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C-8 DATA SUMMARY REPORT
CONSENT ORDER GWR-2001-019
DUPONT WASHINGTON WORKS
FACILITY AND LOCAL, LETART AND
DRY RUN LANDFILLS

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An Alliance between
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EXECUTIVE SUMMARY

A multi-media consent order (Order No. GWR-2001-019; Consent Order) was entered into between the West Virginia Department of Environmental Protection (WVDEP), the West Virginia Department of Health and Human Resources – Bureau for Public Health (WVDHHR-BPH) and DuPont on November 15, 2001. The Consent Order identified a series of requirements and tasks to be performed by the parties (WVDEP, WVDHHR-BPH, and DuPont) in order to determine whether there has been an impact on human health and the environment as a result of releases of ammonium perfluorooctanoate (C-8), CAS Number 3825-26-1, from DuPont operations at the Washington Works facility (facility, also referred to as the "main plant") and the associated landfills (Local, Letart, and Dry Run).

The Consent Order established the C-8 Groundwater Investigation Steering Team (GIST) to oversee investigations and activities of the Consent Order including Task A: Groundwater Use and Well Survey/Groundwater Monitoring, Task B: Assessment of Existing Groundwater and Surface Water Monitoring Data, and Task C: Plume Identification/Groundwater Assessment at each site. The Consent Order also established the C-8 Assessment of Toxicity Team (CATT), which consisted of scientists from academia, government, non-profit organizations, and industry, to assess the toxicity and risk to human health and the environment associated with exposure to C-8 releases from DuPont activities.

This C-8 data summary report documents all activities conducted to meet the requirements of the Consent Order. In addition, the revised site conceptual models are presented, which better represent the current environmental setting (geology, hydrology, hydrogeology, groundwater flow, and water quality) and current human health and ecological exposure pathways for the conditions at and near the sites.

The table below shows the results of the exposure pathways evaluation. This evaluation assessed whether human and ecological receptors were exposed to C-8 impacted media (e.g., soils, surface water, groundwater) both on-site and off-site on the basis of data collected under the Consent Order. Pathways were classified as complete or incomplete. To be conservative, the highest C-8 concentration measured for each type of aqueous media was compared to the CATT-established human health protective screening criteria for water (C-8 SL) of 150 ug/l, regardless of media type. Note, however, that the CATT-established Aquatic Life Advisory Concentration for C-8 (C-8 ALAC) of 1,360 ug/l is a more appropriate benchmark for evaluation provided that waters are not ingested such as surface water, groundwater, process water, and leachate. In this table, highlighted boxes indicate media that exceed the C-8 SL. This table shows that for all on-site and off-site media evaluated for the facility and the three landfills, only leachate and surface water at Letart Landfill exceed the C-8 SL. If these media were compared to the established C-8 ALAC of 1,360 ug/l, only leachate at Letart exceeds the C-8 SL. Most importantly, this table shows that all drinking-water sources are substantially below C-8 SL.

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		C-8 Impacted Media	Exposure Pathway Assessment [Complete (C) or Incomplete (I)]	
			Human Receptors	Ecological Receptors
Washington Works Facility	On-Site	SWMUs/Landfilled Materials	I	I
		Soil	I	I
		Surface Water	I	I
		Groundwater	I	I
		Drinking water (from groundwater)	C [1.9 (L) ug/l]	NA
		Process water (from groundwater)	C (51.2 ug/l)	NA
	Off-site	Drinking Water (wells, springs and/or cisterns) - WV	C (2.8 ug/l)	C (2.8 ug/l)
		Non-drinking water (wells, springs and/or cisterns) - WV	C (5.07 ug/l)	C (5.07 ug/l)
		Unused water sources - WW	I	I
		Drinking Water (wells, springs and/or cisterns) - OH	C (8.59 ug/l)	C (8.59 ug/l)
		Non-drinking water (wells, springs and/or cisterns) - OH	C (23.6 ug/l)	C (23.6 ug/l)
		Unused water sources - OH	I	I
		Ohio River water	C (1.09 ug/l)	C (1.09 ug/l)
		PWS (WV and OH)	C (4.29 ug/l)	C (4.29 ug/l)
Local Landfill	On-Site	SWMUs/Landfilled Materials	I	I
		Soil	I	I
		Leachate	C (120 ug/l)	C (120 ug/l)
		Surface Water	C (115 ug/l)	C (115 ug/l)
		Groundwater	I	I
	Off-site	Drinking Water (wells, springs and/or cisterns) - WV	C (2.8 ug/l)	C (2.8 ug/l)
		Non-drinking water (wells, springs and/or cisterns) - WV	C (5.07 ug/l)	C (5.07 ug/l)
		Unused water sources - Local	I	I
Letart Landfill	On-Site	SWMUs/Landfilled Materials	I	I
		Soil	I	I
		Leachate	C (2050 ug/l)	C (2050 ug/l)
		Surface Water	C (371 ug/l)	C (371 ug/l)
		Groundwater	I	I
	Off-site	Drinking Water wells - Letart	C (0.139 ug/l)	C (0.139 ug/l)
		Non-drinking water wells- Letart	C [NQ (<0.05)]	C [NQ (<0.05)]
		Ohio River water	C (0.128 ug/l)	C (0.128 ug/l)
		Unused water sources - Letart	I	I
Dry Run Landfill	On-Site	SWMUs/Landfilled Materials	C (Unknown)	C (Unknown)
		Soil	C (Unknown)	C (Unknown)
		Leachate (captured and treated)	I	I
		Surface Water	C (87 ug/l)	C (87 ug/l)
		Groundwater	I	I
	Off-site	Drinking Water (wells, springs and/or cisterns) - Dry Run	C (0.422 ug/l)	C (0.422 ug/l)
		Non-drinking water (wells, springs and/or cisterns) - Dry Run	C (0.54 ug/l)	C (0.54 ug/l)
		Unused water sources - Dry Run	I	I

(L) = biased low
NA= not applicable
Highlighted cells indicate exceedence of CATT-established C-8 SL (150 ug/l)

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For the Washington Works facility, the current revised site conceptual model combined with the current revised groundwater model, the current on-site and off-site C-8 concentrations measured, and the current exposure pathways evaluation show that:

- Solid Waste Management Units (SWMUs) on-site are believed to be the primary source of C-8 migration to groundwater. Air deposition of C-8 on the ground surface and migration to groundwater also may have occurred.
- No off-site migration of groundwater is occurring.
- No potential groundwater migration pathway exists beneath the Ohio River. Air-emissions are believed to be the primary migration pathway of C-8 from the facility to adjacent areas in Ohio.
- Air emissions of C-8 from the facility also are believed to be the source of C-8 concentrations detected in West Virginia adjacent to the facility and Local Landfill.
- Air emissions of C-8 and discharge of C-8 through outfalls are believed to be the migration pathways of C-8 from the facility to the Ohio River, and in turn, from the river to public water supplies (PWS) located downstream.
- There are no known complete exposure pathways for human or ecological receptors that exceed the CATT-established C-8 SL or the C-8 ALAC at the facility.

For the Local Landfill, the current revised site conceptual model combined with the current on-site and off-site C-8 concentrations measured and the current exposure pathways evaluation show that:

- C-8 is believed to migrate via water transport from C-8 containing landfilled materials to groundwater at the Local Landfill.
- Groundwater flow from Local Landfill flows toward the facility to the northwest (away from off-site residential areas).
- C-8 detected in the one- and two-mile radius sampling areas near the facility and Local Landfill is likely to have been transported from the facility via air emissions.
- There are no known complete exposure pathways for human or ecological receptors that exceed the C-8 SL or the established C-8 ALAC at the Local Landfill.

For the Letart Landfill, the current revised site conceptual model combined with the current on-site and off-site C-8 concentrations measured and the current exposure pathways evaluation show that:

- C-8 is believed to migrate via water transport from C-8 containing landfilled materials to groundwater at the Letart Landfill.
- Groundwater flow at Letart Landfill is toward the Ohio River and is away from off-site residential areas.

- The annual C-8 loading from groundwater to the Ohio River indicates a very low C-8 concentration in the river from the landfill, which is supported by the very low C-8 concentrations measured in the Ohio River.
- Air emission of C-8 is not a viable migration pathway because there are no air emissions at Letart Landfill.
- Contact with surface water (Cap Runoff location) and leachate at the toe of the Letart Landfill and in the wet-weather stream surface water that discharges to the Ohio River are complete exposure pathways for human or ecological receptors that exceed the C-8 SL. However, exposure is limited because of the remote location of the landfill, the very steep terrain, and the wet-weather nature of the stream. In addition, fencing limits access to the area. Further, the use of health and safety plans, standard operating procedures, and personal protective equipment also limit exposure.

For Dry Run Landfill, the current revised site conceptual model combined with the current on-site and off-site C-8 concentrations measured and the current exposure pathways evaluation show that:

- C-8 is believed to migrate via water transport from C-8 containing landfilled materials to groundwater at the Dry Run Landfill.
- Groundwater flow at the site is toward the west. C-8 concentrations measured within the one-mile radius sampling area show that no off-site migration of C-8 impacted groundwater has occurred.
- Dry Run Landfill is located within eight miles of the facility. Transport of C-8 via air emissions from the facility potentially could be the source of the very low concentrations of C-8 detected within the one-mile radius sampling area.

1.0 INTRODUCTION

Since the early 1950s, ammonium perfluorooctanoate (C-8) has been used by DuPont in its fluoropolymer-related manufacturing processes at the Washington Works facility (facility, also referred to as the "main plant"). Residues containing C-8 from these processes have been released to the air; discharged to the Ohio River; disposed of at the Washington Works facility and/or at the DuPont Local, Letart, and Dry Run landfills; and otherwise shipped off-site for destruction or disposal (see Figure 1.0). C-8 has been detected in varying concentrations in and around the Washington Works facility and the associated landfills (Local, Letart, and Dry Run), in private drinking wells and in public water supplies (PWS) located in West Virginia and in Ohio.

A multi-media consent order (Order No. GWR-2001-019; Consent Order) was entered into between the West Virginia Department of Environmental Protection (WVDEP), the West Virginia Department of Health and Human Resources – Bureau for Public Health (WVDHHR-BPH) and DuPont on November 15, 2001. The Consent Order identified a series of requirements and tasks to be performed by the parties (WVDEP, WVDHHR-BPH, and DuPont) in order to determine whether there has been an impact on human health and the environment as a result of releases of C-8, CAS Number 3825-26-1, from DuPont operations at the Washington Works facility and the associated landfills.

The Consent Order established the C-8 Groundwater Investigation Steering Team (GIST) to oversee investigations and activities that were conducted to assess the presence and extent of C-8 in drinking water, groundwater, and surface water at and around the facility and the associated landfills, as described in Attachment A of the Consent Order.

Pursuant to Attachment A of the Consent Order, three tasks were performed by DuPont and evaluated by the GIST, Tasks A, B, and C. Task A: Groundwater Use and Well Survey/Groundwater Monitoring involved evaluating C-8 in groundwater initially within a one-mile radius from the Washington Works facility and the three landfills by sampling water from wells, cisterns, and springs. Included with these sampling activities was the sampling of PWS located one mile upstream and ten miles downstream of the facility. The area of investigation was expanded based on results obtained. Twelve PWS located within a river reach extending 3.5 miles upstream and 53 miles downstream were sampled. Available results were included in the *One-mile Radius Survey and C-8 Sampling Report and the Ohio River Public Water Supply Sampling* (DuPont, 2002a). Task A activities are re-summarized in this report.

Task B: Assessment of Existing Groundwater and Surface Water Monitoring Data included compiling historical C-8 data, monitoring all wells at the landfills, and developing a Groundwater Monitoring Plan (GMP) for the Washington Works facility and the Local, Letart, and Dry Run Landfills. The historical C-8 data compilation report was submitted to the GIST for evaluation (DuPont, 2002b). The second part of Task B, monitoring C-8 in surface water and groundwater at the landfills, began in December 2001. Sampling was performed monthly for four months and is now conducted quarterly. The Proposed GMP for the Washington Works facility (DuPont, 2002c) was submitted to the GIST for review and was approved following minor modifications (DuPont, 2002d).

Groundwater sampling at the Washington Works facility pursuant to the approved GMP began in late January 2002. Task B activities also are re-summarized in this report.

Task C: Plume Identification/Groundwater Assessment at each site began following the completion of Tasks A and B. This activity included delineating the vertical and horizontal extent of C-8 impacted groundwater and specifically included an assessment of C-8 impacted groundwater at the Letart Landfill and its impact on the Ohio River and PWS along the river as required by the Consent Order. The C-8 Plume Identification Groundwater Assessment Work Plan was submitted to the GIST in May 2002 (DuPont, 2002e). For the Washington Works facility, Task C included groundwater modeling using GIST-approved groundwater modeling tools. Groundwater modeling was used to evaluate possible C-8 migration pathways in groundwater from the facility. A separate groundwater modeling report was issued to the GIST in January 2003 (DuPont, 2003a). This report documents Task C activities and re-summarizes briefly the groundwater modeling results.

While conducting the activities identified in Tasks A, B, and C, which were designed to assess the presence and extent of C-8 in drinking water, surface water, and groundwater, an evaluation of transport mechanisms for C-8 migration also was conducted. This evaluation was conducted to gain a better understanding of how C-8 migrates in the environment and to better understand the results generated during the implementation of Tasks A, B, and C.

Two main possible transport mechanisms were considered in evaluating results. These were air transport and water transport. Air transport was considered because DuPont had released, and continues to release, C-8 in air emissions from the facility. C-8 particles in air emission may have been deposited on surfaces of structures (roofs, etc.) and then have been dissolved and transported by precipitation into cisterns. C-8 in air emissions also may have been deposited on ground surfaces and dissolved and transported by precipitation to surface-water bodies or to groundwater. In addition, C-8 was detected at low concentrations in some of the water samples taken from cisterns. If the cistern was filled using a PWS that had been shown to contain C-8, then the source of the C-8 in the cistern may have been the water used to fill the cistern. Alternatively, the source of C-8 in the cistern may have been from air emissions. It also may have originated from both sources.

Water transport, including transport via surface water and groundwater, was considered because C-8 bearing materials were disposed of on-site (i.e., facility and landfills) and C-8 had been detected in surface water and groundwater from various sources at and near the Washington Works facility and the three landfills. Sampling performed under Task A of the Consent Order resulted in detections of C-8 in the Little Hocking Water Association well field, which is the PWS located immediately across the Ohio River from the Washington Works facility. A formal groundwater modeling evaluation was performed to determine if imported groundwater from the facility migrated off-site toward Little Hocking.

The Consent Order also established the C-8 Assessment of Toxicity Team (CATT). The CATT consisted of scientists from academia, government, non-profit organizations, and industry. The CATT was assembled to assess the toxicity and risk to human health and

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the environment associated with exposure to C-8 releases from the DuPont activities. In a final report issued in August 2002, the CATT established the human health protective screening criteria for water (C-8 SL) of 150 ug/l (WVDEP, 2002). The results presented in this report, which were obtained for Tasks A, B, and C, are compared conservatively to the CATT-established C-8 SL of 150 ug/l, regardless of water use. In addition, as reflected in the August 2002 report, the CATT also established a C-8 screening criteria of 240 mg/kg for soils (WVDEP, 2002). However, development of a method for analyzing C-8 in soils has not yet been completed; therefore, no soil samples have been analyzed. The CATT also established an Aquatic Life Advisory Concentration for C-8 (C-8 ALAC) of 1,360 ug/l in October 2002 (Menzie-Cura & Associates, 2002). Surface-water results presented in this report are compared to these screening criteria and to the C-8 SL.

1.1 Document Organization

Section 2 of this document provides information on C-8 reporting and data validation. The remainder of this report discusses specific activities conducted and results obtained at the facility and the Local, Letart and Dry Run Landfills. Section 3 presents the Washington Works facility data. Sections 4, 5, and 6, present data for the Local, Letart, and Dry Run Landfills, respectively. Within each section, a similar format is followed. A brief introduction is presented. The next three subsections then describe activities performed and results obtained for Tasks A, B, and C, respectively. The revised site conceptual model, which integrates the new results, is then discussed. A human health and ecological exposure assessment follows. Finally, observations for each site are summarized. Section 7 of the report provides a reference list, including Consent Order related documents previously submitted to the GIST.

2.0 C-8 ANALYSES AND ANALYTICAL REPORTING

The Quality Assurance Project Plan (QAPP; DuPont, 2002f) discusses the procedures and protocols developed to ensure that project information, data, and decisions derived from or based on data acquired during the groundwater investigation at The facility and associated landfills are technically sound, usable, and properly documented. Specifically, Sections 5, 6, and 10 of the QAPP present sampling protocols, sample and document custody procedures, and internal quality control checks that were followed during the field sampling activities associated with the groundwater well and water-use survey.

The QAPP also presents information on quality assurance, calibration procedures and frequency, analytical procedures, data reduction, verification, and reporting. Information on the analytical method and the precision criteria used for the C-8 reporting are summarized below.

Exygen Research, Inc. (Exygen), located in State College, Pennsylvania, originally developed and tested a new analytical method that utilizes Liquid Chromatography/Tandem Mass Spectrometry (LC/MS/MS). DuPont adopted this method (LC/MS/MS) for analyzing C-8 in water in November 2001. Currently, Exygen performs all C-8 water sample analyses for DuPont using the laboratory Standard Operating Procedure (SOP) it developed.

Exygen reports C-8 results for the laboratory replicate of each field sample. These results are evaluated for precision by comparing the field sample result to the corresponding laboratory replicate result:

- If both results are less than the practical quantitation limit (PQL), the replicate sample for that analyte is considered to have passed the precision criteria.
- If one or both results are between one and five times the PQL, the replicate is considered to have met the precision criteria if the two results differ by less than the PQL.
- If one result is less than the PQL and the other is not and if the two results differed by a value less than the PQL, the replicate is said to have met the acceptance criteria.
- Finally, if both results are at least five times the PQL, the replicate is considered to have met the criteria if the relative percent difference (RPD) between the two results is less than or equal to 20%. The RPD is the absolute value of the difference of two measurements divided by their average.

When the precision criteria outlined above are met, Exygen reports the average of the field sample and the laboratory replicate results are reported. If criteria for precision are exceeded, Exygen reports the higher of the sample and laboratory replicate results. Finally, when one result (from the sample/laboratory replicate pair) is above the PQL and one below, the result that is above the PQL is reported. C-8 results are recorded in the Corporate Environmental Database (CED) and are reported as FC-143 for consistency with historical results.

An aliquot of each field sample also is analyzed as a matrix spike (MS). Results of the MS analysis are used to assess accuracy. The MS recovery value must fall between 70 to 130%, unless the sample concentration is at least four times the amount spiked. The maximum amount used to spike field samples is 500 ug/l.

The QAPP Addendum (QAPP Addendum, DuPont, 2002g) was generated during May 2002 in order to document a reduction in the number of laboratory QC samples (matrix spike and replicate) to a frequency of 5%, or one each per analytical batch (whichever is greater) for groundwater and surface-water samples collected within the facility and landfill boundaries. Specifically, analysis of well, outfall, and stream samples collected at the facility, Local Landfill, Letart Landfill, and Dry Run Landfill were subsequently performed with the reduced QC sample frequency. This reduction in QC sample frequency was made because a substantial database exists for these samples, including at least three rounds of sample analysis at Exygen. There was no reduction in QC sample frequency for samples collected outside the facility and landfill boundaries, such as off-site wells, tap water samples, cisterns, PWS, and Ohio River water samples.

All data packages generated by Exygen have been reviewed in-house for compliance with the laboratory SOP and QAPP Addendum, and for data usability, using the checklist provided in the QAPP. Results of the in-house review indicate that data reported by Exygen have been generated in compliance with the laboratory SOP and QAPP Addendum with few exceptions, as noted in the individual review summaries and discussed below. All data reported by Exygen have been judged usable for the purposes of the project.

Exygen reported that seven of the Ohio two-mile radius samples (including two field blanks) from one data package, and two samples from Local Landfill, collected during November 2002 and reported in another data package, were analyzed beyond the sample hold time of 14 days (as per the SOP). These samples were analyzed within two times the specified hold time. The laboratory also has reported that non-project, field spiked samples at 100 and 1,000 ug/l, have exhibited stability for periods as long as one year (Exygen, 2002). The data packages were examined in-house, using the review protocol included in the QAPP, and the results were determined to be usable for project purposes. All data reported by Exygen have been judged usable for the purposes of the project.

2.1 Independent Quality Assurance Review

A subset of the data packages generated by Exygen were submitted to Environmental Standards, Inc (ESI) in Valley Forge, Pennsylvania, for an independent (i.e., third-party) quality assurance review. Thirty-eight data packages, containing results for 326 samples, including field blanks and duplicates, were submitted for validation. The samples submitted for review represent samples collected from the West Virginia one- and two-mile radius, Ohio one-and two-mile radius, Ohio River sampling, and PWS. The samples submitted for review represent 23.7% of the samples, collected between December 2001 and November 2002, from the West Virginia one- and two-mile radius, Ohio one-and two-mile radius, Ohio River sampling, PWS, and facility and landfill groundwater and surface-water sampling. Data packages/samples submitted for the independent quality assurance review were selected at random; however, off-site residential and PWS samples were preferentially selected because these samples were collected from drinking-water sources. In addition, samples of particular interest to the GIST, such as samples yielding positive analytical results from the Ohio River sampling were submitted for review. The quality assurance review was performed by ESI with guidance from the Region III Modifications to National Functional Guidelines for Organic Data Review [United States Environmental Protection Agency (USEPA), 1994].

Data were examined by ESI to determine the usability of the analytical results and compliance relative to the QAPP, QAPP Addendum, and the laboratory SOP. Results of the quality assurance review indicated that the quality of the data is acceptable and qualification of the data was not warranted, with the exception that positive results for two samples reviewed were qualified J, as estimated, due to precision criteria between the sample and lab replicate not being met. It should be noted that the laboratory, and DuPont, in this case and any similar cases for data not submitted for independent review, reported the higher of the two results.

3.0 WASHINGTON WORKS FACILITY

3.1 Introduction

The facility is located along the Ohio River in Washington, West Virginia, approximately seven miles southwest of Parkersburg, West Virginia (see Figure 3.0). Consent Order required tasks to be conducted at or immediately adjacent to the facility included the following:

- Task A: Groundwater Well and Water-Use Surveying and C-8 Sampling—conduct a distance-phased groundwater well and water-use survey identifying and sampling all groundwater wells, springs, and cisterns within a one-mile (and possibly two- and three- mile) radial distance of the facility and the Local Landfill.
- Task B: Assessment of Existing Groundwater and Surface Water Monitoring Data—develop and implement a monitoring plan that evaluates the presence and extent of C-8 in drinking water, groundwater, and surface water in and around the facility and perform an assessment of C-8 impact to the Ohio River and to PWS within one mile upstream and 10 miles downstream (and possibly two and three miles upstream and 20 and 30 miles downstream) of the facility.
- Task C: Plume Identification/Groundwater Assessment—determine the vertical and horizontal extent of C-8 impacted groundwater exceeding 1 ug/l or as directed by the GIST, using groundwater modeling tools approved by the GIST if modeling is done.

In Sections 3.2 through 3.4, discussions of the specific activities conducted to meet the requirements of the Consent Order are presented along with the new data acquired while conducting these activities. In Section 3.5, the revised site conceptual model updates the current environmental setting (geology, hydrology, hydrogeology, groundwater flow, and water quality) and current human health and ecological exposure pathways for the conditions at and near the site.

3.2 Task A: Groundwater Well and Water-Use Surveying and C-8 Sampling

3.2.1 One-Mile Radius Sampling

The Local Landfill is located immediately south of the facility. Because of the proximity of the Local Landfill to the facility, groundwater wells located within the combined one-mile radius (of both sites) in West Virginia were sampled (see Figure 3.1). The groundwater well and water-use survey and sampling within the one-mile radius of the facility and the Local Landfill were completed on February 12, 2002. DuPont submitted the results of the one-mile radius survey to the GIST in April 2002 (DuPont, 2002a).

Table 3.0 summarizes the off-site survey and sampling program for the one-mile radius. A total of 269 homes were surveyed, and a total of 44 water sources were sampled. Six wells used for drinking water were sampled. No cisterns or springs sampled were used for drinking water. Table 3.1 provides details for each sample collected, including the C-8 concentration measured (ug/l). Figure 3.1 shows the locations of all samples collected, regardless of water use. Each colored circle represents a sampling location and the color and size of the circle indicate the magnitude of the C-8 concentration measured. For example, small black circles represent samples having C-8 concentrations ranging from to 1.0 to 10 ug/l, while large black circles represent samples having C-8 concentrations greater than 10.0 ug/l. Note that the number of C-8 detections above 10 ug/l are limited.

Table 3.1 shows that the C-8 concentrations in six drinking-water samples during the one-mile radius sampling ranged from 0.328 to 2.8 ug/l. Because the drinking-water samples had C-8 concentrations above the 1 ug/l threshold level described by the Consent Order, the GIST ordered the expansion of the radius to two miles and resampling the drinking-water samples within the one-mile radius. The highest C-8 concentration in a non-drinking source was 5.07 ug/l. The highest C-8 concentration in unused water sources was 14.3 ug/l.

C-8 concentrations measured in the six cisterns sampled ranged from 0.561 to 3.52 ug/l (see Table 3.1). These results indicated that air transport of C-8 as a migration pathway was possible if cisterns were filled by precipitation. If water is added to the cistern from another source (groundwater, PWS, etc.) then water transport of C-8 is possible. Survey results from individual residents show that cisterns were filled predominantly by precipitation.

3.2.2 Two-Mile Radius Sampling

The groundwater well and water-use survey and C-8 sampling within the two-mile radius of the facility and the Local Landfill were completed on June 3, 2002. DuPont submitted the results of the two-mile radius survey to the GIST in August 2002 (DuPont, 2002h).

Table 3.2 summarizes the off-site survey and sampling program for the two-mile radius. Within the two-mile radius a total of 109 homes were surveyed, and 65 water sources were sampled. Seventeen wells and one spring used for drinking water were sampled. None of the eight cisterns sampled was used as a drinking-water source. Table 3.3 provides details for each sample collected, including the C-8 concentration measured (ug/l). Figure 3.1 includes the C-8 results for the two-mile radius. All samples are posted regardless of water use. Of the 18 drinking-water samples, only one (a spring sample) had a C-8 concentration greater than 1.0 ug/l. The C-8 concentration in the spring sample was 1.8 ug/l. All drinking-water samples from wells had C-8 concentrations less than 1.0 ug/l. The highest C-8 concentration measured in non-drinking-water and unused water sources were 1.67 and 2.32 ug/l, respectively. C-8 concentration measured in the wells from the one-mile radius that were resampled ranged from 0.526 to 2.48 ug/l (see Table 3.1).

Again C-8 concentrations measured in the eight cisterns indicated air transport as a possible C-8 migration pathway from the facility because the cisterns were predominantly filled via precipitation.

The results for the two-mile radius showed a trend toward lower concentrations than were found in the one-mile radius sampling area. While the two-mile radius was being conducted, the CATT released the human health protective screening criteria for water (C-8 SL) of 150 ug/l (WVDEP, 2002). In August 2002, the GIST determined that no further off-site surveying or resampling around the facility and the Local Landfill was needed.

3.2.3 Ohio One-Mile Sampling

Off-site surveying and sampling also was conducted in Ohio. C-8 was initially measured in the Little Hocking Water Association well field (a PWS sampling point), located in Ohio directly across the Ohio River from the facility in December 2001 (see Section 3.3.3). DuPont and the Ohio Environmental Protection Agency (OEPA) agreed that the groundwater well and water-use survey would be expanded to a distance one mile from the facility boundary into Ohio. The groundwater well and water-use survey and C-8 sampling within the one-mile radius in Ohio were completed on June 7, 2002. DuPont submitted the results of the one-mile radius survey to the OEPA and the GIST in August, 2002 (DuPont, 2002i).

Table 3.4 summarizes the one-mile radius survey and sampling in Ohio. The total number of homes surveyed was 150, and the total number of water sources sampled was 68. Of the 68 water sources sampled, 17 were from drinking-water wells, and one was from a drinking-water spring. No cisterns sampled were used for drinking water. Table 3.5 provides details on the samples collected, including the measured C-8 concentration. The C-8 concentration measured for the drinking-water wells ranged from non-detectable [<0.01 ug/l (ND)] to 8.59. The C-8 concentration for a drinking-water spring was 1.29 ug/l. The highest C-8 concentration measured in non-drinking-water sources and unused sources was 23.6 and 16.9 ug/l, respectively. Figure 3.2 is a map showing the location of samples, regardless of water use, collected within the Ohio one-mile radius. This figure uses the same symbols as were used in Figure 3.1. Locations of samples having C-8 concentrations greater than 10.0 ug/l appeared to be clustered to the northeast and northwest. C-8 concentrations measured in the five cisterns ranged from 0.748 to 7.33 ug/l. These results indicated that air transport of C-8 was a possible migration pathway from the facility, providing the cisterns were filled by precipitation. Even though the highest C-8 concentration measured for a drinking-water sample within the one-mile radius was an order of magnitude lower that the CATT established C-8 SL of 150 ug/l, nine non-drinking-water and unused water source samples had C-8 concentrations above 10.0 ug/l. Based on these results, OEPA requested an expansion of the survey area to a two-mile radius.

3.2.4 Ohio Two Mile Sampling

The groundwater well and water-use survey and C-8 sampling within the two-mile radius of the facility were completed on September 30, 2002. DuPont submitted the results of

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the two-mile radius survey to the OEPA and the GIST in December, 2002 (DuPont, 2002j).

