (USATHAMA). Terrain conductivity (EM) and ground-penetrating radar (GPR) were used in conjunction with soil-gas analysis, aquifer testing, monitoring well sampling, and soil sampling to characterize the landfill and to delineate the extent of the contaminant migration.

RCRA and CERCLA Technical Policy and Training Support

- Studied the technical training needs of EPA staff from several regions, developed course curricula for idealized training courses that would meet these needs, and evaluated short courses offered by a number of concerns in the areas of contaminant transport, hydrogeology and geophysics.

- Provided hydrogeologic support to EPA for the development of alternate landfill closure regulations and associated technical documents.

- Developed technical and policy guidance documents for EPA Office of Underground Storage Tanks (OUST) concerning corrective action technologies and implementing-agency decision schemes for leaking underground storage tanks. Reviewed data concerning population size and constituent make-up for mixed-regulated substances and exempt substances in USTs.

- Compared the field-analytical approaches developed for RCRA Facility Assessments and Superfund Preliminary Assessment/Site Inspections.

- Wrote technical issues papers concerning RCRA policy alternatives.

Dr. John Erdreich is a Principal with Ostergaard Associates and has 20 years of experience in the field of acoustics and noise. He has specialized in the measurement of environmental noise and the effects of noise on people. He has written the NIOSH strategy for reducing noise-induced hearing loss and serves as a consultant to several standards working groups for the American National Standards Institute. Several of his current projects include evaluation of the impact of noise from industrial operations on residential neighborhoods and identifying techniques for mitigating noise impact. Dr. Erdreich analyzed noise impacts for the Environmental and Health Impact Statement for the New Jersey Hazardous Waste Facilities Siting Commission on the proposed expansion of hazardous waste facilities at the Du Pont Chambers Works.

Previously he has served as an Associate Professor of Environmental Health at the University of Cincinnati and directed the noise research programs at the National Institute for Occupational Safety and Health. Other relevant experience includes:

- Conducting risk assessments for exposure to noise.
- Working with land developers to determine appropriate land use and secure zoning variances.
- Carrying out noise analysis for municipal permits for new industrial facilities.
- Teaching courses in noise control for OJHA, University of Cincinnati, and the Industrial Hygiene Association.
- Thirty papers in scientific journals on effects of noise and vibration.