For the Ohio two-mile radius, the sampling strategy was modified following discussions with the OEPA and the GIST. The two-mile radius survey area was divided into three areas, "A", "B", and "C"(see Figure 3.2). All homes within the entire area within the two-mile radius, areas "A", "B", and "C", were surveyed. In area "B" all identified wells, springs, and cisterns were sampled, regardless of use (drinking water, non-drinking water, or unused) because this portion of the two-mile radius was adjacent to an area within the one-mile radius where the highest C-8 concentrations were measured. In addition, all identified drinking water, non-drinking water, and unused wells, springs, and cisterns from residences located along Township Road 97 (located within area "C") were sampled. In area "A" and "C", wells, springs, and cisterns were sampled only if these sources were used for drinking-water; non-drinking-water and unused sources were not sampled. Areas "A" and "C" are adjacent to areas in the one-mile radius where lower C-8 concentrations were measured.

Table 3.6 provides a summary of the Ohio two-mile survey results. In total, 733 homes were surveyed, and 62 water sources were sampled, including 49 wells used for drinking water. No cisterns or springs sampled were used as drinking-water sources. Figure 3.2 also shows the location of samples, regardless of water use, collected within the Ohio two-mile radius. Table 3.7 provides details of the samples collected, including the measured C-8 concentrations. The C-8 concentrations measured in drinking-water samples ranged from ND to 6.5 ug/l, with only 11 samples having C-8 concentration greater 1.0 ug/l. The highest C-8 concentration measured for the non-drinking-water samples ranged was 6.85 ug/l. The highest C-8 concentration measured in an unused source was 8.68 ug/l. The range of C-8 concentration in the three cistern samples was from 0.217 to 0.592 ug/l. Overall, the C-8 concentrations are lower in the two-mile radius samples than in the one-mile radius.

While the groundwater well and water-use survey and C-8 sampling were being conducted in the one- and two-mile radius in Ohio, groundwater modeling also was being conducted. One of the objectives of the groundwater modeling effort was to determine the likelihood that off-site migration of C-8 impacted groundwater was occurring. The groundwater modeling showed that no potential groundwater migration pathway exists beneath the Ohio River (DuPont, 2003a). Therefore, air transport of C-8 is the most likely migration pathway for C-8 from the facility.

3.3 Task B: Assessment of Existing Groundwater and Surface-water Monitoring Data

3.3.1 Monitoring of C-8 in Groundwater and Surface Water

Groundwater Monitoring

The Consent Order required that a select number of facility monitoring wells were to be sampled following the development of a groundwater monitoring plan by DuPont (DuPont, 2002c) and its approval by the GIST (DuPont, 2002d). Frequency of sampling

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was to be monthly for the first four months following the effective date of the Consent Order, then quarterly thereafter. Monthly sampling of groundwater began in January 2002. Quarterly sampling began in May 2002 (2Q02). The 4Q02 monitoring report was submitted to the GIST in December 2002 (DuPont, 2002k).

Table 3.8 provides a list of the production and monitoring wells included in the groundwater monitoring program for the facility. Well construction data and groundwater elevation data also are provided in this table. The three new bedrock monitoring wells (AJ06-MW02, N04-MW03, and Y14-MW02) that were installed in 3Q02 as part of the C-8 plume delineation work plan were added to the monitoring program in 4Q02. Figure 3.3 shows the location the wells listed in Table 3.8. Table 3.9 presents all of the C-8 concentrations measured in these production and monitoring wells through October 2002, including C-8 data acquired prior to the issuing of the Consent Order. The most recent data are listed first for each well. Figure 3.4 shows the October 2002 C-8 concentrations in groundwater.

Table 3.9 shows that, in general, monitoring and production wells located on the eastern half of the facility have shown a C-8 concentration range from 0.071 to 2.82 ug/l (AE11-MW01, AM07-PW01, AO08-PW01, and AX13-PW01). Monitoring and production wells in the western half of the site generally have shown a C-8 concentration range of 0.117 to51.2 ug/l (V05-PW01, L04-PW01, N13-MW01, Y14-MW01, K16-PW01, West Well Field 1, E13-MW01, and D08-MW01). Monitoring wells located adjacent to the Ohio River near the former Anaerobic Digestion Ponds have higher C-8 concentrations, ranging from less than 100 to 84,100 ug/l (P08-MW01, P04-MW02, Q04-MW02, and R04-MW02). However, evaluation of boring logs for these well shows that three of these wells are screened in a perched water-table located in the clays and silts that stratigraphically overly the sands and gravels of the primary site water-table aquifer (site aquifer). Q04-MW02 is the only well included in the groundwater monitoring program located in the former Anaerobic Digestion Ponds area that is screened in the site aquifer. Recent C-8 concentrations measured for this well have been highly variable, ranging from 32.2 to 7,720 ug/l. (Further discussion of the wells screened in the perched water-table are presented in Section 3.5.1.)

Available data for the bedrock aquifer are very limited (only three wells) but ranges from non-quantifiable [<0.05 ug/l (NQ)] in the central southern boundary (Y14-MW02) to 0.133 ug/l along in the eastern portion (AJ06-MW02) of the site to 21.2 ug/l in the area near the former Anaerobic Digestion Ponds (N04-MW03).

The next groundwater sampling event for the facility is scheduled for the first quarter 2003.

Surface-water Monitoring

The Consent Order also identified six outfalls[1] at the facility that are regulated by West Virginia/National Pollutant Discharge Elimination System (WV/NPDES) Permit No. WV0001279 and where monthly sampling of C-8 was required. Figure 3.3 shows the locations of the six outfalls. Monthly sampling of outfalls began in December 2001. The

[1] In this report, all surface-water samples identified as outlets, inlets, or outfalls will be referred to collectively as outfalls.

November 2002 Surface Water Monitoring Report was submitted to the GIST in January 2003 (DuPont, 2003b). Table 3.10 summarizes the C-8 concentrations measured in the outfalls, including C-8 data acquired prior to the issuing of the Consent Order. The most recent data are listed first for each outfall.

The six outfalls sampled discharge process water and stormwater runoff to the Ohio River. The WVDEP permit required monthly reporting of effluent flow volumes and C-8 concentrations. Outfalls 002, 003, and 007 typically discharge effluent containing the lowest concentrations of C-8, ranging from NQ to 8.56, respectively. Outfalls 001 and 105 have discharged higher C-8 concentrations, ranging from 2.15 to 54.6 ug/l. Outfall 005 has shown the highest concentrations of C-8 and discharges the largest volume of effluent compared to the other outfalls at the facility. C-8 concentrations for Outfall 005 have ranged from 1.43 to 199 ug/l, with one anomalous high concentration of 915 ug/l. However, the C-8 concentration at Outfall 005 has generally decreased in 2001 and 2002 following the installation of a carbon filtration treatment system in the flouropolymers process.

Outfall sampling for December 2002 has been completed, and the monitoring report will be issued to the GIST in February 2003. Outfall sampling for January 2003 has been completed, but the C-8 results have not yet been validated. The next monthly outfall sampling event is scheduled for February 2003.

3.3.2 Ohio River Water Quality

Characterizing Ohio River water quality, with respect to C-8, was a Consent Order requirement. In addition, the evaluation river-water quality was identified as a data gap in the Compilation of Historical C-8 report (DuPont, 2002b) and was included as a recommended activity in the C-8 Plume Identification Work Plan (DuPont, 2002e). The Ohio River Water Sampling Proposal for the facility and the Letart Landfill (DuPont, 2002l) was developed and submitted to the GIST in January 2002.

Near the facility, Ohio River water was sampled to measure concentrations of C-8 in the Ohio River. The sampling investigation was designed to meet three main objectives:

- Characterize background C-8 concentrations in river-water upstream of the facility.
- Assess C-8 concentrations in river water along the facility reach.
- Evaluate C-8 concentrations in river water downstream.

Table 3.11 presents a summary of the Ohio River water sampling program, including sampling near the Letart Landfill. The Letart Landfill samples and C-8 results are discussed in Section 5.4.5. Table 3.12 provides the C-8 results for Outfall 005. Figure 3.5 shows the location of upstream samples and samples along the facility reach. Figure 3.6 shows the concentration of downstream samples. C-8 concentrations for each sample are posted.

In total, 46 river-water samples were collected, including two duplicate samples. Adjacent to the facility, river-water samples were collected at three locations along two transects across the river. Samples were collected at three depths (dip, mid-column, and bottom) at each location. Field parameters were monitored during collection of each sample. During the same time period that river water was sampled, effluent from Outfall 005 was sampled to evaluate dispersion downstream of the outfall.

Of the seven samples collected upstream of the facility, six were ND, and one was NQ. Of the 27 samples collected along the facility reach, all were ND except for two that were NQ. The range of C-8 concentration for the 12 downstream samples was 0.0949 to 1.09 ug/l. The two highest C-8 concentrations were measured in a dip and mid-column sample collected approximately three miles downstream from the facility.

It is likely that the two highest C-8 concentrations measured in the Ohio River water are a direct result of increased C-8 concentrations discharged through Outfall 005. Table 3.12 shows that the C-8 concentrations measured at Outfall 005 are highly variable. C-8 data were not collected from Outfall 005 between July 1 and July 10; but, if C-8 concentration was higher on these days, it might explain why the higher concentrations were measured in the river during this same time frame.

The revised groundwater model showed that no potential migration pathway for C-8 containing groundwater exists beneath the Ohio River. Therefore, air transport of C-8 to the Ohio River is a likely migration pathway, in addition to the direct discharge of C-8 containing surface water to the Ohio River through the permitted outfalls.

3.3.3 Public Water Supply Sampling

PWS in West Virginia and Ohio at various points upstream of the facility were sampled pursuant to the Consent Order. Sampling of PWS within one-mile upstream and 10-miles downstream began in December 2001. Based on the C-8 concentrations measured, the distance upstream and downstream was expanded. Sixteen PWS located as far as three miles upstream and 53 miles downstream were ultimately included in the sampling events (see Figure 3.7). Based on the very low C-8 concentrations measured at the various PWS, the number of PWS required to be sampled and the frequency of sampling were reduced by the GIST in May 2002. Table 3.13 presents all the C-8 concentrations measured in the various PWS. For PWS sampled more than once, the sampling event results are listed in chronological order.

Currently, only three PWS, Lubeck (West Virginia), Tuppers Plains (Ohio), and Little Hocking (Ohio) are sampled on a quarterly basis (DuPont, 2002m). C-8 concentrations measured at Lubeck ranged from 0.283 to 1.21 ug/l, while C-8 concentrations measured at Tuppers Plains ranged from ND to 0.726 ug/l (see Table 3.13).

Little Hocking had the highest C-8 concentrations of all the PWS sampled. C-8 concentrations in production wells have ranged from 0.42 to 8.58 ug/l. C-8 concentrations in drinking water dispersed to customers from these wells at the PWS have ranged from 1.69 to 4.29 ug/l. TW-4, a test well, had the highest measured C-8 concentration at 37.1 ug/l. The concentrations measured at TW-4 have been steadily decreasing; the most recent result for this well was 14.5 ug/l. Based on these results, OEPA requested that an investigation be conducted to evaluate the C-8 concentrations at TW-4 and vicinity, and DuPont agreed to conduct the investigation. DuPont has sampled groundwater and soil samples from borings and collected groundwater samples from all the test and production wells at Little Hocking. Groundwater results have been presented to the OEPA. The method development for analyzing C-8 in soils is still in progress; therefore, none of the soil samples has been analyzed yet. As a result, no final conclusions have yet been drawn from this investigation. However, a report documenting the sampling investigation and the C-8 results for groundwater and soil will be submitted to the OEPA and the GIST when the analytical results have been finalized.

The next PWS sampling event at Little Hocking, Lubeck and Tuppers Plains is scheduled for the first quarter 2003.

3.4 Task C: Plume Identification/Groundwater Assessment

Based on the data gaps identified in the Compilation of Historical C-8 Data report (DuPont, 2002b), the C-8 Plume Identification/Groundwater Assessment Work Plan was developed and submitted to the GIST (DuPont, 2002e). Included in this work plan were specific activities recommended to fill the data gaps. In the following sections, each of the activities recommended in the C-8 plume delineation work plan is summarized briefly. Details of the activity status and the data acquired are then presented.

3.4.1 Installation of New Wells at the Washington Works Facility

Three new bedrock monitoring wells were installed at the facility. These wells were installed to further delineate C-8 concentrations in groundwater, to evaluate groundwater flow direction and to determine the vertical groundwater gradients between the bedrock and the overlying sand and gravel.

Figure 3.3 shows the location of monitoring and production wells, and the locations of the newly installed bedrock wells. Well construction diagrams for the new wells, AJ06-MW02, NO4-MW03 and Y14-MW02, are provided in Appendix A.

Geologic data obtained during the installation of these three wells confirmed the depth to bedrock underlying the facility where these wells are located. These new data also permitted refinement of existing cross-sections that were developed for the facility. These revised cross-sections are discussed in detail in Section 3.5.1.1.

3.4.2 Hydrogeologic Testing of New Wells at the Washington Works Facility

Hydrogeologic testing of the three new bedrock wells was recommended to evaluate aquifer characteristics of the underlying bedrock aquifer in the C-8 Plume Delineation work plan. The bedrock monitoring wells were clustered with or located near existing wells screened in the primary site water-table aquifer. This allowed for the evaluation of the vertical gradients between the primary site water-table aquifer and the underlying bedrock aquifer. Only one round of water levels was measured for these wells (October 2002) and other wells nearby.

The groundwater elevations indicate that at Q04-MW02 and surrounding sand and gravel aquifer wells, there is most likely an upward gradient between the groundwater in the bedrock and groundwater in the overlying sand and gravel near the former Anaerobic Digestion Ponds area.

At well cluster Y14-MW01 and Y14-MW02, located near the southern property boundary of the site, the groundwater gradient appears to be downward from the sand and gravel to the underlying bedrock. The water level measured in AJ06-MW02 in October 2002 is higher than in wells located nearby that were measured in February 2002, indicating a likely upward groundwater gradient from the bedrock to the overlying sands and gravel, in this area.

3.4.3 Washington Works Groundwater Model Refinement

A groundwater model was developed for the facility as part of the RFI report for Washington Works (DuPont, 1999). This model was revised during this investigation partially to address the comments generated by the United States Environmental Protection Agency and the United States Army Corp of Engineers (USACOE). The Consent Order also required refinement of the groundwater model for the facility to re-evaluate the extent of groundwater captured by the pumping wells at the site and to determine the likelihood that off-site migration of C-8 impacted groundwater is occurring.

To meet these requirements, refinement of the groundwater modeling work was completed with input, guidance, and critical review from the United States Geological Survey, the USACOE, the West Virginia Department of Health and Human Resources, and GIST members during the model development, calibration, and finalization process. The report of final findings for the revised groundwater model for the facility and the surrounding area was submitted to the GIST in January 2003 (DuPont, 2003a). The revised groundwater model supports DuPont's previous conclusions that no off-site migration of groundwater is known to be occurring and that no potential groundwater migration pathway exists beneath the Ohio River.

3.4.4 Surface-water Field Reconnaissance at the Washington Works Facility

Conducting field reconnaissance to identify additional surface-water features located on-site and sampling surface water from new locations identified during this effort was a C-8 plume delineation recommended activity. Field reconnaissance was performed and no new surface-water features were identified beyond those locations that are currently sampled.

3.4.5 C-8 Monitoring in Groundwater and Surface Water at the Washington Works Facility

Continuing to monitor C-8 in groundwater, in both the unconfined alluvial aquifer and underlying bedrock aquifer (utilizing the newly installed bedrock wells), and in surface water at existing locations identified in the Consent Order was an activity recommended in the C-8 plume delineation work plan. The results of continued monitoring of groundwater and surface water are presented in Section 3.3.1.

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3.4.6 Washington Works Facility Site Conceptual Model Refinement

The final recommended activity for the facility is the integration of all the new data gathered during completion of Tasks A, B, and C into a revised site conceptual model (SCM). This activity was completed and the revised SCM is presented in the following section.

3.5 Revised Site Conceptual Model

The revised SCM ideally represents the current environmental setting (geology, hydrology, hydrogeology, groundwater flow, and water quality) and current human health and ecological exposure pathways at and surrounding the site. The following sections present the revised SCM in detail.

3.5.1 Current Environmental Setting

Geology

The facility rests on Quaternary alluvial terrace deposits in the Ohio River Valley. Figure 3.8, modified from Simard (1989), is a model block diagram showing the complex set of terraces and floodplains that formed in the Ohio Valley because of the glacial advances and retreats of the pre-, early- and late-Wisconsinan and the resulting successive phases of alluvial fills and the incisions into the alluvial fill by the Ohio River. Simard (1989) identified five facies of the Ohio River Valley: sand and gravel (coarse-grained Ohio River alluvium or outwash); tributary sand and gravel; colluvium; silt and clay (fine-grained Ohio River alluvium or overbank sediments); and sand and silt (eolian).

A generalized north-south cross-section from the Little Hocking Water Association well field in Ohio, through the Ohio River and across the facility, is presented in Figure 3.9. This cross-section shows the Holocene silt and clay overbank deposits that overlie the Pleistocene sand and gravel outwash deposits and the finer reworked Pleistocene alluvium, thought to underlie the river. The alluvial terrace deposits are underlain by a flat, river-scoured bedrock surface of the Dunkard Series that rises steeply and forms the valley walls to the North of Little Hocking Water Association and to the south of the facility. Figure 3.0 shows the relatively flat topography of the alluvial terrace deposits and the steep topography of the valley walls to the north and south.

The detailed geology underlying the facility is shown on seven geologic cross-sections. Six of these cross-sections were developed during the Verification Investigation (DuPont, 1992) and revised in early 2002 for the Compilation of Historical Data Report (DuPont, 2002b) based on additional findings from the RFI. Further refinement of these six cross-sections, based on the installation of three bedrock wells, and the generation of a generalized cross-section near the former Anaerobic Digestion Ponds were completed as part of the C-8 Plume Delineation Work Plan activities. Some of the test wells and monitoring wells portrayed in the cross-sections were temporary and no longer exist. Table 3.14 provides well construction information and groundwater elevation measurements for wells currently in existence at the facility. Figure 3.3 shows the locations of monitoring wells that currently exist at the site. The locations of the geologic cross-sections A-A' through F-F' are shown in Figure 3.10. The location of G-G' is shown on Figure 3.17.

Two east-west cross-sections, A-A' and F-F', are shown in Figures 3.11 and 3.16. Four north-south cross-sections, B-B', C-C', D-D', and E-E' are shown in Figures 3.12, 3.13, 3.14 and 3.15, respectively. Cross-section G-G', Figure 3.17, shows an expanded view of the riverbank area near the former Anaerobic Digestion Ponds and the Riverbank Landfill. Note that wells R04-MW02 and P04-MW02 are screened in a perched groundwater zone within the Holocene overbank deposits.

The main and oldest Quaternary alluvial terrace at the facility is topographically flat and lies approximately 50 feet above the Ohio River while the remains of younger terraces exist at lower elevations along the riverbank. The Holocene overbank deposits consist of silt, sandy silt, clay, silty clay, and clayey silt. The overbank deposits are approximately 35 feet thick near the riverbank and decrease in thickness away from the riverbank. Under the central portion of the facility, these overbank deposits range from approximately 5 to 15 feet thick. The overbank deposits are absent in the western portion of the site. The Quaternary alluvium (sand and gravel outwash deposits) ranges from 30 feet thick (near the river) up to 90 feet thick (under the central portion of the facility). The alluvium consists of coarsening downward unconsolidated poorly to well-sorted, brown and gray sand, silts, clay, and gravel. The Dunkard Series bedrock consists primarily of red and varicolored sandy shale; gray, green and brown sandstone; gray and light gray siltstone; and minor beds of coal, claystone, black carbonaceous shale, and limestone.

Hydrology, Hydrogeology and Groundwater Flow

Hydrology

Surface water at the facility discharges through drains and storm sewers (outfalls) and drainage swales. Six outfalls (001, 002, 003, 005, 007, and 105) collect facility process water and stormwater runoff and discharge it to the Ohio River. These six outfalls are regulated by WV/NPDES Permit No. WV0001279. The locations of these outfalls are shown in Figure 3.3. Two drainage swales, one located in the facility's southwest corner, and the other located on the extreme eastern end of the facility, convey surface runoff during rainy weather to the Ohio River. During dry weather, the drainage swales are dry.

The main groundwater seep area at the Riverbank Landfill was identified, RBLL1 and sampled during the VI (DuPont, 1992). This seep likely originates from precipitation that has infiltrated topsoil or fill and flows along the top of the underlying shallow clay and ultimately discharges along the riverbank (see Figure 3.3). An active French-drain groundwater collection system has been in operation at the Riverbank Landfill since 1991. The RFI verified that the collection system effectively captures water at the seep area (DuPont, 1999). Surface water from the seep is treated by a carbon filtration unit. This treated water discharges through Outfall 005 to the Ohio River.

A second seep at the Riverbank Landfill (RBLL2) is located upriver from RBLL1 (see Figure 3.3). Seep water also is captured at this location by way of an active French-drain collection system. Seepwater is contained in an underground collection vessel that is pumped out periodically, and the seep water is treated at the wastewater treatment facility on-site.

Hydrogeology

Regional groundwater supplies are obtained from the Dunkard Group bedrock and Ohio River alluvial terrace deposits. The saturated portion of the Ohio River alluvial terrace deposits comprise the principal regional aquifer used for water supply purposes. Production wells completed in this aquifer have been known to yield up to 500 gallons per minute (gpm) (Schultz, 1984). Based on these high yields, numerous industrial and commercial water supply companies obtain water from the alluvial aquifer. The yield from alluvial aquifer wells is related to the well's position with respect to the river, as well as formation grain size and thickness.

The Holocene silts and clays underlying the facility contain perched groundwater zones. Along the riverbank, in the vicinity of the former Anaerobic Digestion Ponds, are seven monitoring wells that are completed in this perched groundwater zone (see Table 3.14). Groundwater elevations for these monitoring wells are typically 6 to 18 feet higher than elevations measured in monitoring wells completed in the underlying primary site water-table aquifer. During the February 2002 synoptic water level event, groundwater elevations in the perched water table ranged from 571.91 feet above mean sea level (MSL) to 583.46 feet MSL. Groundwater elevations in the underlying primary site water-table aquifer ranged from 552.15 to 566.62 feet MSL. Figure 3.17 shows a generalized cross-section for the area of the former Anaerobic Digestion Ponds showing the relationship between the Ohio River (normal pool elevation of 582.0 feet MSL), the perched water table, and the underlying primary site water-table aquifer.

The primary site water-table aquifer occurs at a depth of about 60 to 70 feet bgs in the facility area. The saturated zone is approximately 30 to 40 feet thick, extending to the surface of the underlying Dunkard Group bedrock. The on-site production water wells completed in the site aquifer yield 200 to 450 gpm. The underlying Dunkard Group is not a major aquifer. The upper zone of the Dunkard Group (Washington Formation), which consists primarily of shale and siltstone, bounds the lower extent of the site aquifer.

Natural recharge to the alluvial aquifer comes from various sources, including:

- Infiltration of precipitation falling directly on the alluvium
- Lateral movement of the river water through the alluvium via permeable sand and gravel zones
- Seepage from stream tributaries that discharge to the Ohio River

The maximum amount of water available to the alluvium depends on the degree of hydraulic connection to the river. The degree of hydraulic connection is a function of the permeability and thickness of the riverbed, permeability and thickness of the alluvium, and hydraulic gradient between the groundwater and the river. Pumping of on-site active well fields near and parallel to the river (i.e., the Ranney Well, the DuPont-Lubeck Well Field, and the East Well Field shown in Figure 3.3) lowers the groundwater level in the alluvial aquifer to below river stage. This induces water from the river to flow into the alluvium toward the wells, which replaces water pumped from storage in the aquifer, and helps sustain high-yield pumping wells.

In a 1990 hydrogeologic assessment, production well specific capacity testing of the DuPont-Lubeck Well Field and the East Well Field was conducted. The results were used to calculate the transmissivity and the hydraulic conductivity of the primary site aquifer (DuPont, 1990). In the vicinity of the DuPont-Lubeck Well Field, transmissivity values ranged between 114,900 and 127,500 gallons per day per square foot (gpd/ft^2). In the vicinity of the East Well Field, the transmissivity values ranged between 16,050 and 50,000 gpd/ft^2. Hydraulic conductivity values were calculated from the transmissivity values for the East Well Field. For wells AX13-PW01 and AZ13-PW01, the hydraulic conductivity values ranged from 0.013 to 0.055 centimeters/second (cm/sec) and from 0.01 to 0.049 cm/sec, respectively.

Using the hydraulic conductivity values from the 1990 study and the hydraulic gradient values determined from groundwater elevations measured in 1990 and assuming an effective porosity value for sand and gravel of 35 %, the groundwater flow velocity for several well pairs was calculated. The groundwater flow velocity was estimated at 5 feet/day (ft/d) between monitoring wells T13-MW01 and L18-MW01 in the southwest portion of the site. A groundwater flow velocity of 3 ft/d was estimated between monitoring wells P06-MW01 and K14-MW01 in the western central portion of the site. In the eastern portion of the site, a groundwater flow velocity of 2.5 ft/d was estimated for the site aquifer between monitoring wells AL10-MW01 and AO09-MW01.

Groundwater Flow

As part of the C-8 plume delineation work plan, a thorough evaluation of well survey data and well construction data was completed. This evaluation determined that incorrect measuring point elevations were used in calculating groundwater elevations that had been included in the monthly and quarterly monitoring reports. Since this discovery, all groundwater elevation calculations have been redone and corrected values were included in the 4Q02 C-8 monitoring report. In addition, the groundwater elevation map for February 2002, the most recent groundwater measuring event where almost all site wells were included, has been revised using the corrected groundwater elevations and is shown in Figure 3.18. Overall, the revised map did not alter groundwater flow directions on-site.

Figure 3.18 shows groundwater elevations and flow directions. It also shows flow rates on-site are strongly influenced by the Ohio River and by pumping of on-site production wells. Normal pool elevation for the Ohio River is 582.0 feet MSL, higher than the elevation of the primary site aquifer, indicating a gradient from the river to the primary site aquifer. The on-site production wells include the Ranney Well, a radial collector well which pumps 800 to 1,000 gpm; the seven wells in the East Well Field, which pump a combined average rate of 2,000 gpm; and the five DuPont-Lubeck wells, which pump about 700 gpm combined. A groundwater divide exists in the central part of the site with groundwater flowing to the east toward the East Well Field on the eastern side of the divide and to the west on the western side of the divide. Groundwater on the western side of the divide ultimately flows either back to the north toward the Ranney Well, or to the southwest toward the DuPont-Lubeck Well Field. From the northwestern corner of the site, groundwater flows southeast toward the DuPont-Lubeck Well Field. The revised groundwater model supports the interpreted groundwater flow direction generated using groundwater elevations measured in the monitoring wells (DuPont, 2003a).

As discussed in Section 3.4.2, the vertical gradient between groundwater in the sand and gravel and in the underlying bedrock has not been verified, although preliminary evaluation of available data indicates a predominantly upward gradient especially near the river that potentially may be reversed near the groundwater mound/divide located under the central and eastern portion of the facility (see Figure 3.18). The revised groundwater model supports an upward groundwater gradient between the bedrock and the overlying sand and gravel (DuPont, 2003a). Further data are needed to complete this evaluation and will be collected during future quarterly groundwater monitoring events.

Water Quality

Groundwater Quality

The available C-8 concentration data for groundwater at the site was presented in Section 3.3.1. These data show that concentrations of C-8 in the groundwater are variable with the highest concentrations being measured in wells screened in the perched water-table located near the former Anaerobic Digestion Ponds. Historic C-8 concentrations in these wells range from less than 100 to 84,100 ug/l. Groundwater from wells screened in the primary site water-table aquifer has much lower C-8 concentrations than those screened in the perched water table. In addition, C-8 concentrations are variable depending on location of the monitoring well with respect to the locations of the pumping wells. Historic C-8 concentrations in wells located in the eastern half of the facility range from 0.071 to 2.82 ug/l. Historic C-8 concentration data for wells located in the western portion of the site are higher, ranging from 0.117 to 51.2 ug/l. Available data for the bedrock aquifer are very limited but range from 0.133 ug/l in the eastern portion of the site, to NQ along the central southern boundary, to 21.2 ug/l in the area near the former Anaerobic Digestion Ponds.

The C-8 concentrations in groundwater from the monitoring wells screened in the perched water-table is not considered to be representative of the primary site water-table aquifer. Based on measured water elevations in the wells, the perched groundwater in the fine-grained silts and clays of the Holocene overbank deposits is most likely migrating downward into the underlying site aquifer. The rate of migration of groundwater from the perched water table to the underlying site aquifer is likely to be very slow because of the fine-grained sediments present in this area. Therefore, the contribution of the C-8 from the perched groundwater to the overall site groundwater quality is likely to be minimal. In addition, the groundwater at the site is currently captured by the facility production wells. Groundwater elevations at the site show that the site aquifer is recharged from the Ohio River and that groundwater at the site does not discharge from the site aquifer to the river.

C-8 concentrations in groundwater pumped at the site and used for potable or industrial purposes are significantly below the C-8 SL of 150 ug/l established by the CATT (WVDEP, 2002). For example, production well AM07-PW01 (historically known as well 336) supplies potable water to the facility. C-8 concentrations in groundwater from AM07-PW01 have ranged from 0.071 (J) to 1.9 (L) ug/l.

Surface-water Quality

The available C-8 concentration data for surface water at the site was presented in Section 3.3.1. The six outfalls monitored at the facility all discharge process water and stormwater runoff to the Ohio River. Outfalls 003 and 007 discharge effluent with the lowest concentrations of C-8, ranging from NQ to 8.56 ug/l. Outfalls 002, 001, and 105 discharge higher concentrations ranging from 0.118 to 54.6 ug/l. Historically, Outfall 005 has shown the highest concentrations of C-8 and has discharged a larger volume of effluent compared to the other outfalls at the facility with concentrations ranging from 1.43 to 915 ug/l. Note that the 915 ug/l measurement is unusually high compared to the other values measured at this outfall and likely was a sample collected when the system was temporarily off-line. Excluding this anomalous measurement, the C-8 concentration range is from 1.43 to 199 ug/l. The C-8 concentration at Outfall 005 has decreased in 2001 and 2002 following the installation of a carbon filtration treatment system in the flouropolymers process. Comparing the highest measured C-8 concentration in effluent from the outfalls, 915 ug/l, to the CATT-established the Aquatic Life Advisory Concentration for C-8 (C-8 ALAC) of 1,360 ug/l shows that all values are lower than the criteria (Menzie-Cura & Associates, 2002).

3.5.2 Current Human Health and Ecological Exposure Pathways

The main objective of the Consent Order was to determine whether there has been an impact on human health and the environment as a result of releases of C-8 to the environment from DuPont operations at the facility and the associated landfills (Local, Letart, and Dry Run). Therefore, human health and ecological exposure pathways both on-site (at the facility) and off-site (adjacent to the facility and the Local Landfill) were considered. The human health and ecological exposure pathway sections below describe the potential exposure routes for human and ecological receptors on- and off-site the facility/Local Landfill. Potential exposure routes were evaluated and classified as complete or incomplete. Table 3.15 summarizes the on-site and off-site human health and ecological exposure pathways evaluation for the facility. To be conservative, for each complete exposure pathways, the maximum C-8 concentration measured in the C-8 impacted aqueous media is compared to the C-8 SL, regardless of media type.

On-Site Human Health and Ecological Exposure Pathways

On-site human receptors include authorized facility workers and facility visitors. Ecological receptors include animals living within the facility boundaries.

Direct exposure to C-8 bearing materials contained within the Solid Waste Management Units (SWMUs) is limited or non-existent because these materials have been removed and regraded or paved (Riverbank Landfill, Burning Ground, Waste Incinerators, and Digestion Ponds) or covered and vegetated. In addition, institutional controls (such as fencing) and excavation permits also limit exposure. Therefore, human and ecological receptor contact with these materials is considered to be an incomplete exposure pathway.

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A large portion of the facility is covered with asphalt and concrete. Surface-water contact with C-8 impacted soils or groundwater is not likely in these areas. Therefore, surface water contacting C-8 impacted soils is an incomplete exposure pathway. Much of the precipitation falling on-site is routed toward drains and storm sewers, which ultimately discharge into the Ohio River. Precipitation falling on the riverbank slope either infiltrates into the soil or runs off to the river. The seeps that occur in places along the riverbank are likely caused by infiltration of precipitation that accumulates above or in the low-permeability Holocene silt and clay overbank deposits that underlie topsoil and fill along the riverbank. Human receptor contact with impacted seep water is an incomplete exposure pathway due to the active French-drain groundwater collection system. Direct exposure to effluent discharging through the outfalls is an incomplete pathway because there are engineering and institutional controls (such as fencing) in place.

Direct exposure to groundwater impacted by C-8 is also an incomplete pathway at the facility because groundwater is located at about 30 to 38 feet below ground surface (bgs) near the river bank and at 60 to 80 feet bgs under the central portion of the site. The only potential contact route for groundwater is via contact with water pumped from production wells. Water pumped from production wells is used for two purposes: supplying drinking water and providing industrial process water.

Well AM07-PW01 is the production well that provides the majority of the drinking water to the facility. The other wells that provide drinking water at various times are AO08-PW01 and AQ09-PW01. Because AM07-PW01 provides drinking water, it was included in the groundwater monitoring plan for the facility. C-8 concentrations in groundwater from AM07-PW01 have ranged from 0.071 (J) to 1.9 (L) ug/l. These concentrations are significantly lower than the CATT-established C-8 SL of 150 ug/l (WVDEP, 2002). In addition, average concentrations of C-8 in drinking water at point of use (which is a mixture of water from the three wells) will be lower than the maximum concentrations detected in any single well. Human receptors contact with impacted drinking/tap water is a complete exposure pathway.

C-8 was detected in production wells providing industrial process water (K16-PW01, V05-PW01, and L04-PW01). The maximum concentration of C-8 measured in these wells was 51.2 ug/l, detected in well V05-PW01. Water from these wells is not used for drinking, but rather for industrial processes including non-contact and contact cooling water, fire water, process water, conversion to demineralized water to generate steam, and/or consumption in the manufacturing processes. There is a potential for limited contact. However, this contact is expected to be minimal due to the low duration and frequency of contact and because health and safety procedures in place are followed when working with or around process water. Average concentrations of C-8 in process water at the point of use (which is again a mixture of water from several production wells) will be lower than maximum concentrations detected in any single well.

An ecological evaluation conducted as part of the RCRA Facility Investigation focused on identifying whether significant ecological resources may be exposed to site-related constituents released from the SWMUs (DuPont, 1999). This evaluation concluded that surface soil at the Riverbank Landfill/Digestion Ponds was the only potential ecological exposure medium within the RFI study area. However, topsoil and a vegetation cover prevent human and ecological receptor contact with surface soils (i.e., 0 to 1 feet). Therefore, the contact with surface soil at the Riverbank Landfill/Digestion Ponds is an incomplete exposure pathway. Surface-water contact with C-8 impacted soils or groundwater is not likely because the Waste Incinerators and Burning Ground SWMUs are covered with gravel, asphalt, or buildings and do not provide ecological habitat. Subsurface soil (greater than 2 feet) and groundwater are not exposure media of concern for ecological receptors, and groundwater does not discharge to surface water at the site. Therefore, contact with surface water or groundwater or subsurface soil is considered an incomplete ecological exposure pathway.

Off-Site Human Health and Ecological Exposure Pathways

Off-site human receptors include residents using the water sources sampled during the groundwater well and water-use survey. Ecological receptors include livestock using the water sources sampled during the groundwater well and water-use survey.

West Virginia One- and Two-Mile Radius Groundwater and Surface Water

Direct exposure to C-8 impacted surface water and groundwater is considered to be an incomplete pathway in situations where the water source is not used. The pathway is considered to be a complete pathway in situations where the water source is used but the water is not used for drinking-water purposes, although the exposure is considered to be minimal. The highest C-8 concentration in a non-drinking-water sample was 5.07 ug/l, well below the C-8 SL of 150 ug/l. The pathway is considered to be complete if the well is used for drinking-water purposes. The highest C-8 concentration measured in drinking water was 2.8 ug/l, significantly lower than the CATT-established C-8 SL of 150 ug/l (WVDEP, 2002). Therefore, even though the pathway is complete, it also is considered to be limited due to the low C-8 concentrations measured.

An evaluation of ecological exposure to groundwater and surface water shows that there is a complete pathway for exposure to livestock if these water sources are used for these purposes. Within the West Virginia one- and two-mile radius, the highest concentration of C-8 measured in water that was specified as a non-drinking-water source used for livestock is 5.07 ug/l, well below the CATT-established C-8 SL. Exposure of C-8 to ecological receptors is limited due to the low C-8 concentrations measured.

Ohio One- and Two-Mile Radius Groundwater and Surface Water

As stated in the previous section, the exposure pathway for groundwater varies from incomplete to complete depending upon water use. Within the Ohio one- and two-mile radius, the highest drinking-water C-8 concentration measured was 8.59 ug/l. This concentration is significantly lower than the C-8 SL of 150 ug/l (WVDEP, 2002). While the pathway is considered to be complete, exposure also is considered to be limited. The pathway is complete for surface water because one spring used for drinking water within the one-mile radius was sampled. However, the C-8 concentration is low, 1.29 ug/l, compared to the CATT-established C-8 SL.

An evaluation of ecological exposure to groundwater and surface water shows that there is a complete pathway for exposure to livestock if these water sources are used for these purposes. Within the Ohio one- and two-mile radius, no water sources identified as a drinking water or non-drinking water were used for livestock. However, the highest C-8 concentration measured in a non-drinking-water sample, which may be used for livestock, was 23.6 ug/l.

Ohio River Water

Direct exposure to Ohio River water is a complete pathway, although the exposure is considered to be limited because river water is not directly used for drinking water. River water is ultimately the recharge source for PWS along the Ohio River. However, the highest C-8 concentration in the Ohio River water, 1.09 ug/l, is well below the C-8 SL.

Public Water Supplies

The highest C-8 concentration measured in connection with sampling related to PWS along the Ohio River was measured in a test well at Little Hocking Water Association, Ohio. However, this concentration does not represent the concentration of C-8 in drinking water supplied to the public. The highest C-8 concentration measured in the drinking water from the Little Hocking well field was 4.29 ug/l. Compared to the CATT-established C-8 SL of 150 ug/l, this concentration is significantly below that level (WVDEP, 2002). The human health exposure pathway for groundwater from the Little Hocking well field is complete because the water is used for drinking and non-drinking-water purposes.

3.6 Washington Works Facility Summary

Many different activities were conducted at and around the facility in order to determine whether there has been an impact on human health and the environment as a result of releases of C-8 to the environment from DuPont operations at the facility. The C-8 concentration in groundwater and surface water from many sources (on-site, off-site, monitoring wells, production wells, private wells, springs, cisterns, river water, and PWS) was measured. More than 670 samples were analyzed. Based on all of the data evaluated for the Washington Works facility, the following observations were made:

- The current exposure pathways are incomplete for human and ecological receptors contact with the following C-8 impacted media:
  - On-site SWMUs
  - On-site soil
  - On-site surface water
  - On-site groundwater
- In addition, the current exposure pathways are incomplete for ecological receptors contact with the following C-8 impacted media:
  - On-site drinking water
  - On-site process water
- Current on-site human receptors contact with C-8 impacted drinking water is a complete pathway. However, this pathway is considered to be minimal because the highest C-8 concentration measured in drinking water at the site was 1.9

(L) ug/l, significantly lower than the CATT-established C-8 SL of 150 ug/l (WVDEP, 2002).

- Current on-site human receptors contact with C-8 impacted process water is also a complete pathway. However, this pathway is considered to be minimal because health and safety procedures are in place and followed when working with or around process water. The highest C-8 concentration measured in process water at the site was 51.2 ug/l, which is lower than the CATT-established C-8 SL of 150 ug/l.
- Current off-site exposure pathways for human and ecological receptors that are complete but minimal, due to the very low C-8 concentration measured, include residential and public drinking-water sources, residential non-drinking-water sources, and Ohio River water. For the drinking-water sources, the highest C-8 concentration measured was 8.59 ug/l, well below the C-8 SL of 150 ug/l. For the non-drinking-water sources, the highest C-8 concentration measured was 23.6 ug/l, which is significantly lower than the C-8 SL of 150 ug/l. For Ohio River water, the highest C-8 concentration was 1.09 ug/l, again significantly lower than the C-8 SL of 150 ug/l.
- The current revised groundwater model supports DuPont's previous conclusions that no off-site migration of groundwater is known to be occurring and that no potential groundwater migration pathway exists beneath the Ohio River.
- The current groundwater modeling observations combined with the current C-8 concentrations observed in groundwater, surface-water, and PWS in Ohio indicate that air transport of C-8 is the primary migration pathway for C-8 from the facility to adjacent areas. C-8 transported in air emissions and deposited on surfaces is likely to be mobilized by precipitation and migrate via water transport to surface water and/or groundwater.
- Air transport of C-8 in air emissions and water transport of C-8 directly discharging through facility outfalls into the river are believed to be the sources of C-8 in the Ohio River. The highest C-8 concentration measured in Ohio River water was 1.09 ug/l. This C-8 concentration is significantly lower than the CATT established C-8 ALAC of 1,360 ug/l (Menzie-Cura & Associates, 2002). C-8 in the Ohio River is likely to be the source of C-8 in PWS located downstream of the facility.
- SWMUs on-site are believed to be the primary source of C-8 migration to groundwater. Air disposition of C-8 on the ground surface combined with surface water transport to groundwater also may have occurred.
- The current groundwater modeling observations combined with the current C-8 concentrations observed in groundwater at the facility also support potential migration of C-8 from C-8 containing materials in the SWMUs directly into groundwater via water transport.

4.0 LOCAL LANDFILL

4.1 Introduction

The Local Landfill is located immediately south of the Washington Works facility and consists of three separate closed cells. The three cells operated from 1964 to the mid-1980s under WV/NPDES Permit No. WV0076538 (see Figure 4.0). When the cells were closed, the cells were covered with approximately 2 feet of low permeability soil and vegetative cover. Consent Order required tasks to be conducted at or immediately adjacent to the Local Landfill included the following:

- Task A: Groundwater Well and Water-Use Survey and C-8 Sampling—conduct a distance-phased groundwater well and water-use survey identifying and sampling all groundwater wells, springs, and cisterns within a one-mile (and possibly two- and three- mile) radial distance of the facility and the Local Landfill.
- Task B: Assessment of Existing Groundwater and Surface Water Monitoring Data—conducting monthly sampling for C-8 at Local Landfill at certain outfalls identified in WV/NPDES No. WV0076538 as Outfalls 101, 004 (Old), 004 (New), 005 (Old)/SS-1, and 005 (New). C-8 samples were to be taken from all the wells at the Local Landfill monthly for the first four months and quarterly thereafter.
- Task C: Plume Identification/Groundwater Assessment –determine the vertical and horizontal extent of C-8 impacted groundwater at Local Landfill exceeding 1 ug/l or as directed by the GIST.

In Sections 4.2 through 4.4, discussions are presented of the specific activities conducted to meet the requirements of the Consent Order along with the results of the sampling activities. In Section 4.5, the revised site conceptual model that better represents the current environmental setting (geology, hydrology, hydrogeology, groundwater flow, and water quality) and current human health and ecological exposure pathways for the conditions at and surrounding Local Landfill is presented.

4.2 Task A: Groundwater Well and Water-Use Surveying and C-8 Sampling

The Washington Works facility is located immediately north of the Local Landfill. Because of the proximity of the facility to the Local Landfill, groundwater wells located within the combined one-mile radius (of both sites) in West Virginia were sampled. The results for the groundwater well and water-use surveying and sampling for the facility and the Local Landfill are presented in Section 3.2.1 and 3.2.2. Briefly summarized, expansion of the one-mile radius was required by the GIST because the C-8 concentrations in five drinking-water samples within the one-mile radius were above the 1 ug/l threshold level. Within the two-mile radius, only one drinking-water sample had a C-8 concentration above 1.0 ug/l. The results for the two-mile radius showed a trend toward lower concentrations than in the one-mile radius. Based on these results, and the

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establishment of the human health protective screening criteria for water (C-8 SL) of 150 ug/l by the CATT, the GIST determined that no further off-site surveying around the facility and the Local Landfill was needed.

4.3 Task B: Assessment of Existing Groundwater and Surface-water Monitoring Data

4.3.1 Monitoring of C-8 in Groundwater and Surface Water

Groundwater Monitoring

The Consent Order required that all monitoring wells at Local Landfill were to be sampled for C-8. The frequency of sampling was to be monthly for the first four months following the effective date of the Consent Order, then quarterly thereafter. Monthly C-8 sampling of groundwater began in December 2001 and quarterly sampling began in May 2002 (2Q02). Table 4.0 provides a list of the monitoring wells included in the groundwater monitoring program for Local Landfill. Well construction and groundwater elevation data also are provided in Table 4.0. At the time monitoring started, only four monitoring wells existed at Local Landfill, LLMW-4, LLMW-6, LLMW-9, and LLMW-10. Another five wells were installed during 3Q02 as part of the C-8 plume delineation work plan, and these wells were included in the monitoring program starting in 4Q02. Figure 4.1 shows the location of the monitoring wells. Table 4.1 presents the C-8 concentrations measured in these monitoring wells, including C-8 data acquired prior to the issuance of the Consent Order. The most recent data are listed first for each well.

At the present time, only general observations can be made from the five wells recently included in the monitoring program because of the limited data set. Additional groundwater monitoring data will be obtained during the 1Q03 event. However, for the four wells with multiple C-8 measurements, some observations can be made, and the results for the new wells can be compared to the historical data available. LLMW-4, LLMW-6, and LLMW-13B show the highest C-8 concentrations ranging from 1.32 to 79.6 ug/l. Shallow, overburden well LLMW-11A, only sampled once, had a C-8 concentration of 2.22 ug/l. The other five wells at the landfill have lower concentrations, ranging from ND to 1.12 ug/l.

The next groundwater-sampling event for the Local Landfill is scheduled for the first quarter 2003.

Surface-water Monitoring

The Consent Order also identified three outfalls at Local Landfill (regulated by WV/NPDES Permit No. WV0076538) where monthly C-8 sampling was to be performed, Outfalls 101, 004 and 005. Monthly sampling of these three outfalls began in December 2001. In March 2002, two additional outfalls were added to the monitoring program due to a modification of the WV/NPDES permit. [The names of the two of the outfalls already included in the monitoring program were modified. Outfall 004 was renamed Outfall 004 (Old), not to be confused with Outfall 004 (New) and Outfall 005 was changed to Outfall 005 (Old)/SS-1, not to be confused with Outfall 005 (New).]

Figure 4.1 shows the locations of the five outfalls in the monitoring program. The two 004 outfalls monitor a stream on the north side of the property and the two 005 outfalls monitor a stream located on the western side of the property. Both of these streams discharge stormwater runoff from the landfill. Surface water in the two 004 outfalls ultimately discharge to Pages Run, which crosses the facility and enters the Ohio River. Surface water in the two 005 outfalls crosses through the facility in stormwater pipes and ultimately discharges through Outfall 003 to the Ohio River. Outfall 101, located along the northeast perimeter of the landfill property, is located in a plastic sewer pipe that conveys seep water and leachate from a series of three holding ponds located on the east side of the landfill cells in addition to stormwater runoff. Water passing through Outfall 101 is conveyed via the sewer pipe to the Washington Works facility and ultimately discharges through Outfall 001 into the Ohio River. LM1 (Leachate) is a surface-water point that monitors leachate entering Pond 2, one of the holding ponds that then discharge through Outfall 001. LM1 (Leachate) and is monitored bi-annually for C-8.

Table 4.2 provides the C-8 concentration data for the outfalls, including C-8 data acquired prior to the issuing of the Consent Order. The most recent data are listed first for each outfall. Outfall 101 is the only outfall that has consistently had flow since the beginning of the C-8 monitoring program. The other four outfalls have had no-flow conditions for the past three months, most likely due to the drought. The concentrations of C-8 in both 004 outfalls have been in the 10-15 ug/l range, while the concentration in the both 005 outfalls have been higher, in the 20 to 50 ug/l range. Outfall 101 has shown a wider range of C-8, from 12 to 115 ug/l. LM1 (Leachate) has had the highest C-8 concentration at Local Landfill (120 ug/l).

Outfall sampling for December 2002 has been completed, and the monitoring report will be issued to the GIST in February 2003. Outfall sampling for January 2003 has been completed, but the C-8 results have not yet been validated. The next monthly outfall sampling event is scheduled for February 2003.

4.4 Task C: Plume Identification/Groundwater Assessment

Based on the data gaps identified in the Compilation of Historical C-8 Data report (DuPont, 2002b), the C-8 Plume Identification/Groundwater Assessment Work Plan was developed and submitted to the GIST (DuPont, 2002e). This work plan included specific activities recommended to fill the data gaps. In the following sections, each of the activities recommended in the C-8 plume delineation work plan is summarized. Details of the activity status and the data acquired are then presented.

4.4.1 C-8 Monitoring in Groundwater and Surface Water at Local Landfill

Continuing to monitor C-8 in groundwater in the overburden and in the underlying bedrock aquifer (utilizing the newly installed monitoring wells), and in surface water at existing locations identified in the Consent Order, was an activity recommended in the C-8 plume delineation work plan (DuPont, 2002e). The results of continued monitoring of groundwater and surface water are presented in Section 4.3.1. Monitoring of C-8 in groundwater continues on a quarterly basis, while surface-water monitoring of C-8 is conducted on a monthly basis.

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4.4.2 Surface-water Field Reconnaissance at the Washington Works Facility

Conducting field reconnaissance to identify additional surface-water features located at the Local Landfill and sampling surface water from new locations identified during this effort was a C-8 plume delineation recommended activity. Field reconnaissance was performed, and no new surface-water features were identified.

4.4.3 Installation of New Wells at Local Landfill

The installation of four additional well clusters (overburden and bedrock) was proposed in the C-8 plume delineation work plan to further characterize the bedrock stratigraphy under the site, to further delineate C-8 concentrations in groundwater, and to evaluate groundwater flow direction. One well cluster, LLMW-11 A and B, and three bedrock wells, LLMW-12B, LLMW-13B, and LLMW-14B were installed during 3Q02. The overburden wells were not installed at three of the proposed well cluster locations because very little overburden was encountered and the overburden was dry. Figure 4.1 shows the locations of all monitoring wells at the Local Landfill including the locations of the newly installed monitoring wells. Well construction diagrams for the new wells, are provided in Appendix B.

The geological logs for the five wells installed in 3Q02 confirm previous interpretations of subsurface conditions at the site. In general, some thickness of clay and weathered bedrock (shale, sandstone, and/or siltstone) is underlain by unweathered bedrock, which consists of alternating layers of shale and layers of sandstone and/or siltstone. Where the data were available, it confirmed that the lithologic units dip slightly toward the north. The new geological data were used to refine the geologic interpretation used for the revised SCM, which is presented in detail in Section 4.5.1.

4.4.4 Local Landfill Site Conceptual Model Refinement

The final recommended activity for the Local Landfill was the integration of all the new data gathered during completion of Tasks A, B, and C into a revised SCM. This activity has been completed, and the revised SCM is presented in the following section.

4.5 Revised Site Conceptual Model

The revised SCM better represents the current environmental setting (geology, hydrology, hydrogeology, groundwater flow, and water quality) and current human health and ecological exposure pathways for the conditions at and surrounding the Local Landfill. The following sections present the revised SCM in detail.

4.5.1 Current Environmental Setting

Geology

In 1989, eight monitoring wells were installed at the Local Landfill by Tetra Tech Richardson (LLMW-1 through LLMW-8). However, five of these monitor wells (LLMW-1, LLMW-2, LLMW-3, LLMW-5, and LLMW-7) were closed in 1996 because the wells were screened in the discontinuous shallow clays and underlying weathered bedrock. LLMW-8, a bedrock well, was closed in 1997. Two additional bedrock wells, LLMW-9 and LLMW-10 were installed in 1995 and 1997, respectively. LLMW-9 was installed as a background well. These two wells are screened within a sandstone layer that was selected as the significant underlying aquifer for SW/NPDES permit monitoring. Table 4.0 summarizes the well construction data for the existing monitoring wells. Five additional wells, LLMW-11A, LLMW-11B, LLMW-12B, LLMW-13B, and LLMW-14B were installed at Local Landfill in 3Q02 as part of the C-8 plume delineation work plan (DuPont, 2002k).

The locations of three cross-sections developed for the Local Landfill are shown in Figure 4.2. Two cross-sections, A-A' and B-B', were presented in the Compilation of Historical Data Report (DuPont, 2002b) and have been modified to include data not previously available for LLMW-9 and LLMW-10. In addition, LLMW-12B, a newly installed well, was projected onto B-B'. A-A' runs west to east through the central portion of Local Landfill. B-B' runs north to south. Cross-sections A-A' and B-B' are shown in Figures 4.3 and 4.4, respectively. Cross-section C-C', shown in Figure 4.5, is a new cross-section that starts in the south and runs north, and then runs to the east, showing the geological data obtained from many of the newly installed monitoring wells.

The Local Landfill is situated in a hilly area with high relief, up to 100 feet in some valleys, and lower relief of approximately 10 to 25 feet at the landfill cells. The slopes appear to be a combination of natural topography with terraced outcrops of massive sandstone and siltstone underlying varying amounts of soil cover and man-made landfill plateaus. A shallow, tight, clay overburden layer lies at the surface and ranges from 3 to 25 feet thick. The clay can contains some minor sandy and silty zones, and some pebbles and fragments of sandstone in some locations. The clays are of low plasticity and appear to be well compacted, often displaying a laminar structure (DuPont, 1990). Underlying the shallow clay layer is weathered shale, weathered sandstone, and/or weathered siltstone zone ranging from 10 to 35 feet thick (see Figure 4.3). Below this weathered bedrock, at depths ranging from 21 to 40 feet bgs, competent bedrock is present (see Figures 4.3, 4.4, and 4.5).

The bedrock at the Local Landfill consists of inter-bedded red and varicolored sandy or calcareous shale, and gray, green, and brown sandstone and siltstone of the Permian age Dunkard Group. Cross-section B-B' (see Figure 4.4) shows that the sandstone layers dip gently toward the north. Most of the sandstone layers located in the upper portion of the stratigraphic section are lenticular and laterally discontinuous. However, four laterally continuous sandstone and/or siltstone layers are located in the lower stratigraphic section (see Figures 4.3, 4.4, and 4.5). These water-bearing units are referred to as A-Zone (the "underlying significant aquifer"), B-Zone, C-Zone, and D-Zone. These four zones are labeled on the cross-sections and are discussed in detail in the hydrogeology section that follows.

Hydrology, Hydrogeology and Groundwater Flow

Hydrology

In general, infiltration of precipitation is limited due to the very low hydraulic conductivity (5×10^{-7} cm/sec) of the surficial clays (where these clays exist) and the weathered bedrock (DuPont, 1992). In addition, infiltration of precipitation into the cells is limited by a surface cover that includes approximately 2 feet of low permeability soil and vegetation.

Storm runoff flows into two streams, one located on the northern side of the property and one located on the southern side of the property. Surface water in these two streams is monitored. Outfalls 005(Old)/SS-1 and 005(New) monitor surface water in the north-side stream and Outfalls 004(Old) and 004(New) monitor surface water in the south-side stream. For the past few months, no-flow conditions have been observed at Outfalls 004 and 005, indicating that these streams have no base flow. Leachate from the southern cell and the eastern cell flows from the seeps in the steep valley walls to leachate collection ponds, Pond 1, 2, and 3 (see Figure 4.1). However, during the recent drought conditions of 2002, many seeps, which normally do flow, were not observed flowing. The lack of observed flow may be a result of the drought conditions. Leachate from these ponds is discharged into a pipeline. Monitoring of combined pond effluent conveyed in the pipeline is conducted at Outfall 101. Pond effluent is conveyed through Outfall 101 to the facility where it passes through stormwater Outfall 001 into the Ohio River.

Hydrogeology

Groundwater underlying the Local Landfill occurs in multiple stratigraphic units. A discontinuous upper layer consists of the clays and underlying weathered bedrock and has a very low hydraulic conductivity (DuPont, 1992). The lower layers consist of the continuous and discontinuous sandstone units having low permeability of 1×10^{-5} cm/sec.

The lower sandstone and/or siltstone layers are now identified as the A-Zone, B-Zone, C-Zone, and D-Zone based on re-evaluating the old geologic and hydrogeologic data and the new data obtained while installing and monitoring the new wells at Local Landfill. These four zones are indicated on the cross-sections wherever possible (see Figures 4.3, 4.4, and 4.5). The A-Zone through D-Zone are separated by laterally continuous shale layers. Well yields from the sandstone and siltstone layers are very low, ranging from <0.5 gpm to 1.5 gpm (DuPont, 1992).

The highest laterally continuous sandstone layer is located at elevations between 710-740 feet above MSL (see Figures 4.3, 4.4, and 4.5) and is designated as the "underlying significant aquifer." This unit is currently monitored semiannually as required by the permit at monitoring wells LLMW-4, LLMW-6, LLMW-9, and LLMW-10. Based on the new geological data obtained, this unit also will be referred to as the A-Zone. The A-Zone outcrops in the western, northern, and eastern valley walls of the property.

The next lower sandstone unit is designated as the B-Zone and is monitored via LLMW-12B. The B-Zone is located at elevations between approximately 665 and 694 feet above MSL. The B-Zone also should outcrop in the western, northern, and eastern valley walls of the property.

The C-Zone is the next lower sandstone/siltstone unit and is monitored through wells LLMW-13B and LLMW-14B. The C-Zone is located at elevations between approximately 612 and 640 feet MSL. LLMW-11A, located to the south of one of the landfill cells, may be screened in a weathered portion of C-Zone. The screen is located at the correct elevation for C-Zone, and the lithology there is described as clay overlying silt

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and sand. However, because it is located in a valley, the clay, silt and sand could be recent deposits instead of weathered bedrock. In addition, because there is stream nearby, there is likely to be a component of surface-water interaction involved at this location when the stream flows. The Outlets 004(Old) and 004(New), which monitor this stream, were dry during August, September, and October 2002. Based on the data available, LLMW-11A is considered to be part of the C-Zone monitoring wells. The lowest elevation on the north edge of the Local Landfill and the southern edge of the Washington Works facility is approximately 650 feet MLS. The highest elevation of C-Zone, approximately 640 feet MLS, is about 10 feet lower than the surface elevation indicating that this zone is not exposed at the surface but more likely, the edge of this zone contacts the alluvial material directly.

The D-Zone is the lowest hydrogeologic unit encountered, 545 to 562 feet MSL, and is made up of siltstone and sandstone. LLMW-11B is the only well that was drilled deep enough to encounter the D-Zone; therefore, little information about the lateral continuity of this unit is available. This unit may have been encountered at LLMW-1; however, the distance between these two wells is too far to extrapolate the data. The D-Zone also does not outcrop on the surface and most likely contacts the Pleistocene alluvium directly in the subsurface.

Groundwater Flow

Groundwater elevations have been measured semiannually since 1994. Groundwater elevation contour maps for the significant underlying aquifer (A-Zone) have been prepared from these data as required by the WV/NPDES Permit No. WV0076538. Figure 4.6 presents the groundwater elevation map for 4Q02 for the A-Zone. A groundwater elevation map for 4Q02 for the C-Zone is presented in Figure 4.7. Note that data from LLMW-11A was used to make this map because the outfalls monitoring the stream next to these wells showed no-flow conditions. It was assumed that water elevations in this well were not highly influenced by surface water. Comparing Figures 4.6 and 4.7 shows that in general, groundwater in these two zones basically flows the same direction, toward the northwest. The direction of groundwater flow in the B-Zone and the D-Zone cannot be determined with the limited data available; however, groundwater flow in these two zones is likely to be similar to that observed in A-Zone and C-Zone. From a regional perspective, all bedrock groundwater is expected to generally flow north toward the Ohio River alluvial valley.

Evaluation of limited groundwater elevation data for the closed wells (based on well installation information) indicates a downward vertical gradient between the upper discontinuous water bearing zone and the lower sandstone layers containing the underlying significant aquifer (A-Zone). Evaluation of groundwater data for the A-Zone and the C-Zone and of limited groundwater elevation data for the monitoring wells in the B-Zone and the D-Zone also indicates a downward vertical gradient between the zones.

The sandstone/siltstones of the A-Zone (the underlying significant aquifer) and the B-Zone outcrop in the valley walls adjacent to the facility where groundwater discharge may flow downslope within the fractured rocks of the valley walls and ultimately enter the Quaternary alluvial terrace deposit underlying the Washington Works facility. Alternatively, groundwater also may discharge as seeps in the valley walls. Groundwater from the A-Zone and B-Zone that discharges to seeps ultimately migrates to the facility through a number of pathways. It can discharge downward to leachate collection ponds and pipes (Outfall 101) and flow to the facility where it enters storm sewers and discharges to the Ohio River. Groundwater also can seep to small streams draining the property to the north [monitoring points Outfall 005(Old)/SS-1 and 005(New)] and flow to the Quaternary alluvial terrace unconfined aquifer where pumping of on-site active well fields controls groundwater flow. Groundwater seeps in the southern valley wall can seep to the small stream that drains the southern part of the property and ultimately flows toward the north back on to the facility [Outfalls 004(Old) and 004(New)].

Groundwater from C-Zone and D-Zone, which are located in the bedrock at elevations lower than the alluvium surface, likely discharges to the alluvium in the subsurface. Groundwater flow in the alluvial aquifer, adjacent to the valley walls of the Local Landfill, is toward the pumping wells located near and parallel to the Ohio River. The pumping of these well fields lowers the groundwater level in the alluvium to below river stage, inducing surface water from the river to flow into the alluvium and toward the pumping wells.

Water Quality

Groundwater Quality

Table 4.1 presents the data available for C-8 in Local Landfill monitoring wells. C-8 concentrations in the A-Zone, the underlying significant aquifer, are highest at LLMW-4 (maximum of 79.6 ug/l) and at LLMW-6 (maximum of 19.9 ug/l). These two wells are positioned adjacent to landfill cells and are the downgradient wells within the A-Zone. Monitoring well LLMW-10, located under a landfill cell and upgradient of LLMW-4, has shown a range in C-8 concentration of 0.15 to 1.12 ug/l. Monitoring well LLMW-9, an upgradient well located to the southwest of one of the landfill cells has shown C-8 concentrations ranging from non-detectable to 0.14 ug/l. These data indicate that C-8 from the landfill cells (and/or from air deposition) is migrating downward and reaching groundwater within the A-Zone. Water levels in the A-Zone show groundwater flowing from the southeast to the northwest within this zone.

The C-8 concentration measured from the one well screened in the B-Zone (LLMW-12B) is very low, 0.0658 ug/l. Groundwater flow gradients indicate a downward gradient from the A-Zone to the B-Zone, which could be the migration pathway for C-8 to reach the B-Zone. However, groundwater flow with the B-Zone is toward the facility in the northwest and away from the one- and two-mile sampling area.

C-8 concentrations for the one round of data for wells in the C-Zone, LLMW-11A, LLMW-13B, and LLMW-14B, are higher, 2.22, 6.61, and 0.488 ug/l, respectively, supporting a downward vertical gradient for groundwater from the A-Zone to the B-Zone to the C-Zone as indicated by groundwater elevations. Groundwater flow in the C-Zone is likely to be in the same direction as in the A-Zone and the B-Zone, to the northwest.

The one C-8 value from the D-Zone is NQ (LLMW-11B). This may indicate that downward migration of C-8 to the D-Zone has not taken place. However, the location of this well is upgradient of the landfill cells

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Groundwater flow in all zones monitored at the Local Landfill is toward the Washington Works facility (northwest). It is unlikely that C-8 impacted groundwater from any of the zones at Local Landfill would have migrated off-site into the one- and two-mile radius sampling area because of this northwest flow direction.

Surface-water Quality

C-8 concentrations in surface water are presented in Table 4.2. Outfall 101 monitors stormwater runoff and effluent from the leachate ponds and seeps that drain into the ponds. Outfall 101, which has never had no-flow conditions while it has been monitored, has had the highest C-8 concentration measured in surface water at Local Landfill, ranging from 12 to 115 ug/l. The C-8 concentration measured in a sample from Inlet 002 [LM1 (Leachate)], which collects seep water flowing to Pond 2, was 120 ug/l, in November 2002.

Outfalls 004(Old), 004(New), and 005(Old)/SS-1 and 005(New) are monitoring points located along two streams on the southern and northern sides of the property, respectively. These outfalls collect stormwater runoff from the landfill cells. These four outfalls have all had no-flow conditions for the past several months. However, Outfall 005(Old)/SS-1 historically has shown the highest C-8 concentrations of these four outfalls, ranging from 6.8 to 51.4 ug/l.

4.5.2 Current Human Health and Ecological Exposure Pathways

The main objective of the Consent Order was to determine whether there has been an impact on human health and the environment as a result of releases of C-8 to the environment from DuPont operations at the Washington Works facility and the associated landfills (Local, Letart, and Dry Run). Therefore, human health and ecological exposure pathways both on-site (at the Local Landfill) and off-site (adjacent to the facility and the Local Landfill) must be considered. The human health and ecological exposure pathway sections below describe the potential exposure routes for human and ecological receptors on- and off-site. Potential exposure routes were evaluated and classified as complete or incomplete.

On-Site Human Health and Ecological Exposure Pathways Current Environmental Setting

This section describes the potential exposure routes for human and ecological receptors that are found at the Local Landfill. On-site human receptors include authorized facility workers and facility visitors. Ecological receptors include animals living within the landfill boundaries. Potential exposure routes were evaluated and classified as complete or incomplete and are summarized in Table 4.3. Table 4.3 summarizes the human health and ecological exposure pathway evaluation for the Local Landfill. To be conservative, for each complete exposure pathway, the maximum C-8 concentration measured in the C-8 impacted media is compared to the C-8 SL, regardless of media type.

Access to the Local Landfill is restricted by electronic and locked gates at the road entrances. However, a posted nature trail has been established on the east side of the landfill property. The trail loops around the eastern part of the landfill starting and

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ending near the landfill's electrically operated gate. The nature trail is a marked trail and does not come near the cells. Access to the site from surrounding roads is possible but is discouraged due to the heavily wooded nature of the property and the hilly terrain. The three cells at the Local Landfill are covered with a low permeability soil and vegetative cover. This cover prevents human and ecological receptors' exposure to the landfilled materials. Permit WV0076538 requires that the landfill surface will be inspected quarterly for evidence of cracking or erosion (which could allow surface water to enter the solid waste deposit) and evidence of settling of solid waste (causing ponding of surface water). Per Condition G-16 of the permit, a stormwater erosion inspection is conducted annually. Therefore, human and ecological receptors' exposure to C-8 containing landfilled materials is an incomplete pathway.

At the landfill, precipitation is expected to take one of two paths. It may infiltrate downward through the vegetated soil cover and into the cells, although, the low permeability of the soil cover reduces the amount of infiltration. If the precipitation does infiltrate the soil cover, it will possibly encounter the landfill materials and will continue migrating downwards. It may be prevented from further downward migration by the low permeability clays and weathered bedrock. However, if this water does migrate further downward, it should encounter the sandstones and shale layers. Groundwater flowing through the sandstone layers that outcrop in the valley walls located above the facility's southern edge would be exposed at the surface in seeps, if seeps exist. No seeps were identified in the valley walls during field reconnaissance. Seeps near the leachate collection ponds flow almost continuously although the amount of flow is variable. Contact with leachate from the landfill cells that has reached the ponds and surface water via these seeps is possible and therefore, is a complete exposure pathway for human and ecological receptors. However, contact would be very rare since only facility representatives enter this area on an infrequent basis. The highest C-8 concentration measured in leachate from Local Landfill 120 ug/l, which is lower than the CATT-established C-8 SL of 150 ug/l (WVDEP, 2002).

Depths to groundwater at the Local Landfill ranges from around 20 feet to 130 feet bgs (see Figures 4.3, 4.4, and 4.5). In addition, groundwater has not been observed seeping in the valley walls indicating that ground water is not exposed at ground surface on valley walls, but most likely flows in the subsurface of the valley walls. Therefore, contact with C-8 impacted groundwater as an exposure pathway to human or ecological receptors is considered to be incomplete.

Off-site Human Health and Ecological Exposure Pathways

Off-site human receptors include residents using the water sources sampled during the groundwater well and water-use survey. Ecological receptors include livestock using the water sources sampled during the groundwater well and water-use survey.

West Virginia One- and Two-Mile Radius Groundwater and Surface Water

Results for the West Virginia one- and two-mile radius groundwater and surface water was presented in Sections 3.2.1 and 3.2.2. The exposure pathway is incomplete if the water source is not used. The exposure pathway for human and ecological receptors is complete if the water source is used for drinking water. The exposure pathway is complete if the water source is used for non-drinking-water purposes, although, the exposure is considered to be minimal because the water is not ingested. The highest C-8 concentrations for non-drinking-water and drinking-water sources was 14.3ug/l and 2.8 ug/l, respectively, which are significantly below the CATT C-8 SL of 150 ug/l. The pathway is complete but exposure is limited due to the low C-8 concentrations.

4.6 Local Landfill Summary

Many different activities have been conducted at and around the Local Landfill in order to determine whether there has been an impact on human health and the environment as a result of releases of C-8 to the environment from the landfill cells at the Local Landfill. The C-8 concentration in groundwater and surface water from many sources (on-site, off-site, monitoring wells, production wells, private wells, springs, and cisterns) was measured. Based on all of the data evaluated for the Local Landfill, the following observations were made:

- The current exposure pathways are incomplete for human and ecological receptors contact with the following C-8 impacted media:
  - On-site landfilled materials
  - On-site soil
  - On-site groundwater
- Human and ecological receptors contact with on-site leachate and C-8 impacted surface water are currently complete pathways. However, these pathways are considered to be limited because of health and safety practices followed when managing the leachate and because of institutional controls in place to limit access to the site. The highest C-8 concentrations measured in leachate and surface water at the site were 120 and 115 ug/l, respectively, which are lower than the CATT-established C-8 SL of 150 ug/l and the Aquatic Life Advisory Concentration for C-8 (C-8 ALAC) of 1,360 ug/l (WVDEP, 2002; Menzie-Cura & Associates, 2002).
- Current off-site exposure pathways for human and ecological receptors that are complete but limited, due to the very low C-8 concentrations measured, include residential drinking and non-drinking-water sources. For the drinking and non-drinking-water sources, the highest C-8 concentrations measured were 2.8 and 5.07 ug/l, respectively. These concentrations are well below the C-8 SL of 150 ug/l.
- Evaluation of the C-8 results measured at Local Landfill and the groundwater flow directions indicates C-8 migration via water transport from Local Landfill does not occur in any direction other than toward the Washington Works facility in the northwest but outside the boundary of the facility and the Local Landfill.
- C-8 detected at locations within the one- and two-mile radius is believed to have been transported from the Washington Works facility via air emissions. C-8 transported in air emissions and deposited on surfaces is likely to be mobilized by precipitation and migrate via water transport to surface water and/or groundwater.

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5.0 LETART LANDFILL

5.1 Introduction

The Letart Landfill is located about 46 river miles downstream of the Washington Works facility, north of the town of Letart in Mason County, West Virginia (see Figure 5.0). The landfill was operated and closed under WV/NPDES Permit No. WV0076066. The Letart Landfill was permanently closed by installing an engineered multi-layer geosynthetic and soil cap (DuPont, 2001). Included in the closure activities were the installation of a leachate collection system, erosion and drainage control measures, and chain-link fencing. The cap construction was completed in April 2001. The permit requires quarterly groundwater monitoring, surface-water monitoring, and engineered cap maintenance.

Consent Order required tasks that were to be conducted at or immediately adjacent to the Letart Landfill included the following:

- Task A: Groundwater Well and Water-Use Surveying and C-8 Sampling--conduct a distance-phased groundwater well and water-use survey identifying and sampling all groundwater wells, springs, and cisterns within a one-mile (and possibly two- and three- mile) radial distance of the Letart Landfill.
- Task B: Assessment of Existing Groundwater and Surface Water Monitoring Data—conduct monthly sampling for C-8 at Letart Landfill at certain outfalls identified in WV/NPDES Permit No. WV0076066 as Outfalls 002 and 003. C-8 samples were taken from all the wells at the Letart Landfill monthly for the first four months and quarterly thereafter.
- Task C: Plume Identification/Groundwater Assessment—determine the vertical and horizontal extent of C-8 impacted groundwater exceeding 1 ug/l or as directed by the GIST at Letart Landfill. This task included an assessment of the C-8 concentration in Ohio River Water in the vicinity of the Letart Landfill.

In Sections 5.2 through 5.4, discussions are presented of the specific activities that were conducted to meet the requirements of the Consent Order, along with the results of the sampling events. In Section 5.5, the revised site conceptual model is presented that more accurately represents the current environmental setting (geology, hydrology, hydrogeology, groundwater flow and water quality) and current human health and ecological exposure pathways for the conditions at and surrounding the Letart Landfill.

5.2 Task A: Groundwater Well and Water-Use Surveying and C-8 Sampling

The groundwater well and water-use survey and sampling activities conducted within the one-mile radius of the Letart Landfill were completed on February 24, 2002. DuPont submitted the results of the one-mile radius survey to the GIST in April, 2002 (DuPont, 2002a).

Table 5.0 summarizes the off-site surveying and sampling program for the one-mile radius. A total of 46 homes were surveyed, and a total of 30 wells were sampled. Eleven of the wells were used as drinking-water sources. Table 5.1 provides details for each sample collected including the C-8 concentration measured (ug/l). Eight other wells sampled were used for non-drinking water and the other 11 wells were unused. No cisterns or springs were sampled. Figure 5.1 shows the locations sampled, regardless of water use. Each colored circle represents a sampling location, and the color and size of the circle indicate the magnitude of the C-8 concentration measured. Small blue circles represent samples having C-8 concentrations less than 0.05 ug/l. Small green circles represent samples having C-8 concentrations ranging from to 0.05 to 1.0 ug/l.

The C-8 concentrations measured in all Letart one-mile radius samples were ND or NQ, except for one sample collected from a well used for drinking water that had a C-8 concentration of 0.139 ug/l and one sample collected from an unused well that had a concentration of 0.636 ug/l. The GIST required that the drinking-water well sample with a C-8 concentration of 0.139 ug/l be re-sampled. However, the resident declined to have the well re-sampled. Based on the very low C-8 concentrations measured when compared to the human health protective screening criteria for water (C-8 SL) of 150 ug/l, the GIST determined that no further surveying and sampling was needed.

5.3 Task B: Assessment of Existing Groundwater and Surface-water Monitoring Data

5.3.1 Monitoring of C-8 in Groundwater and Surface Water at Letart Landfill

Groundwater Monitoring

The Consent Order required that all monitoring wells at Letart Landfill be sampled for C-8. Monthly C-8 sampling of groundwater began in December 2001 and quarterly sampling began in May 2002. Table 5.2 provides a list of the monitoring wells included in the groundwater monitoring program for Letart Landfill. Well construction data and groundwater elevation data also are provided in this table. At the time monitoring started, 13 monitoring wells existed at Letart Landfill. Another five wells were installed during 3Q02 as part of the C-8 plume delineation work. These wells were included in the monitoring program that began in 4Q02.

Figure 5.2 shows the location of the monitoring wells. Table 5.3 presents the C-8 concentrations measured in these monitoring wells, including C-8 data generated prior to the issuing of the Consent Order. The most recent data are listed first for each well. The water-bearing units at the Letart Landfill are named from ground surface to depth as the A-Zone through the F-Zone, with the A-Zone being the shallowest and F-Zone being the deepest.

Groundwater in the A-Zone, the uppermost water-bearing unit, is monitored through three wells, LMW-1, LMW-7, and LMW-8. These three wells are located along the northwestern edge of the landfill cell. C-8 concentrations in LLMW-1, LMW-7, and LMW-8 have ranged from 0.1 to 30,500 ug/l.

Groundwater in the next lower water-bearing unit, the B-Zone, is not monitored because this zone is not laterally continuous at the site.

Groundwater for the next lower water-bearing unit, the C-Zone, is monitored through LMW-3 and LMW-5A. C-8 concentrations in LMW-3 and LMW-5A ranged from NQ to 2,270 ug/l and from 0.8 to 112 ug/l, respectively. Note that in the groundwater elevations measured for LMW-5A (see Table 5.2) have always been at depths lower than the bottom of the screen indicating that this well has been essentially dry throughout the period it has been monitored. Groundwater sampled from this well and analyzed for C-8 may not be representative of the C-8 concentrations in the C-Zone.

Groundwater in the D/E-Zone, the next lower water-bearing unit, is monitored through LMW-3A, -4, -5B, -12, –13A, and –14A. C-8 concentrations in LMW-3A and 13A ranged from 60.3 to 510 ug/l. C-8 concentrations measured in LMW-4, -5B and –14A ranged from 172 to 3,060 ug/l. LMW-12 was dry during the 4Q02 sampling event.

Groundwater in the F-Zone, the underlying significant aquifer, is monitored by LMW-2A, LMW-6, LMW-10, LMW-11, LMW-13B, and LMW-14B. C-8 concentrations measured in LMW-10, LMW-11, and LMW-13B have always been less than 1 ug/l. Concentrations of C-8 in LMW-6 ranged from 9.4 to 30 ug/l. C-8 concentrations in LMW-2A and -14B ranged from 50 to 990 ug/l.

An additional sandstone and siltstone zone, located under the F-Zone is monitored by LMW-9. The C-8 concentrations measured in LMW-9 ranged from 0.2 to 0.907 ug/l. Table 5.2 shows that groundwater elevations in this well have consistently been below the bottom of the screen, indicating that this well has essentially been dry during the period that is has been monitored. In addition, LMW-9 typically runs dry during sampling and takes days to recharge. Therefore, C-8 concentrations measured in this well (0.2 to 0.907 ug/l) may not be representative of groundwater quality in this zone.

The next groundwater sampling event at the Letart Landfill is scheduled for the first quarter 2003.

Surface-water Monitoring

The Consent Order identified two outfalls at Letart Landfill (regulated by WV/NPDES Permit No. WV0076066) that required monthly C-8 sampling to be performed, Outfalls 002 and 003. Outfall 002 collects leachate and stormwater runoff from the landfill. Outfall 002 then discharges to a small wet-weather stream at the toe of the landfill. Outfall 003 collects stormwater runoff. Monthly sampling of these two outfalls began in December 2001. DuPont also is sampling surface-water samples at selected other locations, including Stormwater Runoff, Rt. 33 Stream, Brinkers Run and Cap Runoff. Figures 5.2 and 5.3 show the locations of the six surface-water sampling points. Table 5.4 summarizes the C-8 concentrations measured in the outfalls, including C-8 data generated prior to the issuing of the Consent Order. The most recent data are listed first for each outfall.

Outfall 002 collects landfill leachate. C-8 concentrations at this outfall have ranged from 4.52 to 3,240 ug/l. Using the 14 (see Table 5.4) C-8 results for samples collected after the landfill cap was installed in April 2001, the range is smaller, from 4.52 to 2,050 ug/l. The C-8 concentrations in this leachate have been highly variable since the landfill cap was installed. Cap Runoff C-8 concentrations ranged from 65.1 to 371 ug/l. The Stormwater Runoff sample had a concentration of 50.9 ug/l. The Rt. 33 Stream, Outfall 003, and Brinker's Run samples' C-8 concentrations ranged from 0.0612 to 3.92 ug/l.

Outfall sampling for December 2002 has been completed and the monitoring report will be issued to the GIST in February 2003. Outfall sampling for January 2003 has been completed, but the C-8 results have not yet been validated. The next monthly outfall sampling event is scheduled for February 2003.

5.4 Task C: Plume Identification/Groundwater Assessment

Based on the data gaps identified in the Compilation of Historical C-8 Data Report (DuPont, 2002b), the C-8 Plume Identification/Groundwater Assessment Work Plan was developed and submitted to the GIST (DuPont, 2002e). This work plan identified specific activities recommended to fill the data gaps. In the following sections, each of the activities recommended in the C-8 plume delineation work plan are summarized. Details of the activity status and the data acquired are then presented. In addition, Task C included an assessment of the C-8 concentrations in Ohio River Water in the vicinity of the Letart Landfill, and these results also are presented.

5.4.1 C-8 Monitoring in Groundwater and Surface Water at Letart Landfill

The delineation work plan recommended continuing to monitor C-8 in groundwater in the overburden and in the underlying bedrock aquifer (utilizing the newly installed monitoring wells), and in surface water at existing locations identified in the Consent Order. The results of continued monitoring of groundwater and surface water are presented in Section 5.3.1. Monitoring of C-8 in groundwater continues on a quarterly basis, while surface-water monitoring of C-8 is conducted on a monthly basis.

5.4.2 Surface-water Field Reconnaissance at the Letart Landfill

Conducting field reconnaissance to identify additional surface-water features located at the Letart Landfill and sampling surface water from new locations identified during this effort was a C-8 plume delineation recommended activity. Field reconnaissance was performed, and no new surface-water features were identified.

5.4.3 Installation of New Wells at Letart Landfill

The installation of three additional well clusters (overburden and bedrock) was proposed in the C-8 plume delineation work plan to characterize the bedrock under the Letart Landfill, to further delineate C-8 concentrations in groundwater and to evaluate groundwater flow direction. One bedrock well, LMW-12, and two well clusters, LMW-13A and LMW-13B and LMW-14A and LMW-14B, and were installed during 3Q02. At LMW-12, no overburden was encountered. Figure 5.2 shows the locations of all monitoring wells at the Letart Landfill including the locations of the newly installed monitoring wells. Well construction diagrams for the new wells, are provided in Appendix C.

Data from the geological logs for the five wells installed in 3Q02 support the previous interpretation of subsurface conditions at the site. Clay and weathered bedrock (shale, sandstone and/or siltstone) is underlain by bedrock, consisting of alternating layers of shale and sandstone, or siltstone or both. The A-Zone through the F-Zone and one additional water-bearing zone, under the F-Zone, were identified. The B-Zone, which exists in the northern areas, thins out toward the south while D/E-Zone exists in the south and thins out to the north. Overall, the new geologic data confirmed that the lithologic units dip slightly toward the south. The new geological data were used to refine the geologic interpretation used for the revised SCM, which is presented in detail in Section 5.5.1.

5.4.4 Letart Landfill Site Conceptual Model Refinement

The final recommended activity for the Letart Landfill was the integration of all the new data gathered during completion of Tasks A, B, and C into a revised SCM. This activity was completed, and the revised SCM is presented in Section 5.5.

5.4.5 Ohio River Water Sampling Near Letart Landfill

Adjacent to the Letart Landfill, Ohio River water also was sampled to measure the C-8 concentrations. Two locations were sampled. These sampling locations are shown in Figure 5.4. One sampling location was positioned in the river near the point where the ravine originating at the landfill discharges surface water into the river. The other sampling point was located approximately 1,000 feet downstream of the first location. All samples were collected near the shoreline (approximately 100 feet east of the shoreline). Dip and mid-column samples were collected at both locations. In total, five river-water samples were collected, including one duplicate sample.

The Ohio River water C-8 results for samples collected near the Letart Landfill are presented at the bottom of Table 3.11 and are shown in Figure 5.4. C-8 concentrations in these five samples ranged from 0.0971 to 0.128 ug/l.

5.5 Revised Site Conceptual Model

The revised SCM better represents the current environmental setting (geology, hydrology, hydrogeology, groundwater flow, and water quality) and current human health and ecological exposure pathways for the conditions at and surrounding the Letart Landfill. The following sections present the revised SCM in detail.

5.5.1 Current Environmental Setting

Geology

At the time Consent Order was issued, 13 monitoring wells existed at Letart Landfill and monitored the water-bearing zones identified at the Letart Landfill, that are labeled as the A-Zone through F-Zone. Another five wells were installed during 3Q02 as part of the C-8 plume delineation work to better characterize the bedrock under the Letart Landfill,

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to further delineate C-8 concentrations in groundwater, and to evaluate groundwater flow direction.

The locations of four cross-sections developed for the Letart Landfill are shown in Figure 5.5. Two cross-sections, A-A' and B-B', were presented in the Compilation of Historical Data Report (DuPont, 2002b) and are shown in Figures 5.6 and 5.7, respectively. Figure 5.8 and 5.9, are new cross-sections, which starts in the north and runs south, showing the geological data obtained from the newly installed monitoring wells.

The Letart Landfill is situated on a heavily dissected plateau consisting of several steep V-shaped valleys. Residual soil covers most landfill areas. In general, the soil at the site has been described as residual in nature, consisting primarily of heavy clays derived from the weathering of bedrock. At most landfill areas, the clay is less than 10 feet thick, with a maximum thickness of 20.5 feet.

The underlying bedrock at the Letart Landfill consists of interbedded red and varicolored sandy or calcareous shale, and gray, green, and brown sandstone and/or siltstone of the Permian age Dunkard Group. Six stratigraphic water-bearing zones that were designated as the A-Zone through F-Zone, with the A-Zone being the shallowest zone and the F-Zone the deepest. These zones are identified on the cross-sections. These zones consist of massive, very fine to fine grained crystalline sandstone and/or siltstone with occasional shale lenses. The A-Zone through the F-Zone are separated by locally continuous shale units that are generally 10 feet or greater in thickness. The B-Zone through the D/E-Zone are laterally discontinuous. The B-Zone and the C-Zone are a single zone in the far north and separate into two distinct zones in the central area. The B-Zone thins out and is missing from logs from the southern area. D-Zone is an isolated unit in the northern area. This unit joins up with E-Zone in the central area. In the southern area, the D-Zone and the E-Zone are a single zone. The A-Zone and the F-Zone are laterally continuous. The A-Zone and the C-Zone outcrop in the valley walls, while the D/E-Zone outcrops along the Ohio River near the southern end of the landfill. The F-Zone likely outcrops in the riverbank of the Ohio River.

The logs for LMW-9, LMW-5A, and LMW-5B were re-examined during construction of new cross-sections and are now believed to be screening other zones. LMW-9 is now interpreted to be screened in a sandstone zone lower than the F-Zone. Because there is only one well in this newly identified zone, it is not clear if this zone is laterally continuous. LMW-5B previously thought to be monitoring the F-Zone, is now believed to be screened in the D/E-Zone. Well LMW-5A, previously interpreted as monitoring the D/E-Zone, is now interpreted to be monitoring the C-Zone.

Hydrology, Hydrogeology and Groundwater Flow

Hydrology

The Letart Landfill engineered cap system prevents surface water from contacting landfilled materials. Precipitation falling on the engineered cap system takes one of two paths. It may infiltrate downward through the vegetated soil and encounter the impermeable geomembrane and then flow laterally downslope on top of the geomembrane. Alternatively, precipitation may flow via overland flow on top of the vegetative layer downslope. In either situation, this surface water does not contact the landfilled materials and migrates downslope toward drainage ditches constructed in or adjacent to the cap system. Precipitation falling on the northwest side of the upper part of the cap flows downslope toward the southwest, away from the landfill, into a drainage ditch that flows to a sediment trap near LMW-6. Precipitation falling on the remaining portions of the cap flows downslope and toward the south in drainage ditches.

Hydrogeology

Hydraulic conductivity testing [i.e., slug tests (A-Zone) and borehole packer tests (C-Zone, D/E-Zone, and F-Zone)] of the bedrock zones indicates that these zones display low hydraulic conductivity (Tetra Tech Richardson, 1990). The A-Zone hydraulic conductivity is low, ranging from 10^{-4} cm/sec to less than 10^{-5} cm/sec. (There are no wells monitoring the B-Zone; therefore, it was not tested.) The C-Zone and the F-Zone have very low hydraulic conductivities ranging from 10^{-6} cm/sec to less than 10^{-8} cm/sec. The D/E-Zone hydraulic conductivities also are very low and range from 10^{-5} cm/sec to 10^{-8} cm/sec. The low hydraulic conductivities can be attributed to the very fine-grained nature of the water-bearing units. In addition, many sandstone units in the region typically display effective porosity as low as 1 percent. This low porosity results from pore space being filled in by authigenic minerals (e.g., kaolinite) sometime after original sediment deposition.

The F-Zone has been designated the "underlying significant aquifer" as defined by the West Virginia Solid Waste Management Regulations because it is laterally continuous under the landfill and is thought to be hydraulically connected to the Ohio River south of the landfill. The F-Zone groundwater average linear velocities were calculated for flow from the north to the southwest and from the north to the southeast (DuPont, 2000). These values are relatively low, 0.01 and 0.003 ft/day, respectively. The low velocities calculated in the F-Zone indicate that groundwater flow beneath the landfill is very slow, attributable to the low hydraulic conductivity present in the F-Zone and all the overlying units as well. Low vertical hydraulic conductivities in the overlying shallow zones limit infiltration and recharge down to the F-Zone.

The saturated thickness of F-Zone is higher in the upgradient wells (LMW-2A and LMW-11) and is lower in the downgradient wells (LMW-6, LMW-13B, LMW-14B, and LMW-10). In many instances, the monitoring wells at the landfill cannot be sampled until 48 hours (or longer) after purging, when a sufficient quantity of groundwater has recovered in the well screen interval. LMW-10 appears to essentially be dry (see Table 5.2).

Groundwater Flow

Groundwater elevation contour maps for the significant underlying aquifer (F-Zone) were prepared as required by the WV/NPDES Permit No. WV0076538. Table 5.2 provides groundwater elevation data for wells in the monitoring program. Figure 5.10 presents a groundwater elevation map for 4Q02 data from the D/E-Zone. Figure 5.11 presents groundwater elevation map for 4Q02 data from F-Zone. Note that Figure 5.11 has been revised compared to the groundwater elevation map for 4Q02 that was provided in the 4Q02 groundwater and surface-water monitoring report. Figure 5.11 now includes the new wells that monitor the F-Zone. LMW-9, which is screened below the F-Zone, has been removed.

Groundwater flow in both the D/E-Zone and the F-Zone is basically from the north toward the south. For Figure 5.10, the 4Q02 groundwater elevation contour map for the D/E-Zone, two wells that monitor this zone were not used. The D/E-Zone becomes quite complicated in the southern portion of the landfill area. In the very northern areas, the D/E-Zone does not exist. In the north-central portion of the landfill area, the D/E-Zone appears as a single lithological unit. In the south-central part, the D/E-Zone splits into a thinner upper unit and a thicker lower unit. At the toe of the landfill are three wells that monitor the D/E Zone, two are screened in the upper unit (LMW-3A and LMW-4) and one (LMW-5B) is screened in the lower unit. Although these wells are relatively close together, the groundwater elevations measured in these three wells differ significantly. Therefore, LMW-3A and LMW-4 were not used in constructing the groundwater elevation map because the elevations that were observed in these wells were not thought to be representative of overall groundwater flow within this zone. In general, ground water flow in this zone is from the north toward the south.

Figure 5.11 presents the 4Q02 groundwater elevation map for the F-Zone. In this zone, groundwater also flows from the north. However, in the southern portion of the landfill, groundwater flow starts to be perpendicular the Ohio River and flows toward the southeast. For this groundwater elevation map, the water level measured for LMW-10 was not used. Table 5.2 shows that water levels in this well have consistently been within 1 foot of the bottom of the screen, and sampling this well has been difficult because the well frequently goes dry during purging and is very slow to recharge. In addition, water levels in this well are much lower than expected compared to adjacent wells.

The location and limited number of monitoring wells within the A-Zone and the C-Zone prevents determination of groundwater flow directions within these zones. However, elevations measured in the monitoring wells indicate a downward vertical gradient within the site groundwater system.

Rapid decreases in the observed volume of water discharging from the leachate collection system in 2001 indicate that groundwater flow under the landfill is being greatly reduced in response to the installation of the engineered cap system.

Water Quality

Groundwater Quality

Table 5.3 presents all historical analysis available for C-8 from monitoring wells at the Letart Landfill. Data in this table are presented and discussed by zone.

Figure 5.7 shows a cross-section through the southern end of the Letart Landfill. Prior to the filling of the valley, this cross-section shows that the A-Zone, the B-Zone, and the C-Zone most likely outcropped in the western valley wall, the C-Zone outcropped in the eastern valley wall, and the D/E-Zone likely outcropped in the valley floor. Further up the valley toward the north, it is likely that the A-Zone, the B-Zone, and the C-Zone outcrop on both the western and eastern sides of the valley. The landfill is an unlined landfill. This means that C-8 impacted water migrating through the landfilled material prior to the installation of the engineered cap may have been able to migrate directly into the C-Zone, then the B-Zone, then the A-Zone as the landfill was filled. The groundwater elevations also indicate that there is an overall downward gradient from the A-Zone to the F-Zone. This downward gradient also would help transport C-8 downward from one zone to the next lower zone. Groundwater flow within the zones also would move C-8 around within the individual zone. However, the installation of the engineered cap will minimize the amount of precipitation able to infiltrate into the landfilled material.

The concentration of C-8 in the various wells in the different zones indicated that the C-8 impact is the greatest at differing locations within the zones, which is expected given that the C-8 concentration in the landfilled materials was most likely highly variable. In the A-Zone, LMW-1 shows the highest concentrations; and, in general, the C-8 concentrations appear to be increasing over time for all three wells. In the C-Zone, C-8 concentrations have been higher in LMW-3 than in LMW-5A. In the D/E-Zone, the highest C-8 concentrations are found in LMW-4 and LMW-5B, both located at the toe of the landfill. In the F-Zone, LMW-2A, which is located near the northern edge of the landfill, has the highest C-8 concentrations. In LMW-9, which monitors a zone lower than the F-Zone, C-8 concentrations have always been less than 1 ug/l.

C-8 concentrations in groundwater from 28 residential wells located within a one-mile radius of the Letart Landfill have concentrations that are ND or NQ (DuPont, 2002a). Two groundwater samples had higher values, 0.139 and 0.636 ug/l. These data indicate that although the groundwater in the zones under and near the landfill cell has higher levels of C-8, the C-8 impacted groundwater has not migrated far. The 0.139 ug/l sample is located amongst many other samples that had C-8 concentration of ND or NQ. The location of the 0.636 ug/l sample is almost the same location as where the Rt. 33 Stream sample is collected. C-8 concentrations in the Rt. 33 Stream sample have ranged from 0.573 to 3.92 ug/l. It is possible that this well is in communication with C-8 impacted surface water at this location. The stream that is being sampled does receive surface-water runoff from the landfill. The C-8 concentration measured within the One-mile radius are significantly lower that the CATT-established C-8 SL a of 150 ug/l.

In the Compilation of Historical Data Report (DuPont, 2002b), the annual loading of C-8 to the Ohio River from C-8 impacted groundwater at Letart Landfill was calculated. The estimation was based on the assumption that impacted groundwater flows from the A-Zone downward to the F-Zone and ultimately migrates to the Ohio River. The C-8 historical mean for LMW-5B can be used along with the estimated groundwater flux to calculate the C-8 loading to the river. The estimated annual loading was 1 x 10-3 lb/yr. This calculated mass is reasonable given the low hydraulic conductivities and low average linear velocities observed in the F-zone. This annual loading should result in a very low C-8 concentration in the Ohio River.

The annual loading estimation was recalculated using a new historical mean value for the C-8 concentration in LMW-5B now that more C-8 monitoring data are available. The new mean value is 1,149 ug/l, higher than the previous mean used. Therefore, the revised annual loading estimate is 0.017 lb/yr, also higher than previously estimated. The revised annual loading also should result in a very low concentration in the Ohio River. The measured C-8 concentrations in the Ohio River near the Letart Landfill are indeed low, with the maximum concentration measured being 0.128 ug/l. These concentrations are orders of magnitude lower than the C-8 SL of 150 ug/l and the Aquatic Life Advisory Concentration for C-8 (C-8 ALAC) of 1,360 ug/l.

Surface-water Quality

Table 5.4 presents the C-8 results for surface-water locations monitored at the Letart Landfill. Sampling locations, Outfall 002, Cap Runoff, and Stormwater Runoff are associated with leachate from the landfill and have had the highest C-8 concentrations measured in surface water at the Letart Landfill. Cap Runoff and stormwater runoff have had C-8 concentrations ranging from 50.9 to 317 ug/l. Outfall 002, which discharges leachate and stormwater runoff, has had highly variable C-8 concentrations that have ranged from 4.52 to 2,050 ug/l since the installation of the landfill cap. Outfall 003, which discharges stormwater runoff, has been dry or has had C-8 concentration lower than 0.4 ug/l. The Brinker Run sample, which was collected from a stormwater drainage ditch, had a very low C-8 concentation, 0.0612 ug/l. Stormwater runoff from the northern part of the landfill flows down the stormwater drainage ditch, off the property and into Brinker's Run. Brinker's Run discharges into a pond that is located off the north side of the landfill property. The Rt. 33 Stream sample is collected at the point where Brinker's Run enters the pond. The C-8 concentrations for the Rt. 33 Stream samples have ranged from 0.573 to 3.92 ug/l. The pond then discharges to the Ohio River. Other than Outfall 002 and Cap Runoff samples, all the surface-water samples for the Letart Landfill are less than the drinking water and the C-8 ALAC (WVDEP, 2002; Menzie-Cura & Associates, 2002).

5.5.2 Current Human Health and Ecological Exposure Pathways

The main objective of the Consent Order was to determine whether there has been an impact on human health and the environment as a result of releases of C-8 to the environment from DuPont operations at the Washington Works facility and the associated landfills (Local, Letart, and Dry Run). Therefore, human health and ecological exposure pathways both on-site (at the Letart Landfill) and off-site (adjacent to the Letart Landfill) must be considered. The human health and ecological exposure pathway sections below describe the potential exposure routes for human and ecological receptors on- and off-site. Potential exposure routes were evaluated and classified as complete or incomplete. Table 5.5 summarizes the human health and ecological exposure pathway evaluation for the Letart Landfill. To be conservative, for each complete exposure pathway, the maximum C-8 concentration measured in the C-8 impacted media is compared to the C-8 SL, regardless of media type.

On-Site Human Health and Ecological Exposure Pathways Current Environmental Setting

This section describes the potential exposure routes for human and ecological receptors that are found at the Letart Landfill. On-site human receptors include authorized facility workers and facility contractors. Ecological receptors include animals living within the landfill boundaries. Potential exposure routes were evaluated and classified as complete or incomplete.

The Letart Landfill closure was completed in April 2001 with the installation of an engineered cap system. The cap system drainage controls were designed to convey the runoff from the landfill cap to a designated discharge point and to eliminate the potential for runoff-related erosion of the cap. In addition, the landfill cap is required to be inspected at least quarterly (permit requirement C.12.A) for evidence of erosion as part of the landfill's Stormwater Pollution Prevention Plan. The engineered cap system prevents human and ecological contact with the landfilled materials and soils that may have been impacted by C-8. Contact with C-8 containing landfilled materials and soils is considered an incomplete exposure pathway to human and ecological receptors.

The Letart Landfill engineered cap system also prevents surface water from contacting landfilled materials. Surface water flows toward drainage ditches constructed in the cap system and is discharged at the southern edge of the landfill. Because this surface water does not contact the landfilled materials, it is not impacted by C-8. However, leachate discharging from the leachate collection system is piped to Outfall 002 (leachate basin), where it mixes with stormwater runoff. Outfall 002 enters a small, wet-weather stream that flows approximately 400 feet before it discharges to the Ohio River. However, exposure is limited because of the remote location of the landfill, the very steep terrain, and the wet-weather nature of the stream. In addition, fencing limits access to the area. Further, the use of health and safety plans, standard operating procedures, and personal protective equipment also limit exposure. The highest C-8 concentration measured in leachate since the installation of the landfill cap was 2,050 ug/l. The highest C-8 concentration measured in the Ohio River adjacent to where this wet-weather stream enters the river was 0.128 ug/l.

The D/E-Zone and the F-Zone exist at elevations lower than the leachate collection system. Groundwater flowing from these zones to the south discharges to the Ohio River. Contact with this water is limited to the areas where these zones may outcrop on the valley walls. However, in general, groundwater flows downslope within the shallow soil, colluvium, and fractured rocks of the valley walls and would only be exposed at the surface if seeps exist. Field reconnaissance did not identify any seeps in the valley walls; therefore, this exposure pathway for human and ecological receptors is incomplete.

Off-site Human Health and Ecological Exposure Pathways

Off-site human receptors include residents using the water sources sampled during the groundwater well and water-use survey. Ecological receptors include livestock using the water sources sampled during the groundwater well and water-use survey.

West Virginia One-Mile Radius Groundwater and Surface Water

Direct exposure to C-8 impacted surface water and groundwater is an incomplete pathway in situations where the water source is not used. The pathway is considered to be a complete pathway in situations where the water source is used, but not for drinking-water purposes, although the exposure is considered to be minimal because the water is not ingested. The highest C-8 concentration in a non-drinking-water sample was NQ, well below the C-8 SL of 150 ug/l . The pathway is considered to be complete if the well is used for drinking-water purposes. The highest C-8 concentration measured in drinking water was 0.139 ug/l, significantly lower than the CATT-established C-8 SL of 150 ug/l (WVDEP, 2002). Therefore, even though the pathway is complete, it also is limited due to the low C-8 concentrations measured.

5.6 Letart Landfill Summary

Many different activities have been conducted at and around the Letart Landfill in order to determine whether there has been an impact on human health and the environment as a result of releases of C-8 to the environment from the landfill. The C-8 concentration in groundwater and surface water from many sources (on-site, off-site, monitoring wells, production wells, private wells, and Ohio River water) was measured. Based on all of the data evaluated for the Letart Landfill, the following observation were made:

- The current exposure pathways are incomplete for human and ecological receptors contact with the following C-8 impacted media:
  - On-site landfilled materials
  - On-site soil
  - On-site groundwater
- Human and ecological receptors contact with C-8 impacted surface water and leachate (Cap Runoff and Outlet 002) discharging to the wet-weather stream at the toe of the landfill are currently complete exposure pathways. The highest C-8 concentrations measured at these locations are 371 and 2,050 ug/l, respectively. However, exposure is limited because of the remote location of the landfill, the very steep terrain, and the wet-weather nature of the stream. In addition, fencing limits access to the area. Further, the use of health and safety plans, standard operating procedures, and personal protective equipment also limit exposure.
- Current off-site exposure pathways for human and ecological receptors that are complete but limited, due to the very low C-8 concentration measured, include residential drinking and non-drinking-water sources and river water. For the drinking and non-drinking-water sources, the highest C-8 concentrations measured were 0.139 and NQ, respectively, which are well below the C-8 SL of 150 ug/l (WVDEP, 2002). The highest C-8 concentration measured in Ohio River water is 0.128 ug/l, well below the C-8 SL of 150 ug/l and the 1,360 ug/l C-8 ALAC developed by the CATT (Menzie-Cura & Associates, 2002).
- Groundwater flow in the site significant aquifer under the landfill is toward the southwest and the Ohio River. C-8 impacted groundwater from the water-bearing zones at Letart Landfill ultimately flows into the Ohio River.
- Evaluation of the groundwater flow directions at the landfill and of the Letart one-mile radius C-8 results shows that C-8 impacted groundwater is not migrating toward off-site residences.
- The revised C-8 annual loading estimate from groundwater indicates a very low C-8 concentration in the Ohio River from the Letart Landfill. This low estimated concentration is supported by C-8 concentrations measured in the Ohio River

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(0.128 ug/l) that are well below the C-8 SL and the C-8 ALAC that were determined by the CATT (WVDEP, 2002; Menzie-Cura & Associates, 2002).

- The transport pathway of C-8 at the Letart Landfill is believed to be via water transport from C-8 containing landfill materials.
- Air emission of C-8 as a migration pathway is not possible because there are no air emissions at the Letart Landfill. In addition, the Letart Landfill is too far away from the Washington Works facility to be impacted by C-8 containing air emissions emanating from the facility.

6.0 DRY RUN LANDFILL

6.1 Introduction

The Dry Run Landfill is located west of the town of Lubeck, in Wood County, West Virginia, about eight miles southwest of the Washington Works facility and the Local Landfill (see Figure 6.0). The landfill covers approximately 17 acres of a 535-acre parcel of land owned by DuPont. The landfill was constructed within the drainage basin of Dry Run, a tributary of the North Fork of Lee Creek, which is a tributary of the Ohio River. The landfill began operation in 1986 and the central portion is still active and operates under WV/NPDES Permit No. WV 0076244. The upper portion of the landfill is closed and is covered with a soil and vegetative cover. The lower portion of the landfill also is closed and is covered by a engineered landfill cap. Consent Order required tasks to be conducted at or immediately adjacent to the Dry Run Landfill included the following:

- Task A: Groundwater Well and Water-Use Surveying and C-8 Sampling—conduct a distance-phased groundwater well and water-use survey identifying and sampling all groundwater wells, springs, and cisterns within a one-mile (and possibly two- and three- mile) radial distance of the facility and the Dry Run Landfill.
- Task B: Assessment of Existing Groundwater and Surface Water Monitoring Data—conduct monthly sampling for C-8 will be performed at Dry Run Landfill at outfalls identified in WV/NPDES Permit No. WV0076244 as Outfalls 001, 003, and 004. C-8 samples were to be taken from all the wells at the Dry Run Landfill monthly for the first four months and quarterly thereafter.
- Task C: Plume Identification/Groundwater Assessment—determine the vertical and horizontal extent of C-8 impacted groundwater exceeding 1 ug/l or as directed by the GIST at Dry Run Landfill.

In Sections 6.2 through 6.4, discussions of the specific activities conducted to meet the requirements of the Consent Order are discussed along with the new data generated during these activities. In Section 6.5, the revised site conceptual model that better represents the current environmental setting (geology, hydrology, hydrogeology, groundwater flow, and water quality) and current human health and ecological exposure pathways for the conditions at and surrounding the Dry Run Landfill is presented.

6.2 Task A: Groundwater Well and Water-Use Surveying and C-8 Sampling

The groundwater well and water-use survey and sampling within the one-mile radius of the Dry Run Landfill were completed on February 28, 2002. DuPont submitted the results of the one-mile radius survey to the GIST in April, 2002 (DuPont, 2002a).

Table 6.0 summarizes the off-site surveying and sampling program for the one-mile radius. A total of 64 homes were surveyed, and a total of 53 water sources (wells, cisterns and springs) were sampled. Thirteen wells, one cistern, and one spring sampled were used as drinking-water sources. Table 6.1 provides details for each sample collected including the C-8 concentration measured (ug/l). Figure 6.1 shows the locations of all samples collected, regardless of water use. Each colored circle represents a sampling location, and the color and size of the circle indicate the magnitude of the C-8 concentration measured. Small blue circles represent samples having C-8 concentrations less than 0.05 ug/l. Small green circles represent samples having C-8 concentrations ranging from to 0.05 to 1.0 ug/l.

The C-8 concentrations measured in all the Dry Run Landfill one-mile radius samples were less than 1.0 ug/l. The highest C-8 concentrations measured for unused and non-drinking-water sources were 0.974 and 0.54 ug/l. Seven of the 15 drinking-water samples were ND or NQ, and the range of C-8 concentrations in the other eight drinking-water samples was between 0.0505 and 0.339 ug/l. Based on the very low C-8 concentrations measured when compared to the human health protective screening criteria for water (C-8 SL) of 150 ug/l, the GIST determined that no further surveying and sampling was needed. However, the GIST did require resampling of the eight drinking-water sources with measurable concentrations of C-8. Residents of five of the eight drinking-water sources declined to have their water sources resampled. Resampling of the three drinking-water sources was completed in April 2002. C-8 concentrations ranged from NQ to 0.422 ug/l in these samples (DuPont, 2002h).

In addition, a surface-water sample was taken from the Lee Creek near the Graham residence, which is located a few miles west-northwest outside of the Dry Run one-mile radius. This sample was taken to evaluate C-8 quality in the Lee Creek before it discharges to the Ohio River. The Dry Run creek, which begins at the toe of the landfill, discharges surface water to the Lee Creek. The C-8 concentration measured was 0.28 ug/l (DuPont, 2002h). At this same residence, a drinking-water well and a spring used for non-drinking-water purposes also were sampled and analyzed for C-8. The C-8 concentrations measured in these water sources were ND and 0.331 ug/l, respectively.

6.3 Task B: Assessment of Existing Groundwater and Surface-water Monitoring Data

6.3.1 Monitoring of C-8 in Groundwater and Surface Water at Dry Run Landfill

Groundwater Monitoring

The Consent Order required that all monitoring wells at Dry Run Landfill be sampled for C-8. Monthly C-8 sampling of groundwater began in December 2001, and quarterly sampling began in May 2002. Table 6.2 provides a list of the monitoring wells included in the groundwater monitoring program for Dry Run Landfill. Well construction data and groundwater elevation data also are provided in this table. At the time monitoring started, eight monitoring wells were installed at the Dry Run Landfill. Another seven wells were installed during 3Q02 as part of the C-8 plume delineation work plan, and these new wells were included in the monitoring program starting in 4Q02 (DuPont, 2002k).

Figure 6.2 shows the location of the monitoring wells. Table 6.3 presents the C-8 concentrations measured in these monitoring wells, including C-8 data acquired prior to the issuing of the Consent Order. The most recent data are listed first for each well. The water-bearing units at Dry Run are named from ground surface to depth as the Overburden, and the A-Zone, the B-Zone, and the C-Zone.

Wells monitoring the overburden include DRMW-6A, DRMW-12A, DRMW-12B, DRMW-13A, and DRMW-21A. DRMW-13A has shown the highest C-8 concentrations in overburden, ranging from 0.07 to 15 ug/l. This well is located at the toe of the landfill. DRMW-6A has shown a C-8 concentration range of 0.096 to 1.24 ug/l. DRMW-12A, DRMW-12B, and DRMW-21A have had much lower C8 concentrations, ranging from ND to 5.4 ug/l.

Wells monitoring the A-Zone include DRMW-16B, DRMW-17B, DRMW-18B, DRMW-19B, and DRMW-20B. DRWM-14 is a continuous open hole; therefore, effectively monitors all water-bearing sandstone and siltstone units above the A-Zone as well as the A-Zone. All of these wells are new wells, except DRMW–14, and have only been sampled one time. C-8 concentrations in these new wells has ranged from ND to 0.155 ug/l. C-8 concentration in DRMW -14 has ranged from <0.1 to 2.5 ug/l.

Wells monitoring the B-Zone include DRMW-12, DRMW-13, and DRMW-15. DRMW-12 has shown the lowest C-8 concentrations, ranging from <0.1 to 0.16. DRMW-15 has had higher C-8 concentrations ranging from 0.263 to 5.0 ug/l. DRMW-13, which is located at the toe of the landfill, has had the highest concentration of C-8, ranging from 3.6 to 20.9 ug/l.

Only one well monitors the C-Zone, DRMW-21B. This is a new well that has only been sampled once, and the C-8 concentration measured was NQ.

The next groundwater sampling event for the facility is scheduled for the first quarter 2003.

Surface-water and Leachate Monitoring

The Consent Order identified three outfalls at the Dry Run Landfill (regulated by WV/NPDES Permit No. WV0076244) where monthly C-8 sampling was to be performed, Outfalls 001, 003, and 004. (Outfall 002 is a required outfall sampling location as stated in the WV/NPDES permit. However, it was a temporary relocation of Outfall 001 and no longer exists). Outfall 001 collects stormwater and leachate. Outfalls 003 and 004 collect stormwater only. Monthly sampling of these three outfalls began in December 2001. In addition, there are five other locations that are sampled quarterly for C-8. These include Stream Samples-1 (SS-1) and -2 (SS-2), Pond Underdrain, Property Boundary, and DR Leachate. The locations of the surface-water and leachate sampling points are shown in Figure 6.2. The Property Boundary sample location is located along the western property boundary where the Dry Run creek crosses over the property boundary (see Figure 6.0). Table 6.4 provides the C-8 concentrations measured in the outfalls and leachate, including C-8 data acquired prior to the issuing of the Consent Order. The most recent data are listed first for each outfall.

Outlet 004 is upgradient and flows into SS-1. SS-1, Outlet 001, Outlet 003, and Pond Underdrain flow into SS-2, which flows ultimately into the Property Boundary sampling point.

Outlet 004 has had no-flow conditions in 10 of 12 sampling events. In the two events in which samples could be taken, the C-8 concentrations were 0.7 and 158 ug/l, making it difficult to determine a representative C-8 concentration for this location. SS-1 has shown the lowest C-8 concentrations, ranging from 0.54 to 1.63 ug/l. The C-8 concentrations in Outlet 003 and Property Boundary have been higher, ranging from 0.88 to 39 ug/l, although, Outlet 003 has had no-flow conditions in nine of the 12 sampling events. The Outlet 001, SS-2 and Pond Underdrain sampling locations have shown C-8 concentrations ranging from 4.6 to 87 ug/l.

The DR Leachate sampling point, from which leachate is sampled, has shown the highest C-8 concentrations in surface water, ranging from 27.4 to 704 ug/l. The inactive lower half of the landfill is covered by geotextiles and geomembranes of the leachate collection system. Leachate at the Dry Run Landfill does not discharge to surface water. Leachate is captured by the leachate collection system at Dry Run and is transported to the Washington Works facility where it is treated.

Outfall sampling for December 2002 has been completed, and the monitoring report will be issued to the GIST in February 2003. Outfall sampling for January 2003 has been completed, but the C-8 results have not yet been validated. The next monthly outfall sampling event is scheduled for February 2003.

6.4 Task C: Plume Identification/Groundwater Assessment

Based on the data gaps identified in the Compilation of Historical C-8 Data Report (DuPont, 2002b), the C-8 Plume Identification/Groundwater Assessment Work Plan was developed and submitted to the GIST (DuPont, 2002e). Included in this work plan were specific activities recommended to fill the data gaps. In the following sections, each of the activities recommended in the C-8 plume delineation work plan is summarized briefly. Details of the activity status and the data acquired are then presented.

6.4.1 C-8 Monitoring in Groundwater and Surface Water at Dry Run Landfill

Continuing to monitor C-8 in groundwater in the overburden and in the underlying bedrock aquifer (utilizing the newly installed monitoring wells), and in surface water at existing locations identified in the Consent Order, was an activity recommended in the C-8 plume delineation work plan. The results of continued monitoring of groundwater and surface water are presented in Section 6.3.1. Monitoring of C-8 in groundwater continues on a quarterly basis, while surface-water monitoring of C-8 is conducted on a monthly basis. In addition, sampling of Lee Creek, which crosses the site boundary, also was recommended in the C-8 plume delineation work plan. This sample was recommended to evaluate C-8 concentrations further downstream from the landfill than pre-existing surface-water monitoring points. The Dry Run creek begins at the toe of the landfill and then discharges to Lee Creek, which discharges to the Ohio River. This sample was collected, and the C-8 results are presented in Section 6.3.1.

6.4.2 Surface-water Field Reconnaissance at the Dry Run Landfill

Conducting field reconnaissance to identify additional surface-water features located at the Dry Run Landfill and sampling surface water from new locations identified during this effort was a C-8 plume delineation recommended activity. Field reconnaissance was performed (during drought conditions) and no new surface-water features were identified beyond those locations that are currently sampled.

6.4.3 Installation of New Wells at Dry Run Landfill

Six additional well clusters (overburden and bedrock) were installed as proposed in the C-8 plume delineation work plan to better characterize the bedrock at the Dry Run Landfill, to further delineate C-8 concentrations in groundwater and to re-evaluate groundwater flow direction. During implementation of field activities, overburden was minimal or was dry at most locations; therefore, five bedrock wells and one well cluster were installed. Figure 6.2 shows the locations of all monitoring well at the Dry Run Landfill including the locations of the newly installed monitoring wells. Well construction diagrams for the new wells, are provided in Appendix D.

The geological logs for the five bedrock wells and the one well cluster installed in 3Q02 confirm previous interpretations of subsurface conditions at the Dry Run Landfill. Clay, silty clay, or fill material is underlain by bedrock, consisting of alternating layers of sandstone and siltstone separated by layers of shale. Further, the new geologic logs also confirm that the lithologic units are essentially horizontal. New to our geological interpretation is the identification of three individual water-bearing bedrock zones labeled as A-Zone, B-Zone, and C-Zone. These zones are discussed in detail in Section 6.5.1.

6.4.4 Dry Run Site Conceptual Model Refinement

The final recommended activity for the Dry Run Landfill was the integration of all the new data gathered during completion of Tasks A, B, and C into a revised SCM. This activity has been completed, and the revised SCM is presented in the following section.

6.5 Revised Site Conceptual Model

The revised SCM ideally should accurately represent the current environmental setting (geology, hydrology, hydrogeology, groundwater flow, and water quality) and current human health and ecological exposure pathways for the conditions at and surrounding the Dry Run Landfill. The following sections present the revised SCM in detail.

6.5.1 Current Environmental Setting

Geology

The locations of four cross-sections developed for the Dry Run Landfill are shown in Figure 6.3. Two cross-sections, A-A' and B-B', were presented in the Compilation of Historical Data Report (DuPont, 2002b). Cross-section A-A' was based on minimal data. This original cross-section has been abandoned, and a new cross-section A-A', which includes many of the new wells installed in 3Q02, was generated. This new cross-section

A-A', which runs northwest to south east along the northeast side of the landfill, is presented in Figure 6.4. Cross-section B-B', running north to south across the toe of the landfill, has been modified slightly but the basic information in the cross-section remain. The modified cross-section B-B' is presented in Figure 6.5. In addition, cross-sections A-C' and D-B' (see Figures 6.6 and 6.7), which include the new wells, were developed. Cross-section A-C runs from the northwest to the southeast on the southwest side of the landfill. Cross-section D-B' runs across the center of the landfill crossing from the northeast to the southwest.

The Dry Run Landfill is situated on a heavily dissected plateau consisting of several steep V-shaped valleys. Residual soil covers most landfill areas. In general, the soil at the site has been described as residual in nature, consisting primarily of heavy clays derived from the weathering of shale.

A geotechnical investigation of the overburden underlying the Dry Run Landfill was completed by DuPont (1996). The investigation consisted of advancing soil test borings, test pits, laboratory testing of soil physical properties, stability analyses, and settlement analyses. DuPont (1996) determined that the natural residual soil underlying the landfilled materials consisted of stiff to very hard silty clay and clayey silt with occasional rock fragments and a trace of sand. The thickness of this natural soil ranged from 12 to 28 feet in the test borings within the landfilled area. In 1989, a monitoring well installation program, performed by Tetra Tech Richardson Inc., indicated similar silty clay and weathered shale overburden. Currently, there are five monitoring wells that monitor the water-bearing overburden (DRMW-6A, DRMW-12A, DRMW-12B, DRMW-13A, and DRMW-21A) at the Dry Run Landfill (see Figures 6.4 through 6.6). Completion depths for these wells range from approximately 12 to 20 feet bgs.

The underlying bedrock at the Dry Run Landfill consists of inter-bedded red and varicolored sandy or calcareous shales, and gray, green, and brown sandstones and/or siltstones of the Permian age Dunkard Group. Based on the new geological data, three separate water-bearing siltstones and/or sandstone units have been identified within the bedrock at Dry Run. These zones are shown on the cross-sections when possible. These are labeled the A-Zone, the B-Zone, and the C-Zone, with the A-Zone being the uppermost unit and the C-Zone being the lowest unit bgs. The A-Zone is laterally continuous under most of the landfill area, while the B-Zone is known to be laterally continuous under the toe of the landfill in the northwest. None of the new wells were drilled deep enough to encounter the C-Zone. The B-Zone was not observed in DRMW-14, the well located furthest to the southeast. However, no additional sandstone or siltstone units were encountered under the A-Zone at the projected elevation of the B-Zone. The C-Zone was only encountered at the furthest northwest location, DRMW-21B.

Hydrology, Hydrogeology and Groundwater Flow

Hydrology

The Dry Run Landfill is situated on a heavily dissected plateau consisting of several steep V-shaped valleys. The Dry Run creek drains the valley in which the landfill is located.

Many small tributaries discharge from the nearby valleys into the Dry Run creek before it joins up with the North Fork of Lee Creek.

The installation of landfill cap and a leachate collection system at the Dry Run Landfill encompassing the inactive lower half of the landfill was completed by Potesta & Associates, Inc. in 1999. Leachate from the landfill discharges into a leachate collection sump located northwest of the landfill (see Figure 6.2) through perforated pipes buried at the low edge of the fill area. The leachate is pumped from the collection sump to a 50,000-gallon collection tank located at the top of the hill. Leachate is pumped from the collection tank to a tanker truck, which is then hauled to the facility for treatment in the wastewater treatment plant.

Six surface-water sampling points are located near the toe of the landfill (see Figure 6.2). Four of these six points are man-made monitoring points associated with the leachate collection system and the lower landfill cap. Two points, SS-1 and SS-2, monitor surface water in streams located near the toe of the landfill. Ultimately, all of these surface-water monitoring points discharge into Dry Run creek. Dry Run creek ultimately discharges into Lee Creek. Lee Creek discharges into the Ohio River.

Hydrogeology

Groundwater occurs in the overburden and the underlying bedrock aquifers. A total of 22 monitoring wells were installed at the Dry Run Landfill to monitor the overburden and bedrock aquifers. Currently, five overburden wells and 10 bedrock wells still exist. The other seven wells were abandoned in 1999 by Potesta & Associates, Inc. as required by the permit because these wells were not being utilized for quarterly monitoring (Potesta & Associates, 1999).

Groundwater Flow

In the 4Q02 Surface Water and Groundwater report (DuPont, 2002k), revised groundwater elevation maps for 2Q02, 3Q02 and 4Q02 were generated. These maps did not include data from the new wells because the site conceptual model had not yet been revised. Using the new geological interpretation of three distinct water-bearing zones and using groundwater elevation data from the new wells, new groundwater elevation contour maps were constructed for the A-Zone and the B-Zone using 4Q02 data. These maps are presented in Figures 6.8 and 6.9. The groundwater elevation map for the A-Zone (see Figure 6.8) shows that overall the direction of groundwater flow is toward the west. DRMW-14 was not used in the construction of this map because it is an open hole well and water levels measured in this well may be influenced by shallow water bearing zones that are higher in elevation than the A-Zone. Figure 6.9 shows the direction of groundwater flow in the B-Zone. The groundwater contour lines on this map are dashed because there are very limited data for the zone. However, groundwater flow direction in this zone also is generally toward the west. Groundwater flow directions in the underlying the C-Zone cannot be determined because there is only one well in the zone. However, a downward vertical gradient is indicated from the A-Zone to the B-Zone and to the C-Zone based on groundwater elevations observed in the three zones.

Water Quality

Groundwater Quality

Groundwater quality data for the Dry Run Landfill were presented in detail in Section 6.3.1. Fifteen wells monitor the overburden and the three underlying water-bearing zones (A-Zone, B-Zone, and C-Zone) at the Dry Run Landfill. The highest concentrations of C-8 measured in the overburden and underlying zones are found in the wells that are the closest to the toe of the landfill. The highest C-8 concentration measured in groundwater at the Dry Run Landfill is 20.9 ug/l, significantly lower that the CATT-established C-8 SL of 150 ug/l. The highest concentration of C-8 in groundwater used as drinking-water source by residences located within a one-mile radius of the landfill was 0.422 ug/l. The highest concentrations of C-8 in groundwater used as non-drinking-water and unused sources by residences located within a one-mile radius of the landfill was 0.54 and 0.974 ug/l, respectively. These values are also significantly lower that the C-8 SL of 150 ug/l.

Surface-water and Leachate Quality

Surface-water and leachate quality was discussed in detail in Section 6.3.1. Surface-water and leachate sampling points have been monitored at the Dry Run Landfill. The leachate samples have shown the highest C-8 concentrations with a maximum concentration of 704 ug/l. It is expected that leachate from the landfill would have the highest concentration of C-8 because the source for the C-8 is likely the landfilled materials. Leachate at the Dry Run Landfill does not discharge to surface water. It is collected at the landfill and is treated at the facility. Six of the surface-water sampling points are located in the vicinity of the toe of the landfill, and four of these are associated with the landfill cap. The four sampling points associated with the landfill cap flow into the other two sampling points located on streams that discharge stormwater from the area. The maximum concentration measured for these six sampling points has been 87 ug/l. The other sampling point is located at the western property boundary. The highest concentration of C-8 observed at this location has been 39 ug/l, although, seven of the 11 samples collected from this point have had C-8 concentration less than 10 ug/l. With the exception of the leachate samples, the C-8 concentration of all surface-water samples have been less than the CATT-established C-8 SL of 150 ug/l. Further, these concentrations are significantly less than the Aquatic Life Advisory Concentration for C-8 (C-8 ALAC) of 1,360 ug/l.

6.5.2 Current Human Health and Ecological Exposure Pathways

The main objective of the Consent Order was to determine whether there has been an impact on human health and the environment as a result of releases of C-8 to the environment from DuPont operations at the Washington Works facility and the associated landfills (Local, Letart, and Dry Run). To meet this objective, human health and ecological exposure pathways both on-site (at the Dry Run Landfill) and off-site (adjacent to the Dry Run Landfill property) must be evaluated. The human health and ecological exposure pathway sections below describe the potential exposure routes for human and ecological receptors on- and off-site. Potential exposure routes were evaluated and classified as complete or incomplete. Table 6.5 summarizes the human health and ecological exposure pathway evaluation for the Dry Run Landfill. To be conservative, for each complete exposure pathway, the maximum C-8 concentration measured in the C-8 impacted media is compared to the C-8 SL, regardless of media type.

On-Site Human Health and Ecological Exposure Pathways Current Environmental Setting

The on-site current human health and ecological exposure pathways section describes the potential exposure routes for human and ecological receptors that are found at the Dry Run Landfill. On-site human receptors include authorized facility workers and facility visitors. Ecological receptors include animals living within the landfill boundaries. Potential exposure routes were evaluated and classified as complete or incomplete.

Access to the Dry Run Landfill by is controlled by electronic gates on the major roads and locked gates on smaller roads. In addition, because the landfill is active, there is a crew of workers in the central portion of the landfill area during normal working hours. The institutional controls and the daily activity discourages trespassers on the site. Direct contact with landfill materials or soils impacted by the materials in the inactive, lower half of the landfill is incomplete due to the leachate collection system's geotextile and geomembrane cover. However, direct contact with landfilled materials or soils impacted by the materials at the active, upper half of the landfill is a complete pathway and is limited to the workers in active portions of the landfill.

Precipitation falling in the upper half of the landfill may infiltrate the soil and vegetative cover and contact the landfilled materials as it migrates downward. However, this impacted surface water flowing within the landfill will be collected by the leachate collection system. Contact with leachate captured at the landfill is an incomplete pathway.

If this impacted surface water migrates downward through the landfilled materials, it may eventually contact the underlying shales and sandstone of the bedrock and migrate downward as groundwater into the bedrock aquifer. Contact with groundwater is considered to be an incomplete exposure route. The water-bearing zones that are monitored at the landfill are located at several hundreds of feet bgs at the upper end of the landfill. In the lower end of the landfill, the A-Zone is exposed at the surface. However, no seeps were observed in the areas where this zone is exposed. In addition, in the lower end of the landfill, the depth to groundwater in the overburden is 5 to 8 feet bgs; therefore, contact with this groundwater as an exposure pathway is also incomplete.

Contact with C-8 impacted surface water near the toe of the landfill is considered a complete exposure pathway. However, this exposure pathway is limited because site workers follow health and safety procedures (i.e., personal protective equipment) when managing surface water at the site. The C-8 concentration measured in surface water in this area has ranged from 0.54 to 87 ug/l, less than the C-8 SL established by the CATT and significantly less that the C-8 ALAC of 1,360 ug/l. Contact with C-8 impacted surface water at the property boundary is also a complete exposure pathway for human and ecological receptors. C-8 concentrations at this location have ranged from 0.88 to 39 ug/l, which are below the C-8 SL and are significantly lower than the C-8 ALAC. In addition, C-8 concentrations measured in the seven of the 11 samples from this location were less than 10 ug/l. Therefore, although this exposure pathway is complete, it is limited due to the low C-8 concentrations measured.

Off-site Human Health and Ecological Exposure Pathways

Off-site human receptors include residents using the water sources sampled during the groundwater well and water-use survey. Ecological receptors include livestock using the water sources sampled during the groundwater well and water-use survey.

West Virginia One-Mile Radius Groundwater and Surface Water

Direct exposure to C-8 impacted surface water and groundwater is considered to be an incomplete pathway in situations where the water source is not used. The pathway is considered to be a complete pathway when the water source is used but not for drinking-water purposes although the exposure is considered to be minimal because the water is not ingested. The highest C-8 concentration in a non-drinking-water sample was 0.54 ug/l, well below the C-8 SL of 150 ug/l (WVDEP, 2002). The pathway is considered to be complete if the well is used for drinking water. The highest C-8 concentration measured in drinking water was 0.422 ug/l, significantly lower than the CATT-established C-8 SL of 150 ug/l. Therefore, the pathway is complete, and exposure is considered to be limited due to the low C-8 concentrations measured.

Outside of the one-mile radius, a surface-water sample was taken from the Lee Creek near a private residence. The C-8 concentration measured in the Lee Creek was 0.28 ug/l (DuPont, 2002g). At this same residence, a drinking-water well and a spring used for non-drinking-water purposes also were sampled and analyzed for C-8. The C-8 concentrations measured in these water sources were ND and 0.331 ug/l, respectively. The exposure pathways for these water sources are complete. However, all three of these concentrations measured are significantly lower than the C-8 SL.

6.6 Dry Run Landfill Summary

Many different activities have been conducted at and around the Dry Run Landfill in order to determine whether there has been an impact on human health and the environment as a result of releases of C-8 to the environment from the landfill. The C-8 concentration in groundwater and surface water from many sources (on-site, off-site, monitoring wells, production wells, private wells, springs, and cisterns) was measured. Based on all of the data evaluated for the Dry Run Landfill, the following observation were made:

- The current exposure pathways are incomplete for human and ecological receptors contact with on-site leachate and groundwater.
- Human and ecological receptor contact with C-8 impacted landfill materials, soils, and surface water are currently complete exposure pathways. However, these pathways are considered to be minimal because of institutional controls on the property, personal protective equipment worn, and health and safety procedures that are in place and followed when working with or around the active landfill and when managing the leachate collected at the Dry Run Landfill and surface water.

- Contact with surface water exiting the site that has been impacted by C-8 is also currently a complete exposure pathway for human and ecological receptors. The highest C-8 concentration measured in surface water exiting the site was 39 ug/l, which is lower than the CATT-established C-8 SL of 150 ug/l and lower than the C-8 ALAC of 1,360 ug/l (Menzie-Cura & Associates, 2002). C-8 concentrations measured in seven of the samples taken at the property boundary were less than 10 ug/l, indicating that while this exposure pathway is complete, exposure is limited because of the low concentrations of C-8 detected.
- Current off-site exposure pathways for human and ecological receptors that are complete but limited, due to the very low C-8 concentration measured, include residential drinking and non-drinking-water sources. For the drinking and non-drinking-water sources, the highest C-8 concentration measured were 0.422 and 0.54 ug/l respectively, which are well below the C-8 SL of 150 ug/l and the C-8 ALAC of 1,360 ug/l (WV DEP, 2002; Menzie-Cura & Associates, 2002).
- Evaluation of the C-8 results measured at the Dry Run Landfill, of the groundwater flow direction at the landfill, and of the one-mile radius C-8 results shows that C-8 impacted groundwater is not migrating off-site.
- The on-site C-8 results for groundwater and surface-water support water transport as the migration pathway for C-8 from C-8 containing landfilled materials to surface water and groundwater. However, the Dry Run Landfill is located within eight miles southwest of the facility. Therefore, air transport of C-8 by air emissions from the facility cannot completely be ruled out, and may be the source of C-8 for the very low concentrations measured within the Dry Run one-mile sampling area.

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TABLES

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Table 3.0
Summary of Off-site Sampling Program (C-8 Sampling)
DuPont Washington Works Facility and Local Landfill
Washington, WV

RESIDENTIAL SAMPLING FOR 1-MILE RADIUS		
Homes	Number of homes contacted (1)	311
	Number of homes surveyed (1)	269
Wells	Number of wells identified (2)	51
	Number of wells sampled (2)	34
	Number of wells sampled that are used for drinking water	6
Cisterns	Number of cisterns identified (2)	17
	Number of cisterns sampled (2)	6
	Number of cisterns sampled that are used for drinking water	0
Springs	Number of springs identified (2)	6
	Number of springs sampled (2)	4
	Number of springs sampled that are used for drinking water	0
Samples	Total number of samples	44
	Total number of collected samples used for drinking water	6

Note: Field duplicates not considered in sample count.

(1) During this investigation, homeowners/residents identified within the sampling radius were contacted to determine residential water usage. Up to two contacts were attempted at each residence. After the second contact attempt, a voluntary survey was left at the residence. Because not all homeowners/residences responded to the survey, the number of residences surveyed is less than the number of homes contacted.

(2) Some water sources (e.g. wells, cisterns, springs) identified during the survey were not sampled. In many cases, sampling of these water sources was refused by the homeowners/residents. In other cases, the water sources were either not accessible or damaged. As a consequence, the number of water sources sampled was less than the number of water sources identified.

Table 3.1
Summary of C-8 Analytical Results In Groundwater and Surface Water (ug/l)
Washington Works Facility and Local Landfill
(Off-site Wells, Springs, and Cisterns - One Mile Radius)
Washington, WV

Sample ID	Sample Date	C-8 ug/l	Water Use *	Sample Type
OS-AHEARTR	12/19/2001	2.8	Drinking Water	Well
OS-BALSEYAR	12/21/2001	1.74	Drinking Water	Well
OS-BALSEYAR	4/11/2002	2.48	Drinking Water	Well
OS-CHRISTMANS	12/21/2001	0.328	Drinking Water	Well
OS-CHRISTMANS	4/11/2002	0.526	Drinking Water	Well
OS-SMITHMT	2/5/2002	1.33	Drinking Water	Well
OS-VINCENTS	12/17/2001	1.1	Drinking Water	Well
OS-VINCENTS	4/11/2002	1.36	Drinking Water	Well
OS-WILCOXA	1/28/2002	1.72	Drinking Water	Well
OS-WILCOXA	4/14/2002	1.74	Drinking Water	Well
OS-AINSLEYB	1/28/2002	1.83	Unused	Well
OS-BEEBEED	1/15/2002	3.2	Unused	Well
OS-BLANKENSHIPR	2/21/2002	0.715	Unused	Well
OS-BURCHARDA	1/9/2002	0.416	Unused	Well
OS-BURDETTEP	1/10/2002	1.7	Unused	Well
OS-CAINM	1/27/2002	2.93	Unused	Well
OS-CAYTONW	1/25/2002	3.63	Unused	Well
OS-COCHRANG	1/25/2002	1.3	Unused	Well
OS-CORBITTG	1/23/2002	0.945	Unused	Well
OS-COWANJW	3/27/2002	14.3	Unused	Well
OS-CREELK1	1/27/2002	2.7	Unused	Well
OS-CREELK2	1/27/2002	7.47	Unused	Well
OS-DAVISJ	1/9/2002	3.36	Unused	Well
OS-EAKINE	1/9/2002	0.569	Misc.	Well
OS-FIKER	1/23/2002	0.32	Unused	Well
OS-FURBEEC	1/23/2002	5.07	Water Cattle	Well
OS-HENDRICKSR	1/25/2002	1.72	Unused	Well
OS-LAKEWASHC1	1/14/2002	0.347	Unused	Well
OS-LAKEWASHC2	1/15/2002	0.867	Misc.	Well
OS-LAWSONDH	1/8/2002	9.56	Unused	Well
OS-MILLERJ	1/14/2002	3.94	Unused	Well
OS-MILLSS	12/17/2001	0.932	Misc.	Well
OS-NEWHOUSES	1/27/2002	0.304	Unused	Well
OS-PARSONS D	2/5/2002	3.44	Unused	Well
OS-RICHARDSV	12/17/2001	2.37	Misc.	Well
OS-RIDDLED1	2/12/2002	3.24	Unused	Well
OS-WAYBRIGHTO	1/15/2002	0.252	Unused	Well
OS-WHITAKERK	1/10/2002	2.3	Unused	Well
OS-LAWSONDH2	1/10/2002	10.9	Unused	Spring
OS-RIDDLED2	2/12/2002	2.8	Unused	Spring
OS-SHOCKEYG	1/27/2002	1.33	Unused	Spring
OS-TALLHAMER	1/28/2002	1.63	Water Cattle	Spring

Table 3.1
Summary of C-8 Analytical Results in Groundwater and Surface Water (ug/l)
Washington Works Facility and Local Landfill
(Off-site Wells, Springs, and Cisterns - One Mile Radius)
Washington, WV

Sample ID	Sample Date	C-8 ug/l	Water Use *	Sample Type
OS-ALKIREF	1/27/2002	3.15	Unused	Cistern
OS-COLLINSC	12/18/2001	1.56	Misc.	Cistern
OS-PORTEREL	12/19/2001	0.561	Misc.	Cistern
OS-SMITHMM	12/17/2001	2.48	Misc.	Cistern
OS-THOMPSONB	12/17/2001	3.52	Water Cattle	Cistern
OS-WATKINSCL	12/17/2001	1.32	Misc.	Cistern

* Drinking Water (highlighted in bold blue) indicates human consumption. Non-drinking Water uses include livestock watering, gardening and any other non-human consumption water uses.
Misc. = Miscellaneous water use is not used for drinking.
Data highlighted in yellow are results for water sources located within the one-mile radius that were resampled during the two-mile radius sampling event.

Table 3.2
Summary of Off-site Sampling Program (C-8 Sampling)
Washington Works Facility and Local Landfill Two-mile Radius
DuPont Washington Works

RESIDENTIAL SAMPLING FOR THE 2-MILE RADIUS		
Homes	Number of homes contacted [(1)]	667
	Number of homes surveyed [(1)]	109
Wells	Number of wells identified [(2)]	98
	Number of wells in sampled [(2)]	52
	Number of wells sampled that are used for drinking water	17
Cisterns	Number of cisterns identified [(2)]	17
	Number of cisterns sampled [(2)]	8
	Number of cisterns sampled that are used for drinking water	0
Springs	Number of springs identified [(2)]	7
	Number of springs sampled [(2)]	5
	Number of springs sampled that are used for drinking water	1
Samples	Total number of samples	65
	Total number of collected samples used for drinking water	18

Note: Field duplicates not considered in sample count.

[(1)] During this investigation, homeowners/residents identified within the sampling radius were contacted to determine residential water usage. Up to two contacts were attempted at each residence. After the second contact attempt, a voluntary survey was left at the residence. Because not all homeowners/residences to the survey, the number of residences surveyed is less than the number of homes contacted.

[(2)] Some water sources (e.g. wells, cisterns, springs) identified during the survey were not sampled. In many cases, sampling of these water sources was refused by the homeowners/residents. In other cases, the water sources were either not accessible or damaged. As a consequence, the number of water sources sampled was less than the number of water sources identified.

Table 3.3
Summary of C-8 Analytical Results in Groundwater and Surface Water
(Off-site Wells, Springs, and Cisterns)
Washington Works Facility and Local Landfill Two-mile Radius
Washington, WV

2-Mile Sample ID	Date	C-8 ug/L	Water Use*	Sample Type
OS-HAMILTONF	3/14/2002	0.737	Drinking Water	Well
OS-LINGERAC1	3/14/2002	ND (<0.010)	Drinking Water	Well
OS-STEPHENSDS	3/14/2002	0.625	Drinking Water	Well
OS-STEPHENSEE	3/14/2002	0.229	Drinking Water	Well
OS-MCMAHANGE	3/15/2002	ND (<0.010)	Drinking Water	Well
OS-BAKERER	3/18/2002	NQ (<0.050)	Drinking Water	Well
OS-JAMESONRD	3/18/2002	ND (<0.010)	Drinking Water	Well
OS-COLVINRL	3/19/2002	0.242	Drinking Water	Well
OS-FOUTTBL	3/19/2002	0.899	Drinking Water	Well
OS-NAYJL	3/19/2002	0.465	Drinking Water	Well
OS-BOSOEC	3/28/2002	NQ (<0.050)	Drinking Water	Well
OS-HESSOK	3/28/2002	NQ (<0.050)	Drinking Water	Well
OS-NEWBERRYPC	4/5/2002	0.386	Drinking Water	Well
OS-MILLSLE	4/18/2002	ND (<0.010)	Drinking Water	Well
OS-SMITHPL	4/24/2002	ND (<0.010)	Drinking Water	Well
OS-PHILIPSAE	4/25/2002	0.73	Drinking Water	Well
OS-COLEMANC1	6/4/2002	ND (<0.010)	Drinking Water	Well
OS-JOHNSONL1	3/14/2002	ND (<0.010)	Non-drinking Water	Well
OS-WEATHERHOLTLJ	3/20/2002	0.078	Non-drinking Water	Well
OS-GARNESAL	4/3/2002	1.3	Non-drinking Water	Well
OS-RHOADESRW	4/29/2002	1.56	Non-drinking Water	Well
OS-WIGALJ	5/8/2002	0.625	Non-drinking Water	Well
OS-YOSTJ	5/14/2002	0.081	Non-drinking Water	Well
OS-GOLDSMITHML	5/20/2002	0.874	Non-drinking Water	Well
OS-SAMSCW	5/20/2002	1.2	Non-drinking Water	Well
OS-SACCHID	5/31/2002	ND (<0.010)	Non-drinking Water	Well
OS-JOHNSONL2	3/14/2002	1.08	Unused	Well
OS-LINGERAC2	3/14/2002	1.36	Unused	Well
OS-ARNOLDWC	4/8/2002	2	Unused	Well
OS-BARKERC	4/8/2002	0.708	Unused	Well
OS-WOLFEDJ	4/8/2002	0.17	Unused	Well
OS-WYATTVE	4/12/2002	1.19	Unused	Well
OS-DOTSONH	5/8/2002	0.164	Unused	Well
OS-EATONJD	5/8/2002	ND (<0.010)	Unused	Well
OS-HAMMONDE	5/10/2002	0.074	Unused	Well
OS-CAMPBELLG	5/13/2002	0.091	Unused	Well
OS-SARTORL	5/13/2002	0.927	Unused	Well
OS-GLASSC	5/14/2002	0.425	Unused	Well
OS-MATHEWSJR	5/14/2002	0.781	Unused	Well
OS-REEDERHJ	5/14/2002	1.17	Unused	Well
OS-MILLSS	5/21/2002	1.57	Unused	Well
OS-TUCKERCM	5/21/2002	0.095	Unused	Well
OS-TALLMANE	5/22/2002	0.325	Unused	Well
OS-LIFEM	5/23/2002	0.257	Unused	Well
OS-MOREHEADV	5/29/2002	1.19	Unused	Well
OS-NORMANE	5/29/2002	0.592	Unused	Well

Table 3.3
Summary of C-8 Analytical Results in Groundwater and Surface Water
(Off-site Wells, Springs, and Cisterns)
Washington Works Facility and Local Landfill Two-mile Radius
Washington, WV

2-Mile Sample ID	Date	C-8 ug/L	Water Use*	Sample Type
OS-BIRAMB	5/29/2002	0.268	Unused	Well
OS-VAUGHNDE	5/30/2002	ND (<0.010)	Unused	Well
OS-MITCHELLL	5/30/2002	1.26	Unused	Well
OS-SMITHLK	5/31/2002	0.092	Unused	Well
OS-WRIGHTW	6/3/2002	1.07	Unused	Well
OS-RICHARDSC	6/3/2002	1.52	Unused	Well
OS-STUTTLERLR	3/27/2002	1.8	Drinking Water	Spring
OS-BLOOMERCG	3/21/2002	0.857	Non-drinking Water	Spring
OS-BURTONDE	4/16/2002	0.823	Non-drinking Water	Spring
OS-RITTENHOUSE	4/16/2002	0.898	Non-drinking Water	Spring
OS-ARTHURRS	3/20/2002	2.32	Unused	Spring
OS-WALTERSMM	3/22/2002	1.39	Non-drinking Water	Cistern
OS-WILLISJL	4/24/2002	0.772	Non-drinking Water	Cistern
OS-HERTZTL	4/25/2002	1.67	Non-drinking Water	Cistern
OS-BLUERE	4/18/2002	0.447	Unused	Cistern
OS-EDDYMM1	4/24/2002	2.27	Unused	Cistern
OS-EDDYMM2	4/24/2002	1.84	Unused	Cistern
OS-PUGHJA	5/14/2002	NQ (<0.050)	Unused	Cistern
OS-NUTTERK	5/22/2002	0.174	Unused	Cistern

* Drinking Water (highlighted in bold blue) indicates human consumption. Non-drinking Water uses include livestock watering, gardening and any other non-human consumption water uses.
ND = Not Detected at or above the limit of detection (LOD). The listed LOD is approximate and varies by instrument and over time.
NQ = Not Quantifiable. Detected at a concentration above the LOD and below the limit of quantification (LOQ).

Table 3.4
Summary of Off-site Sampling Program (C-8 Sampling)
Ohio One-mile Radius Residential Sampling
DuPont Washington Works

RESIDENTIAL SAMPLING FOR OHIO 1-MILE RADIUS		
Homes	Number of homes contacted [(1)]	361
	Number of homes surveyed [(1)]	150
Wells	Number of wells identified [(2)]	78
	Number of wells sampled [(2)]	47
	Number of wells sampled that are used for drinking water	17
Cisterns	Number of cisterns identified [(2)]	16
	Number of cisterns sampled that are used for drinking water [(2)]	5
	Number of cisterns sampled that are used for drinking water	0
Springs	Number of springs identified [(2)]	15
	Number of springs sampled [(2)]	15
	Number of springs sampled that are used for drinking water	1
Other	Pool	1
Samples	Total number of samples	68
	Total number of collected samples used for drinking water	18

Note: Field duplicates not considered in sample count.

[(1)] During this investigation, homeowners/residents identified within the sampling radius were contacted to determine residential water usage. Up to two contacts were attempted at each residence. After the second contact attempt, a voluntary survey was left at the residence. Because not all homeowners/residences to the survey, the number of residences surveyed is less than the number of homes contacted.

[(2)] Some water sources (e.g. wells, cisterns, springs) identified during the survey were not sampled. In many cases, sampling of these water sources was refused by the homeowners/residents. In other cases, the water sources were either not accessible or damaged. As a consequence, the number of water sources samplec was less than the number of water sources identified.

Table 3.5
Summary of C-8 Analytical Results in Groundwater and Surface Water
Ohio One-mile Radius Residential Sampling

1-Mile Sample ID	Sample Date	C-8 ug/L	Water Use*	Sample Type
OS-MARCUMLL	3/20/2002	ND (<0.010)	Drinking Water	Well
OS-KANITZKP	3/21/2002	0.303	Drinking Water	Well
OS-KANITZKP (dup)	3/21/2002	0.286	Drinking Water	Well
OS-RUMERJH	3/21/2002	3.91	Drinking Water	Well
OS-RYANSP	3/21/2002	0.0962	Drinking Water	Well
OS-SWAINPH	3/21/2002	0.203	Drinking Water	Well
OS-WILCOXENWT	3/21/2002	NQ (<0.050)	Drinking Water	Well
OS-COLLINSRL	3/22/2002	0.224	Drinking Water	Well
OS-FARLEYFL	3/22/2002	0.239	Drinking Water	Well
OS-PRICEFL	3/22/2002	0.802	Drinking Water	Well
OS-HORNBECKLK	4/1/2002	0.237	Drinking Water	Well
OS-LEGLEITNERJK	4/1/2002	ND (<0.010)	Drinking Water	Well
OS-MATHENYBL	4/1/2002	0.0805	Drinking Water	Well
OS-MATHENYTL	4/1/2002	0.195	Drinking Water	Well
OS-EDDYEE	4/3/2002	6.4	Drinking Water	Well
OS-PARSONSCF	4/8/2002	8.59	Drinking Water	Well
OS-GERBERDA	4/17/2002	0.102	Drinking Water	Well
OS-GIVENSDL	5/22/2002	0.416	Drinking Water	Well
OS-SMITHPW1	3/20/2002	1.35	Non-drinking Water	Well
OS-WICKHAMYD	3/20/2002	0.0842	Non-drinking Water	Well
OS-RYANSP1A	3/21/2002	0.278	Non-drinking Water	Well
OS-ARMORBS	3/22/2002	0.675	Non-drinking Water	Well
OS-BAILESMD	4/15/2002	1.24	Non-drinking Water	Well
OS-PIERCELR	4/15/2002	3.8	Non-drinking Water	Well
OS-SHEPPARDRO	4/17/2002	ND (<0.010)	Non-drinking Water	Well
OS-FUCHSSL	5/22/2002	0.955	Non-drinking Water	Well
OS-SICKLESTS	4/9/2002	12.1	Unused	Well
OS-LEFEBVRESA	4/11/2002	12.9	Unused	Well
OS-RIPPETOK	4/16/2002	4.49	Unused	Well
OS-WATSON MP1	4/18/2002	17.2	Unused	Well
OS-PARSONSDOH	4/23/2002	2.09	Unused	Well
OS-COLLINSRL2	5/1/2002	0.104	Unused	Well
OS-DAUGHERTYD	5/1/2002	16.9	Unused	Well
OS-MCGEET	5/1/2002	0.0761	Unused	Well
OS-MAYLEVJ	5/2/2002	1.11	Unused	Well
OS-WINDLANDB	5/2/2002	11.5	Unused	Well
OS-HUMEJD	5/3/2002	2.35	Unused	Well
OS-SHETLERF	5/3/2002	0.161	Unused	Well
OS-CURREYLM	5/6/2002	ND (<0.010)	Unused	Well
OS-FRANSICCM	5/6/2002	16.7	Unused	Well
OS-WILLIAMSG	5/6/2002	1.35	Unused	Well
OS-STAHLPR4	5/15/2002	6.35	Unused	Well
OS-STAHLPR4-2	5/15/2002	6.36	Unused	Well
OS-STAHLPR3	5/15/2002	11.1	Unused	Well
OS-MATHENYB	5/15/2002	0.582	Unused	Well

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Table 3.5
Summary of C-8 Analytical Results in Groundwater and Surface Water
Ohio One-mile Radius Residential Sampling

1-Mile Sample ID	Sample Date	C-8 ug/L	Water Use*	Sample Type
OS-THOMPSONAM	5/16/2002	4.22	Unused	Well
OS-ARBAUGHJ	5/23/2002	1.02	Unused	Well
OS-YATESL	5/24/2002	3.28	Unused	Well
OS-SPICERRF	4/15/2002	1.29	Drinking Water	Spring
OS-STAHLPR2	4/8/2002	5.72	Non-drinking Water	Spring
OS-STEPHANML2	4/9/2002	8.88	Non-drinking Water	Spring
OS-RAUCH SPG1	4/11/2002	3.58	Non-drinking Water	Spring
RAUCH SPG2	4/11/2002	4.67	Non-drinking Water	Spring
OS-RAUCH SPG3	4/11/2002	4.4	Non-drinking Water	Spring
OS-RAUCH SPG4	4/11/2002	4.97	Non-drinking Water	Spring
OS-RAUCH SPG5	4/11/2002	5.76	Non-drinking Water	Spring
OS-WATSON MP2	4/18/2002	18.1	Non-drinking Water	Spring
OS-WATSON MP3	4/18/2002	23.6	Non-drinking Water	Spring
OS-SWEARINGENW	4/22/2002	8.55	Non-drinking Water	Spring
OS-STAHLPR1	4/8/2002	4.97	Non-drinking Water	Spring
OS-CASTOB1	6/7/2002	3.81	Non-drinking Water	Spring
OS-CASTOB1-2	6/7/2002	4.3	Non-drinking Water	Spring
OS-CASTOB2 (dup)	6/7/2002	2.98	Non-drinking Water	Spring
OS-CASTOB3	6/7/2002	5.83	Non-drinking Water	Spring
OS-STEPHANML	4/9/2002	5.41	Non-drinking Water	Cistern
OS-FARLEYED	4/15/2002	1.26	Non-drinking Water	Cistern
OS-WATSON MP4	4/18/2002	7.33	Non-drinking Water	Cistern
OS-BEECHJB	5/29/2002	2.85	Unused	Cistern
OS-BARICKMANCH	6/4/2002	0.748	Non-drinking Water	Cistern
OS-STEPHANML3	4/9/2002	2.52	Non-drinking Water	POOL

* Drinking Water (highlighted in bold blue) indicates human consumption. Non-drinking Water uses include livestock watering, gardening and any other non-human consumption water uses.
ND = Not Detected at or above the limit of detection (LOD). The listed LOD is approximate and varies by instrument and over time.
NQ = Not Quantifiable. Detected at a concentration above the LOD and below the limit of quantification (LOQ).

Table 3.6
Summary of Off-site Sampling Program (C-8 Sampling)
Ohio Two-mile Radius Residential Sampling
DuPont Washington Works

RESIDENTIAL SAMPLING FOR OHIO 2-MILE RADIUS		
Homes	Number of homes contacted [1]	1131
Homes	Number of homes surveyed [1]	733
Wells	Number of wells identified [2]	123
Wells	Number of wells in survey sampled [2]	58
Wells	Number of wells sampled that are used for drinking water	49
Cisterns	Number of cisterns identified [2]	7
Cisterns	Number of cisterns sampled [2]	3
Cisterns	Number of cisterns sampled that are used for drinking water	0
Springs	Number of springs identified [2]	3
Springs	Number of springs sampled [2]	1
Springs	Number of springs sampled that are used for drinking water	0
Samples	Total number of samples	62
Samples	Total number of collected samples used for drinking water	49

Note: Field duplicates not considered in sample count.

[1] During this investigation, homeowners/residents identified within the sampling radius were contacted to determine residential water usage. Up to two contacts were attempted at each residence. After the second contact attempt, a voluntary survey was left at the residence. Because not all homeowners/residences to the survey, the number of residences surveyed is less than the number of homes contacted.

[2] Some water sources (e.g. wells, cisterns, springs) identified during the survey were not sampled. In many cases, sampling of these water sources was refused by the homeowners/residents. In other cases, the water sources were either not accessible or damaged. As a consequence, the number of water sources sampled was less than the number of water sources identified.

Table 3.7
Summary of C-8 Analytical Results Zones A, B and C
Ohio Two-Mile Radius C-8 Residential Sampling

Zone	Sample ID	Sample Date	C-8 ug/L	Water Use*	Sample Type
A	OS-AnkromCA	7/9/2002	0.059	Drinking Water	Well
	OS-BedillonWW	7/1/2002	1.710	Drinking Water	Well
	OS-BoringAE	6/26/2002	1.150	Drinking Water	Well
	OS-CantleyWA	7/19/2002	1.490	Drinking Water	Well
	OS-CollinsNJ	7/9/2002	0.281	Drinking Water	Well
	OS-HarrahGC	6/26/2002	0.844	Drinking Water	Well
	OS-HolcombB	7/25/2002	NQ (<0.05)	Drinking Water	Well
	OS-KnottsC	9/10/2002	2.590	Drinking Water	Well
	OS-LittleJM	7/9/2002	2.130	Drinking Water	Well
	OS-McLaughlinJL	7/24/2002	0.064	Drinking Water	Well
	OS-PhillipsPJ	7/2/2002	2.240	Drinking Water	Well
	OS-WaltonDM	6/26/2002	0.413	Drinking Water	Well
	OS-WhiteAL	7/8/2002	3.960	Drinking Water	Well
B	OS-BoardJG	8/6/2002	6.500	Drinking Water	Well
	OS-BosoFE	7/25/2002	0.290	Drinking Water	Well
	OS-BuchananAF	7/25/2002	0.755	Drinking Water	Well
	OS-FlemingWV	8/22/2002	NQ (<0.05)	Drinking Water	Well
	OS-GrimRR	7/30/2002	0.501	Drinking Water	Well
	OS-KidderEM	9/17/2002	4.150	Non-drinking Water	Well
	OS-McKownFL	7/24/2002	0.973	Non-drinking Water	Well
	OS-MercerVE	7/24/2002	0.784	Drinking Water	Well
	OS-MerinarJL	9/23/2002	0.943	Drinking Water	Well
	OS-SmithDD	7/31/2002	1.810	Drinking Water	Well
	OS-SmithWW	9/12/2002	3.030	Unused	Well
	OS-SordenD	9/10/2002	0.289	Drinking Water	Well
	OS-StarkeyRR	7/25/2002	0.164	Non-drinking Water	Well
	OS-ThomasJB	9/19/2002	6.380	Non-drinking Water	Well
	OS-WelchJD	9/10/2002	6.850	Non-drinking Water	Well
	OS-WellsB	9/17/2002	7.290	Unused	Well
	OS-WilliamsH	9/30/2002	8.680	Unused	Well
	OS-WilsonRM1	7/31/2002	2.040	Drinking Water	Well
	OS-WilsonRM2	7/31/2002	4.750	Non-drinking Water	Well
	OS-FrameRD	7/24/2002	3.020	Non-drinking Water	Spring
	OS-SamsJR	8/8/2002	0.592	Non-drinking Water	Cistern
	OS-SpiresRA	8/8/2002	0.217	Non-drinking Water	Cistern
	OS-TurlczekJM	9/5/2002	0.374	Non-drinking Water	Cistern
C	OS-AdamsGL	8/22/2002	0.205	Drinking Water	Well
	OS-BowersockVK	8/14/2002	0.083	Drinking Water	Well
	OS-CastoHE	8/16/2002	0.092	Drinking Water	Well
	OS-CookJM	8/14/2002	ND (<0.01)	Drinking Water	Well
	OS-DavisJH	9/11/2002	ND (<0.01)	Drinking Water	Well
	OS-FosterTV	8/14/2002	0.812	Drinking Water	Well
	OS-HigginsJL	8/15/2002	ND (<0.01)	Drinking Water	Well
	OS-JacobsDK	8/16/2002	ND (<0.01)	Drinking Water	Well
	OS-KautzCR	8/22/2002	ND (<0.01)	Drinking Water	Well
	OS-KempN	9/11/2002	0.091	Drinking Water	Well
	OS-KetelsonD	9/11/2002	0.092	Drinking Water	Well

Table 3.7
Summary of C-8 Analytical Results Zones A, B and C
Ohio Two-Mile Radius C-8 Residential Sampling

Zone	Sample ID	Sample Date	C-8 ug/L	Water Use*	Sample Type
C (cont.)	OS-KingCD	8/16/2002	ND (<0.01)	Drinking Water	Well
	OS-KingCD-2 (DUP)	8/16/2002	ND (<0.01)	Drinking Water	Well
	OS-KirkWE	8/14/2002	ND (<0.01)	Drinking Water	Well
	OS-KnoxGT	8/16/2002	ND (<0.01)	Drinking Water	Well
	OS-MillironMP	8/21/2002	ND (<0.01)	Drinking Water	Well
	OS-MoodyDA	8/20/2002	ND (<0.01)	Drinking Water	Well
	OS-ShivelyJH	8/22/2002	NQ (<0.05)	Drinking Water	Well
	OS-SouthallSA	8/22/2002	0.085	Drinking Water	Well
	OS-SpaderJD	8/16/2002	ND (<0.01)	Drinking Water	Well
	OS-St. Clair	9/25/2002	NQ (<0.05)	Drinking Water	Well
	OS-StimpertFE	8/21/2002	ND (<0.01)	Drinking Water	Well
	OS-TaittWJ	9/9/2002	5.610	Drinking Water	Well
	OS-Transport	8/16/2002	ND (<0.01)	Drinking Water	Well
	OS-WebbD	9/25/2002	0.128	Drinking Water	Well
	OS-WheatonCA	8/24/2002	NQ (<0.05)	Drinking Water	Well
	OS-WheatonDL	8/21/2002	0.087	Drinking Water	Well

* Drinking Water (highlighted in bold blue) indicates human consumption. Non-drinking Water uses include livestock watering, gardening and any other non-human consumption water uses.
ND = Not Detected at or above the limit of detection (LOD). The listed LOD is approximate and varies by instrument and over time.
NQ = Not Quantifiable. Detected at a concentration above the LOD and below the limit of quantification (LOQ).

Table 3.8
Monitoring Well Construction and Groundwater Elevation Data
DuPont Washington Works Facility
Washington, WV

Monitoring Wells									
New Well ID	AE11-MW01	AJ08-MW02	AM07-PW01	AO08-PW01	AX13-PW01	D08-MW01	E13-MW01	K16-PW01	L04-PW01
Old Well ID	TW-74		336	331	335	TW-M5	TW-76	L4(354)	GALLERY
Measuring Point Elevation (ft)	628.94	635.55	634.26	632.91	630.69	600.67	625.47	623.24	589.75
Total Depth (ft)	69.29	128	96	95	90		76.8		
Well Diameter (inches)	2	2	18	18	18	4	2	18	
Slot Size (inches)	0.010	0.010					0.010		
Screen Length (ft)	10	15	20	20	13		10		NA
Elevation of Screen Interval (ft)	569.65 - 559.65	522.55 - 507.55	558.26 - 538.26	557.91 - 537.91	553.69 - 540.69		558.67 - 548.67		
Groundwater Elevation (feet)									
January-02	567.02	—	*	*	—	562.73	561.29	*	*
February-02	566.02	—	*	*	*	562.69	561.12	*	*
March-02	564.20	—	*	*	*	562.09	562.04	*	*
April-02	565.93	—	*	*	*	562.51	560.59	*	*
May-02	566.54	—	*	*	*	562.71	560.76	*	*
August-02	567.61	—	*	*	*	564.55	562.23	*	*
October-02	568.52	569.55	*	*	*	564.24	561.91	*	*

*Groundwater elevations not measured in production wells.
**Well was dry

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Table 3.8
Monitoring Well Construction and Groundwater Elevation Data
DuPont Washington Works Facility
Washington, WV

	Monitoring Wells								
New Well ID	N04-MW03	N13-MW01	P04-MW02	P08-MW01	Q04-MW02	R04-MW02	V05-PW01	Y14-MW01	Y14-MW02
Old Well ID		Ron's MW-5	TW-83	Ron's MW-4	Ron's MW-1	TW-85	RANNEY	TW-90	
Measuring Point Elevation (ft)	595.44	625.87	592.39	629.29	598.76	594.92	632.00	642.25	643.12
Total Depth (ft)	88.5	59.95	27.81	68.3	39.64	27.64	92	90	131.59
Well Diameter (inches)	2	2	2	2	2	2	NA	2	2
Slot Size (inches)	10	0.010	0.010			0.010		0.010	0.010
Screen Length (ft)	15	5	10	5	10	10	1	10	15
Elevation of Screen Interval (ft)	521.94 - 506.94	570.92 - 565.92	574.58 - 564.58	565.99 - 560.99	569.12 - 559.12	577.28 - 567.28	542.00 - 541.00	562.25 - 552.25	526.53 - 511.53
	Groundwater Elevation								
January-02	—	—	572.35	—	560.88	576.61	*	562.78	—
February-02	—	559.92	571.91	560.10	560.05	576.39	*	562.15	—
March-02	—	**	573.35	*	559.45	577.36	*	561.39	—
April-02	—	**	573.13	**	560.40	576.97	*	561.34	—
May-02	—	**	574.32	**	559.77	577.10	*	561.67	—
August-02	—	**	572.69	**	563.77	575.28	*	563.05	—
October-02	567.82	**	572.11	562.09	563.06	574.98	*	562.89	561.75

*Groundwater elevations not measured in production wells.
**Well was dry

Table 3.9
Summary of Analytical Results:
C-8 in Groundwater
DuPont Washington Works Facility
Washington, WV

Sample	Date	C-8 (ug/l)
AE11-MW01	10/16/2002	1.74
	9/4/2002	1.92
	5/23/2002	1.25
	4/29/2002	1.22
	3/26/2002	2.82
	2/22/2002	1.45
	1/28/2002	1.20
	2/2/1999	0.69 L
	11/10/1998	0.41
AJ06-MW02	10/16/2002	0.133
AM07-PW01	10/22/2002	0.269
	8/26/2002	0.335
	5/17/2002	0.247
	4/16/2002	0.159
	3/21/2002	0.171
	2/14/2002	0.129
	1/22/2002	0.131
	11/20/2000	0.24
	8/16/2000	0.071 J
	5/12/1999	0.578
	2/3/1999	0.082 B
	11/18/1998	1.9 L
	6/19/1998	0.4
	6/2/1997	0.79
	4/2/1996	0.48
AO08-PW01	10/22/2002	0.415
	8/26/2002	0.42
	5/17/2002	0.499
	4/16/2002	0.497
	3/21/2002	0.568
	2/14/2002	0.439
	1/22/2002	0.355
	11/20/2000	0.4
	11/20/00 (dup)	0.26
	8/15/2000	0.167
	5/12/1999	0.307
	6/19/1998	1
	6/2/1997	0.55
	4/2/1996	0.52
AX13-PW01	10/22/2002	0.721
	8/26/2002	0.834
	5/17/2002	0.911
	4/16/2002	1.42
	3/21/2002	1.22
	2/14/2002	1.03

Table 3.9
Summary of Analytical Results:
C-8 In Groundwater
DuPont Washington Works Facility
Washington, WV

Sample	Date	C-8 (ug/l)
D08-MW01	10/16/2002	0.126
	9/4/2002	0.117
	5/23/2002	0.551
	4/29/2002	0.424
	3/26/2002	0.262
	2/22/2002	1.27
	1/28/2002	0.582
E13-MW01	10/16/2002	3.43
	9/4/2002	2.39
	5/23/2002	2.47
	4/29/2002	2.44
	3/28/2002	1.62
	2/22/2002	2.32
	1/28/2002	2.11
	5/12/1999	0.882
	2/2/1999	0.59 L
	11/11/1998	2
K16-PW01	10/22/2002	16.2
	8/26/2002	9.71
	5/17/2002	12.4
	4/16/2002	13.2
	3/21/2002	17.2
	2/14/2002	12
	1/22/2002	10.5
	11/20/2000	7.5
	2/9/1999	16.2
	11/18/1998	0.46 L
L04-PW01	10/25/2002	14.3
	8/13/2002	3.06
	5/21/2002	15.1
	4/18/2002	16.1
	3/21/2002	40.9
	2/7/2002	23.5
	1/15/2002	30.9
	7/11/2001	0.202
	4/11/2001	3.99
	11/20/2000	13.8
	2/7/1999	5.89
	11/18/1998	7.9 J
	11/18/98 (dup)	3.9 J
N04-MW01	1/28/2002	689
N04-MW03	10/16/2002	21.2

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Table 3.9
Summary of Analytical Results:
C-8 in Groundwater
DuPont Washington Works Facility
Washington, WV

Sample	Date	C-8 (ug/l)
N13-MW01	10/16/2002	Dry-no sample
	9/4/2002	Dry-no sample
	5/23/2002	Dry-no sample
	4/29/2002	Dry-no sample
	3/28/2002	Dry-no sample
	2/25/2002	57.8
	2/2/1999	29.6L
	11/11/1998	<0.1
P04-MW02	10/16/2002	46600
	10/16/02 (dup)	48300
	9/4/2002	34400
	5/23/2002	42400
	4/29/2002	36500
	3/26/2002	32300
	2/25/2002	26800
	1/28/2002	23600
	1/25/2001	12600
	2/6/1999	13600
	11/12/1998	8300
P08-MW01	10/16/2002	120
	9/4/2002	Dry-no sample
	5/23/2002	Dry-no sample
	4/29/2002	Dry-no sample
	3/28/2002	Pump problems-no sample
	2/25/2002	20.7
	2/4/1999	43.4
	11/13/1998	36
Q04-MW02	10/16/2002	7720
	9/4/2002	32.2
	5/23/2002	1480
	4/29/2002	1210
	3/26/2002	2070
	2/25/2002	1590
	1/28/2002	1480
	2/4/1999	994
	11/13/1998	660
R04-MW02	10/16/2002	84100
	9/4/2002	66500
	5/23/2002	68100
	4/29/2002	56300
	3/26/2002	54400
	2/25/2002	43600
	1/28/2002	47500
	1/25/2001	13800
	2/6/1999	9420
	11/12/1998	1300

Table 3.9
Summary of Analytical Results:
C-8 in Groundwater
DuPont Washington Works Facility
Washington, WV

Sample	Date	C-8 (ug/l)
V05-PW01	10/25/2002	51.2
	8/13/2002	34.8
	5/21/2002	35.8
	4/18/2002	37.6
	3/21/2002	40.9
	2/7/2002	25.1
	1/15/2002	29
	7/11/2001	11.4
	4/11/2001	5.48
	11/20/2000	13.7
	2/7/1999	12.4
	2/7/99 (dup)	3.95
	11/18/1998	0.66 L
Y14-MW01	10/16/2002	18.2
	9/4/2002	18.4
	5/23/2002	15.3
	4/29/2002	13.9
	3/28/2002	15.5
	2/22/2002	10.9
	1/28/2002	12.7
	2/2/1999	4.95 L
	11/10/1998	12
Y14-MW02	10/16/2002	NQ (< 0.05)
West Well Field (1)	10/25/2002	10.3
	8/13/2002	6.41
	5/21/2002	7.09
	4/16/2002	6.69
	3/21/2002	7.72
	2/7/2002	5.77
	1/15/2002	6.52
	7/11/2001	2.31
	4/11/2001	1.58

J = estimated value (below laboratory quantification limit)
L = possible low bias result (relative to QA/QC)
B= compound detected in QC blank
Note: Analytical method changed as of November 2001 (see Section 2.0 of DuPont (2003b) for details).

Table 3.10
Summary of Analytical Results: C-8 in Surface Water
DuPont Washington Works Facility
Washington, WV

Sample	Date	C-8 (ug/l)
OUTLET 001	11/13/2002	17.0
	10/18/2002	10.5
	9/24/2002	2.15
	8/27/2002	2.94
	7/23/2002	8.63
	6/25/2002	17.9
	5/20/2002	22.4
	4/16/2002	19.7
	3/19/2002	21.4
	2/5/2002	9.43
	1/17/2002	10.9
	12/20/2001	3.72
OUTFALL 002	11/13/2002	4.75
	11/13/02 (dup)	5.28
	10/18/2002	3.49
	9/24/2002	2.14
	8/27/2002	2.56
	8/27/02 (dup)	2.51
	7/23/2002	2.29
	6/25/2002	3.86
	6/25/02 (dup)	3.81
	5/20/2002	4.13
	4/16/2002	2.45
	3/19/2002	5.85
	2/5/2002	4.66
	1/17/2002	4.23
	12/20/2001	1.98
	11/26/01*	4.84
	10/25/2001	2.8
	9/19/2001	0.118
	7/11/2001	0.558
	6/14/2001	0.594
	5/31/2001	0.436
	4/11/2001	1.5
	3/21/2001	8.54
	2/14/2001	1.74
OUTLET 003	11/13/2002	1.24
	10/18/2002	0.87
	9/24/2002	0.317
	8/27/2002	0.268
	7/23/2002	0.291
	6/25/2002	0.175
	5/20/2002	0.503
	4/16/2002	2.76
	3/19/2002	2.91
	3/19/02 (dup)	2.81
	2/5/2002	1.33

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Table 3.10
Summary of Analytical Results: C-8 in Surface Water
DuPont Washington Works Facility
Washington, WV

Sample	Date	C-8 (ug/l)
OUTLET 003 (Cont.)	1/17/2002	0.956
	1/17/02 (dup)	3.99
	12/20/2001	0.713
OUTFALL 005	11/13/2002	18.1
	10/18/2002	12.1
	9/24/2002	4.64
	9/24/02 (dup)	5.02
	8/27/2002	12.4
	7/23/2002	19.2
	6/25/2002	17.9
	5/20/2002	98.6
	5/17/2002	65.7
	4/16/2002	3.8
	3/19/2002	9.26
	2/6/2002	141
	1/17/2002	137
	12/20/2001	31.4
	12/20/01(dup)	35.2
	11/26/2001	915
	10/25/2001	65.7
	9/19/2001	2.86
	8/30/2001	2.16
	7/11/2001	120
	6/14/2001	7.4
	5/31/2001	1.43
	4/11/2001	4.31
	3/21/2001	199
	2/14/2001	153
OUTLET 007	11/13/2002	8.56
	10/18/2002	0.251
	10/18/02 (dup)	0.209
	9/24/2002	NQ (<0.05)
	8/27/2002	0.207
	7/23/2002	0.597
	7/23/02 (dup)	0.544
	6/25/2002	0.284
	5/20/2002	0.49
	4/16/2002	0.567
	3/19/2002	0.483
	2/5/2002	0.32
	2/5/02(dup)	0.339
	1/17/2002	0.871
	12/20/2001	1.99
OUTLET 105	11/13/2002	10.5
	10/18/2002	54.6
	9/24/2002	3.69
	8/27/2002	6.73
	7/23/2002	34.7

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EID639948

Table 3.10
Summary of Analytical Results: C-8 in Surface Water
DuPont Washington Works Facility
Washington, WV

Sample	Date	C-8 (ug/l)
OUTLET 105 (Cont.)	6/25/2002	3.86
	5/20/2002	6.27
	5/20/02 (dup)	5.18
	4/16/2002	15.9
	3/19/2002	13.2
	2/5/2002	14.6
	1/17/2002	7.53
	12/20/2001	9.78

Note: Analytical method changed as of November 2001 (see Section 2.0 of DuPont (2003b) for details).

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EID639949

Table 3.11
Ohio River Water Sampling C-8 Results
DuPont Washington Works Facility and Letart Landfill

River Water Investigations		Transect Location Description	Number of Sampling Points	Sample Depths	Total Number of Samples	Transect Number	Location on Transect	Sample Type	Sample ID	C-8 ug/L	Date
Washington Works Facility	Upstream	26 Miles Upstream of the Washington Works Facility	1	Dip and Mid-column	2	1	center	mid-column	WWK-R-TS 1-2M	ND (<0.010)	6/25/2002
						1	center	dip	WWK-R-TS 1-2S	ND (<0.010)	6/25/2002
		10 Miles Upstream of the Washington Works Facility	1	Dip and Mid-column	2	2	center	mid-column	WWK-R-TS 2-2M	ND (<0.010)	6/26/2002
						2	center	dip	WWK-R-TS 2-2S	ND (<0.010)	6/26/2002
		Upstream of the Washington Works Facility - eastern end of Blennerhassett Island	1	Dip, Mid-column and Bottom	3	3	center	bottom	WWK-R-TS 3-2B	NQ (<0.050)	10/17/2002
						3	center	mid-column	WWK-R-TS 3-2M	ND (<0.010)	6/26/2002
						3	center	dip	WWK-R-TS 3-2S	ND (<0.010)	6/26/2002
	Near Facility	Along Washington Works Facility - North of Outfall 001	3	Dip, Mid-column and Bottom	9	4	WV-side	bottom	WWK-R-TS 4-1B	ND (<0.010)	6/28/2002
						4	WV-side	mid-column	WWK-R-TS 4-1M	ND (<0.010)	6/28/2002
						4	WV-side	dip	WWK-R-TS 4-1S	ND (<0.010)	6/28/2002
						4	center	bottom	WWK-R-TS 4-2B	ND (<0.010)	6/28/2002
						4	center	mid-column	WWK-R-TS 4-2M	ND (<0.010)	6/28/2002
						4	center	dip	WWK-R-TS 4-2S	ND (<0.010)	6/28/2002
						4	OH-side	bottom	WWK-R-TS 4-3B	ND (<0.010)	6/28/2002
						4	OH-side	mid-column	WWK-R-TS 4-3M	ND (<0.010)	6/28/2002
						4	OH-side	dip	WWK-R-TS 4-3S	ND (<0.010)	6/28/2002
		Along Washington Works Facility - East of Outfall 007	3	Dip, Mid-column and Bottom	9 +1 (Dup)	5	WV-side	bottom	WWK-R-TS 5-1B	ND (<0.010)	6/27/2002
						5	WV-side	mid-column	WWK-R-TS 5-1M	ND (<0.010)	6/27/2002
						5	WV-side	dip	WWK-R-TS 5-1S	NQ (<0.050)	6/27/2002
						5	center	bottom	WWK-R-TS 5-2B	ND (<0.010)	6/27/2002
						5	center	mid-column	WWK-R-TS 5-2M	ND (<0.010)	6/27/2002
						5	center	dip	WWK-R-TS 5-2S	ND (<0.010)	6/27/2002
						5	OH-side	bottom	WWK-R-TS 5-3B	ND (<0.010)	6/27/2002
						5	OH-side	mid-column	WWK-R-TS 5-3M	ND (<0.010)	6/27/2002
						5	OH-side	dip	WWK-R-TS 5-3S	ND (<0.010)	6/27/2002
						5	OH-side	dip	WWK-R-TS 5-3S-2 (DUP)	ND (<0.010)	6/27/2002
		Along Washington Works Facility - Downstream of Outfall 005	3	Dip, Mid-column and Bottom	9	6	WV-side	bottom	WWK-R-TS 6-1B	ND (<0.010)	6/27/2002
						6	WV-side	mid-column	WWK-R-TS 6-1M	ND (<0.010)	6/27/2002
						6	WV-side	dip	WWK-R-TS 6-1S	ND (<0.010)	6/27/2002
						6	center	bottom	WWK-R-TS 6-2B	ND (<0.010)	6/27/2002
						6	center	mid-column	WWK-R-TS 6-2M	ND (<0.010)	6/27/2002
						6	center	dip	WWK-R-TS 6-2S	ND (<0.010)	6/27/2002
						6	OH-side	bottom	WWK-R-TS 6-3B	NQ (<0.050)	6/27/2002
						6	OH-side	mid-column	WWK-R-TS 6-3M	ND (<0.010)	6/27/2002
						6	OH-side	dip	WWK-R-TS 6-3S	ND (<0.010)	6/27/2002
	Downstream	1.5 Miles Downstream of the Washington Works Facility	2	Dip, Mid-column and Bottom	6 +1 (Dup)	7	WV-side	bottom	WWK-R-TS 7-1B	0.113	10/17/2002
						7	WV-side	mid-column	WWK-R-TS 7-1M	0.131	10/17/2002
						7	WV-side	dip	WWK-R-TS 7-1S	0.113	10/17/2002
						7	WV-side	dip	WWK-R-TS 7-1S-2 (DUP)	0.138	10/17/2002
						7	center	bottom	WWK-R-TS 7-2B	0.123	10/17/2002
						7	center	mid-column	WWK-R-TS 7-2M*	0.0949	10/17/2002
						7	center	dip	WWK-R-TS 7-2S*	0.104	10/17/2002
		3 Miles Downstream of the Washington Works Facility	1	Dip and Mid-column	2	8	center	mid-column	WWK-R-TS 8-2M	0.999	7/10/2002
						8	center	dip	WWK-R-TS 8-2S	1.09	7/10/2002
		10 Miles Downstream of the Washington Works Facility	1	Dip and Mid-column	2	9	center	mid-column	WWK-R-TS 9-2M	0.292	7/10/2002
						9	center	dip	WWK-R-TS 9-2S	0.298	7/10/2002
		18 Miles Downstream of the Washington Works Facility	1	Dip and Mid-column	2	10	center	mid-column	WWK-R-TS 10-2M	0.236	7/10/2002
						10	center	dip	WWK-R-TS 10-2S	0.239	7/10/2002

Table 3.11
Ohio River Water Sampling C-8 Results
DuPont Washington Works Facility and Letart Landfill

River Water Investigations		Transect Location Description	Number of Sampling Points	Sample Depths	Total Number of Samples	Transect Number	Location on Transect	Sample Type	Sample ID		C-8 ug/L	Date
Letart Landfill	Near Landfill	Adjacent to the Letart Landfill	1	Dip and Mid-column	2	11	WV-side	mid-column	WWK-R-TS	11-1M	0.109	7/11/2002
						11	WV-side	dip	WWK-R-TS	11-1S	0.101	7/11/2002
	Downstream	Downstream of the Letart Landfill	1	Dip and Mid-column	2 +1 (Dup)	12	WV-side	mid-column	WWK-R-TS	12-1M	0.0971	7/11/2002
						12	WV-side	dip	WWK-R-TS	12-1S	0.118	7/11/2002
						12	WV-side	dip	WWK-R-TS	12-1S-2 (DUP	0.128	7/11/2002

* C-8 WWK-R-TS7-2M and WWK-R-TS7-2S were also sampled on 7/10/02. C-8 concentrations were 0.134 and 0.0984, respectively.

Table 3.12
Outfall 005 C-8 concentration (ug/l)
DuPont Washington Works

Sample ID		Date	C-8 ug/L
WWK-Z-	OUTFALL 005	6/24/2002	26.7
WWK-Z-	OUTFALL 005	6/25/2002	17.9
WWK-Z-	OUTFALL 005	6/26/2002	47.7
WWK-Z-	OUTFALL 005	6/27/2002	79.3
WWK-Z-	OUTFALL 005	7/1/2002	13.6
WWK-Z-	OUTFALL 005	7/10/2002	37.8
WWK-Z-	OUTFALL 005	7/11/2002	239.0
WWK-Z-	OUTFALL 005	7/12/2002	12.5
WWK-Z-	OUTFALL 005	10/16/2002	141.0
WWK-Z-	OUTFALL 005	10/17/2002	18.0

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Table 3.13
Summary of C-8 in Groundwater
Public Water Supplies, West Virginia and Ohio
Dupont Washington Works Facility, Washington WV

Location	Sample ID	Sample Date	C-8 ug/l	Comments
Parkersburg, WV	PPSDPT	3/6/2002	NQ (<0.050)	Before Treatment Sample
	PPSDAT	3/6/2002	NQ (<0.050)	After Treatment Sample
	PPSDAT	4/25/2002	NQ (<0.050)	After Treatment Sample
	PPSDRANY1	3/6/2002	0.0693	Production Well
	PPSDRANY1	3/6/2002	0.0686	duplicate
	PPSDRANY1	4/25/2002	0.0746	Production Well
	PPSDRANY2	3/6/2002	ND (<0.010)	Production Well
	PPSDRANY3	3/6/2002	ND (<0.010)	Production Well
	PPSDRANY4	3/6/2002	ND (<0.010)	Production Well
	PPSDRANY5	3/6/2002	ND (<0.010)	Production Well
Belpre, OH	BELPSDAT	2/7/2002	0.0818	After Treatment Sample
	BELPSDAT	3/25/2002	0.113	After Treatment Sample
	BELPSDAT	4/23/2002	0.12	After Treatment Sample
	BELPSDPW1	2/7/2002	0.0995	Production Well
	BELPSDPW1	3/25/2002	0.13	Production Well
	BELPSDPW2	2/7/2002	NQ (<0.050)	Production Well
	BELPSDPW2	2/7/2002	NQ (<0.050)	duplicate
	BELPSDPW2	3/25/2002	NQ (<0.050)	Production Well
	BELPSDPW3	3/25/2002	0.141	Production Well
	BELPSDPW3	4/23/2002	0.12	Production Well
	BELPSDPW4	2/7/2002	0.101	Production Well
	BELPSDPW4	3/25/2002	0.133	Production Well
	BELPSDPW4	4/23/2002	0.114	Production Well
	BELPSDPW5	2/7/2002	0.107	Production Well
	BELPSDPW5	3/25/2002	0.103	Production Well
	BELPSDPW5	4/23/2002	0.107	Production Well
	BELPSDPW5	4/23/2002	0.111	duplicate
Blennerhassett Island, WV	BLENI TW0	2/21/2002	ND (<0.010)	Test well
	BLENI TW7	2/21/2002	NQ (<0.050)	Test well
	BLENI W19A	2/21/2002	0.316	Test well
	BLENISLEPS1	1/30/2002	0.166	Drinking Supply Well
Little Hocking, OH	LHPSD1	12/20/2001	1.82	Production Well
	LHPSD1	1/21/2002	1.72	Production Well
	LHPSD1	2/22/2002	2.37	Production Well
	LHPSD1	3/26/2002	2.99	Production Well
	LHPSD1	4/23/2002	2.02	Production Well
	LHPSD1	8/21/2002	3.65	Production Well
	LHPSD1	10/16/2002	3.41	Production Well
	LHPSD2	12/20/2001	3.72	Production Well
	LHPSD2	12/20/2001	3.52	duplicate
	LHPSD2	1/21/2002	2.97	Production Well
	LHPSD2	2/22/2002	2.03	Production Well
	LHPSD2	2/22/2002	2.07	Production Well
	LHPSD2	3/26/2002	3.31	Production Well
	LHPSD2	4/23/2002	3.4	Production Well
	LHPSD2	8/21/2002	4.26	Production Well
	LHPSD2	10/16/2002	3.98	Production Well
	LHPSD3	12/20/2001	0.844	Production Well
	LHPSD3	1/21/2002	0.744	Production Well

Table 3.13
Summary of C-8 in Groundwater
Public Water Supplies, West Virginia and Ohio
Dupont Washington Works Facility, Washington WV

Location	Sample ID	Sample Date	C-8 ug/l	Comments
Little Hocking, OH (cont.)	LHPSD3	2/22/2002	0.42	Production Well
	LHPSD3	3/26/2002	0.827	Production Well
	LHPSD3	4/23/2002	0.783	Production Well
	LHPSD3	8/21/2002	0.952	Production Well
	LHPSD3	10/16/2002	0.495	Production Well
	LHPSD3	10/16/2002	0.434	duplicate
	LHPSD5	12/20/2001	7.66	Production Well
	LHPSD5	1/21/2002	6.22	Production Well
	LHPSD5	1/21/2002	6.14	duplicate
	LHPSD5	2/22/2002	5.69	Production Well
	LHPSD5	3/26/2002	6.57	Production Well
	LHPSD5	4/23/2002	6.11	Production Well
	LHPSD5	8/21/2002	8.09	Production Well
	LHPSD5	10/16/2002	8.58	Production Well
	LHPSDEP001	1/22/2002	1.69	Water System Point
	LHPSDEP001	3/26/2002	2.62	Water System Point
	LHPSDEP001	4/23/2002	1.93	Water System Point
	LHPSDEP001	10/16/2002	4.29	Water System Point
	LHPSDTW1	1/22/2002	2.16	Test well
	LHPSDTW1	8/21/2002	0.81	Test well
	LHPSDTW10	1/21/2002	1.9	Test well
	LHPSDTW10	8/21/2002	1.1	Test well
	LHPSDTW11	1/21/2002	1.41	Test well
	LHPSDTW11	8/21/2002	1.73	Test well
	LHPSDTW12	1/21/2002	0.758	Test well
	LHPSDTW12	8/21/2002	0.824	Test well
	LHPSDTW2	1/22/2002	0.103	Test well
	LHPSDTW2	8/21/2002	0.081	Test well
	LHPSDTW3	1/22/2002	4.48	Test well
	LHPSDTW3	8/21/2002	4.17	Test well
	LHPSDTW4	1/22/2002	37.1	Test well
	LHPSDTW4	3/26/2002	33.3	Test well
	LHPSDTW4	4/23/2002	28.7	Test well
	LHPSDTW4	8/21/2002	12.3	Test well
	LHPSDTW4	10/16/2002	14.5	Test well
	LHPSDTW5	8/21/2002	6.26	Test well
	LHPSDTW6	1/22/2002	1.79	Test well
	LHPSDTW6	8/21/2002	1.15	Test well
	LHPSDTW6	8/21/2002	1.23	duplicate
	LHPSDTW9	1/22/2002	0.364	Test well
	LHPSDTW9	8/21/2002	0.812	Test well
	LHTORCHBS	1/22/2002	1.85	Water System Point
	BARTLETTCC	1/22/2002	1.94	Water System Point
	339B STA	1/22/2002	1.81	Water System Point
General Electric, WV	GE WELL 3	1/3/2002	1.78	Production Well
	GE WELL 3	1/3/2002	1.67	duplicate
	GE WELL 3	2/21/2002	1.75	Production Well
	GE WELL 3	4/26/2002	1.84	Production Well
Lubeck, WV	LPSDAT	3/28/2002	0.69	After Treatment Sample
	LPSDAT	4/26/2002	0.652	After Treatment Sample

Table 3.13
Summary of C-8 in Groundwater
Public Water Supplies, West Virginia and Ohio
Dupont Washington Works Facility, Washington WV

Location	Sample ID	Sample Date	C-8 ug/l	Comments
Lubeck, WV (cont.)	LPSDAT	6/24/2002	0.6	After Treatment Sample
	LPSDAT	10/15/2002	0.653	After Treatment Sample
	LPSD WELL A	1/3/2002	0.764	Production Well
	LPSD WELL A	2/21/2002	0.883	Production Well
	LPSD WELL A	3/28/2002	0.796	Production Well
	LPSD WELL A	4/26/2002	0.938	Production Well
	LPSD WELL A	7/24/2002	0.753	Production Well
	LPSD WELL A	10/15/2002	0.858	Production Well
	LPSD WELL B	2/21/2002	0.61	Production Well
	LPSD WELL B	3/28/2002	0.551	Production Well
	LPSD WELL B	4/26/2002	0.532	Production Well
	LPSD WELL B	7/24/2002	0.443	Production Well
	LPSD WELL B	10/15/2002	0.537	Production Well
	LPSD WELL C	1/3/2002	0.592	Production Well
	LPSD WELL C	2/21/2002	0.479	Production Well
	LPSD WELL C	3/28/2002	0.491	Production Well
	LPSD WELL C	4/26/2002	0.471	Production Well
	LPSD WELL C	7/24/2002	0.398	Production Well
	LPSD WELL C	10/15/2002	0.504	Production Well
	LPSD WELL D	1/3/2002	0.758	Production Well
	LPSD WELL D	2/21/2002	0.725	Production Well
	LPSD WELL D	3/28/2002	0.692	Production Well
	LPSD WELL D	4/26/2002	0.506	Production Well
	LPSD WELL D	7/24/2002	0.444	Production Well
	LPSD WELL D	10/15/2002	0.517	Production Well
	LPSD WELL E	1/3/2002	0.332	Production Well
	LPSD WELL E	2/21/2002	1	Production Well
	LPSD WELL E	3/28/2002	1.09	Production Well
	LPSD WELL E	4/26/2002	1.11	Production Well
	LPSD WELL E	7/24/2002	1.02	Production Well
	LPSD WELL E	10/15/2002	1.21	Production Well
	LPSD WELL F	1/3/2002	1.04	Production Well
	LPSD WELL F	2/21/2002	0.313	Production Well
	LPSD WELL F	3/28/2002	0.358	Production Well
	LPSD WELL F	3/28/2002	0.362	duplicate
	LPSD WELL F	4/26/2002	0.332	Production Well
	LPSD WELL F	7/24/2002	0.284	Production Well
	LPSD WELL F	7/24/2002	0.283	duplicate
	LPSD WELL F	10/15/2002	0.355	Production Well
Belleville Hydra Plant, WV	BELLEVILLELD	1/29/2002	NQ (<0.050)	Miscellaneous Use
Tuppers Plains PSD, OH	TPPSDPT	2/6/2002	0.372	Before Treatment Sample
	TPPSDPT	3/25/2002	0.347	Before Treatment Sample
	TPPSDPT	7/23/2002	0.24	Before Treatment Sample
	TPPSDPT	10/15/2002	0.226	Before Treatment Sample
	TPPSDAT	2/6/2002	0.361	After Treatment Sample
	TPPSDAT	3/25/2002	0.358	After Treatment Sample
	TPPSDAT	4/24/2002	0.363	After Treatment Sample
	TPPSDAT	7/23/2002	0.246	After Treatment Sample
	TPPSDAT	10/15/2002	0.268	After Treatment Sample
	TPPSDPW1	2/6/2002	0.726	Production Well

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Table 3.13
Summary of C-8 in Groundwater
Public Water Supplies, West Virginia and Ohio
Dupont Washington Works Facility, Washington WV

Location	Sample ID	Sample Date	C-8 ug/l	Comments
Tuppers Plains PSD, OH (cont.)	TPPSDPW1	3/25/2002	0.705	Production Well
	TPPSDPW1	4/24/2002	0.702	Production Well
	TPPSDPW1	7/23/2002	0.588	Production Well
	TPPSDPW1	10/15/2002	0.486	Production Well
	TPPSDPW2	2/6/2002	0.417	Production Well
	TPPSDPW2	3/25/2002	0.327	Production Well
	TPPSDPW2	4/24/2002	0.371	Production Well
	TPPSDPW2	7/23/2002	0.235	Production Well
	TPPSDPW2	10/15/2002	0.255	Production Well
	TPPSDPW3	2/6/2002	NQ (<0.050)	Production Well
	TPPSDPW3	3/25/2002	NQ (<0.050)	Production Well
	TPPSDPW3	7/23/2002	ND (<0.010)	Production Well
	TPPSDPW3	10/15/2002	ND (<0.010)	Production Well
	TPPSDPW4	2/6/2002	0.0734	Production Well
	TPPSDPW4	3/25/2002	0.07	Production Well
	TPPSDPW4	7/23/2002	0.052	Production Well
	TPPSDPW4	10/15/2002	0.076	Production Well
	TPPSDPW5	2/6/2002	0.201	Production Well
	TPPSDPW5	3/25/2002	0.201	Production Well
	TPPSDPW5	7/23/2002	0.216	Production Well
	TPPSDPW5	10/15/2002	0.229	Production Well
	TPPSDPW6	2/6/2002	0.649	Production Well
	TPPSDPW6	3/25/2002	0.634	Production Well
	TPPSDPW6	4/24/2002	0.62	Production Well
	TPPSDPW6	7/23/2002	0.62	Production Well
	TPPSDPW6	10/15/2002	0.433	Production Well
Ravenswood Municipal, WV	COR ASIN	3/27/2002	ND (<0.010)	Air Stripper In
	COR ASOUT	3/27/2002	NQ (<0.050)	Air Stripper Out
	COR BLEND AT	3/27/2002	ND (<0.010)	Blend After Treatment
	COR WELL1	3/27/2002	ND (<0.010)	Production Well
	COR WELL 2	3/27/2002	ND (<0.010)	Production Well
	COR WELL3	3/27/2002	ND (<0.010)	Production Well
	COR WELL 4	3/27/2002	ND (<0.010)	Production Well
	COR WELL 5	3/27/2002	ND (<0.010)	Production Well
Mason County PSD, WV	MASONCPSD1	1/29/2002	NQ (<0.050)	Production Well
	MASONCPSD1	3/27/2002	NQ (<0.050)	Production Well
	MASONCPSD1	4/25/2002	NQ (<0.050)	Production Well
	MASONCPSD2	1/29/2002	0.0618	Production Well
	MASONCPSD2	3/27/2002	0.0838	Production Well
	MASONCPSD2	4/25/2002	0.0714	Production Well
	MASONCPSD3	1/29/2002	0.0707	Production Well
	MASONCPSD3	3/27/2002	0.102	Production Well
	MASONCPSD3	4/25/2002	0.063	Production Well
Racine Locks and Dam, WV	RACINELD	1/4/2002	0.518	Miscellaneous Use
Village of Racine, OH	VORAT	3/26/2002	ND (<0.010)	After Treatment Sample
	VORRV3	3/26/2002	ND (<0.010)	Production Well
	VORWELL1	3/26/2002	ND (<0.010)	Production Well
	VORWELL2	3/26/2002	ND (<0.010)	Production Well
New Haven Water Dept., WV	NHPSDAT	4/10/2002	ND (<0.010)	After Treatment Sample
	NHPSDPW1	4/10/2002	NQ (<0.050)	Production Well

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Table 3.13
Summary of C-8 in Groundwater
Public Water Supplies, West Virginia and Ohio
Dupont Washington Works Facility, Washington WV

Location	Sample ID	Sample Date	C-8 ug/l	Comments
New Haven Water Dept., WV	NHPSDPW1	4/10/2002	NQ (<0.050)	duplicate
Village of Syracuse, OH	VOSAT	3/29/2002	NQ (<0.050)	After Treatment Sample
	VOSAT	4/24/2002	ND (<0.010)	After Treatment Sample
	VOS NORTH 2	3/29/2002	NQ (<0.050)	Production Well
	VOS NORTH 2	4/24/2002	0.491	Production Well
	VOS SOUTH R3	3/26/2002	0.298	Production Well
	VOS SOUTH R3	4/24/2002	ND (<0.010)	Production Well
Village of Pomeroy, OH	VOPAT	3/26/2002	0.0659	After Treatment Sample
	VOPAT	4/24/2002	0.0628	After Treatment Sample
	VOPWELL1	4/24/2002	ND (<0.010)	Production Well
	VOPWELL2	3/26/2002	0.0689	Production Well
	VOPWELL2	4/24/2002	ND (<0.010)	Production Well
	VOPWELL4	3/26/2002	0.0851	Production Well
	VOPWELL4	4/24/2002	0.0712	Production Well

ND = Not Detected at or above the limit of detection (LOD).
The listed LOD is approximate and varies by instrument and over time.
NQ = Not Quantifiable. Detected at a level above the LOD and below the limit of quantification (LOQ).
All C-8 results are reported in ug/l.
Misc. = Miscellaneous water use is not used for drinking.

Table 3.14
Synoptic Groundwater Elevations February 2002 and Well Screen Locations
DuPont Washington Works Facility Washington, West Virginia

New ID	Measuring Point Elevation (feet) *	Old ID	February 2002 DTW	February 2002 Groundwater Elevation (feet)	Screen Locations
AC05-MW01	635.22	TW-E6	68.6	566.62	site primary aquifer
AL10-MW01	631.61	TW-M1	67.12	564.49	site primary aquifer
AO08-MW01	636.02	TW-48	74.93	561.09	site primary aquifer
AO09-MW01	632.89	TW-26	70.32	562.57	site primary aquifer
AR09-MW01	635.27	TW-38	75.01	560.26	site primary aquifer
AX12-MW01	635.23	TW-39	73.81	561.42	site primary aquifer
D08-MW01	600.67	TW-M5	37.98	562.69	site primary aquifer
F06-MW01	601.14	TW-M6	38.9	562.24	site primary aquifer
I07-MW01	610.23	TW-M3	49.18	561.05	site primary aquifer
J08-MW01	630.21	TW-20	69.8	560.41	site primary aquifer
K14-MW01	627.34	TW-M4	68.25	559.09	site primary aquifer
L18-MW01	635.82	TW-27	78.87	556.95	site primary aquifer
M16-MW01	627.14	TW-55	68.9	558.24	site primary aquifer
N04-MW01	594.48	TW-32	16.46	578.02	perched water table
N13-MW01	625.87	TW-54	65.95	559.92	site primary aquifer
P08-MW01	629.29	TW-53	69.19	560.1	site primary aquifer
Q04-MW02	598.76	TW-50	38.71	560.05	site primary aquifer
T13-MW01	632.69	TW-24	71.59	561.1	site primary aquifer
U05-MW02	631.17	TW-P12	79.02	552.15	site primary aquifer
U16-MW01	638.23	TW-25	76.5	561.73	site primary aquifer
V09-MW01	628.5	TW-3(pw-3)	67.38	561.12	site primary aquifer
Y05-MW01	631.16	TW-E5	67.48	563.68	site primary aquifer
Z07-MW02	632.49	TW-22	67.9	564.59	site primary aquifer
AA04-MW01	599.95	TW-70	34.4	565.55	site primary aquifer
AA05-MW01	633.32	TW-71	67.71	565.61	site primary aquifer
AB07-MW02	633.02	TW-72	67.41	565.61	site primary aquifer
AE11-MW01	628.94	TW-74	62.92	566.02	site primary aquifer
E13-MW01	625.47	TW-76	64.35	561.12	site primary aquifer
G17-MW01	632.81	TW-77	73.35	559.46	site primary aquifer
M04-MW02	595.51	TW-79	13.42	582.09	perched water table
M04-MW03	595.43	TW-80	13.93	581.5	perched water table
N04-MW02	595.82	TW-81	13.78	582.04	perched water table
N05-MW01	633.17	TW-82	73.18	559.99	site primary aquifer
P04-MW02	592.39	TW-83	20.48	571.91	perched water table
P05-MW02	631.24	TW-84	71.14	560.1	site primary aquifer
R04-MW02	594.92	TW-85	18.53	576.39	perched water table
S05-MW02	630.64	TW-86	71.66	558.98	site primary aquifer
U04-MW01	595.43	TW-87	11.97	583.46	perched water table
V06-MW01	629.49	TW-88	70.53	558.96	site primary aquifer
W05-MW01	629.9	TW-89	70.42	559.48	site primary aquifer
Y14-MW01	642.25	TW-90	80.1	562.15	site primary aquifer
Z06-MW02	629.21	TW-91	65.2	564.01	site primary aquifer
Z07-MW01	632.98	TW-92	68.97	564.01	site primary aquifer
Z09-MW01	624.65	TW-93	60.95	563.7	site primary aquifer

* All Measuring Point Elevation data is from Vernon surveys in 1989 or 1998.

Table 3.15
Summary of On-site and Off-site Exposure Pathways Evaluation
DuPont Washington Works Facility

Exposure Pathways Evaluation					
		Exposure Pathways for Human Receptors		Exposure Pathways for Ecological Receptors	
	C-8 Impacted Media	Pathway Assessment [Complete (C) or Incomplete (I)]	Comparison to Screening Criteria*	Pathway Assessment (Complete or Incomplete)	Comparison to Screening Criteria*
On-Site	SWMUs/Land filled Materials	I	--	I	--
	Soil	I	--	I	--
	Surface Water	I	--	I	--
	Groundwater	I		I	
	Drinking water (from groundwater)	C	1.9(L) ug/l << 150 ug/l	NA	
	Process water (from groundwater)	C	51.2 ug/l < 150 ug/l	NA	
		Exposure Pathways for Human and Ecological Receptors			
	C-8 Impacted Media	Pathway Assessment [Complete (C) or Incomplete (I)]	Comparison to Screening Criteria*		
Off-Site	Drinking Water (wells, springs and/or cisterns) - WV	C	2.8 ug/l << 150 ug/l		
	Non-drinking water (wells, springs and/or cisterns) - WV	C	5.07 ug/l <150 ug/l		
	Unused water sources - WV	I	--		
	Drinking Water (wells, springs and/or cisterns) - OH	C	8.59 ug/l << 150 ug/l		
	Non-drinking water (wells, springs and/or cisterns) - OH	C	23.6 ug/l < 150 ug/l		
	Unused water sources - OH	I	--		
	Ohio River water	C	1.09 ug/l << 150 ug/l		
	PWS (WV and OH)	C	4.29 ug/l << 150 ug/l		

* Highest value in category is compared to the screening criteria. Screening criteria was established by CATT of 240 mg/kg for soil, 1360 ug/l for aquatic life (surface water), 150 ug/l for drinking water. For complete exposure pathways, all water samples are compared to the drinking water screening criteria to be conservative. No comparison is made for incomplete exposure pathways.

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Table 4.0
Monitoring Well Construction and Groundwater Elevation Data
Local Landfill
Washington, WV

	Monitoring Wells								
	A-Zone				B-Zone	C-Zone			D-Zone
Parameters	LLMW-4	LLMW-6	LLMW-9	LLMW-10	LLMW-12B	LLMW-11A	LLMW-13B	LLMW-14B	LLMW-11B
Measuring Point Elevation (feet)	847.55	796.27	788.54	805.94	764.28	663.83	750.80	672.04	665.12
Total Depth (feet)	157.1	93.09	81.39	87.75	94.94	42.37	139.87	57.28	115.95
Well Diameter (inches)	4	4	4	4	2	2	2	2	2
Slot Size (inches)	0.020	0.020	0.020	0.020	0.010	0.010	0.010	0.010	0.010
Screen Length (feet)	20	20	20	20	20	20	15	15	20
Screen Interval (feet)	710.45 - 690.45	723.18 - 703.18	727.15 - 707.15	738.19 - 718.19	689.34 - 669.34	641.46 - 621.46	625.93 - 610.93	629.76 - 614.76	569.17 - 549.17
Groundwater Elevation (feet)									
December-01	692.55	719.69	727.78	720.67	-	-	-	-	-
January-02	715.39	720.41	728.06	720.51	-	-	-	-	-
February-02	715.28	719.76	728.01	720.73	-	-	-	-	-
March-02	715.31	722.00	728.12	720.90	-	-	-	-	-
May-02	714.93	721.52	728.48	721.84	-	-	-	-	-
August-02	715.52	719.77	728.24	722.97	-	-	-	-	-
October-02	715.53	719.56	728.10	723.01	681.93	640.42	648.29	627.74	563.60

ASH021728

EID639960

Table 4.1
Summary of Analytical Results:
C-8 in Groundwater
Local Landfill
Washington, WV

Sample	Date	C-8 (ug/l)
	A-Zone	
LLMW-4	10/15/2002	79.6
	9/3/2002	63.5
	5/20/2002	55.7
	3/28/2002	47.2
	2/25/2002	50.2
	1/27/2002	58.4
	12/13/2001	54.6
	5/16/2001	1.40
	5/11/2000	10
	5/19/1999	16.2
	5/27/1998	28
	4/11/1996	39
LLMW-6	10/15/2002	19.9
	10/15/02 (dup)	17
	9/3/2002	13.7
	5/20/2002	18.6
	3/28/2002	11.5
	2/25/2002	10.1
	1/27/2002	12.2
	12/13/2001	11.9
	5/16/2001	3
	5/10/2000	1.42
	5/19/1999	1.32
	5/27/1998	9
	4/11/1996	15
LLMW-9	10/15/2002	0.0569
	9/3/2002	NQ
	5/20/2002	NQ
	3/28/2002	NQ
	2/25/2002	NQ
	1/27/2002	NQ
	12/13/2001	ND
	5/16/2001	0.039 J
	5/10/2000	<0.029
	5/20/1999	0.046 J
	5/27/1998	<0.1
	4/11/1996	0.14

Table 4.1
Summary of Analytical Results:
C-8 in Groundwater
Local Landfill
Washington, WV

Sample	Date	C-8 (ug/l)
LLMW-10	10/15/2002	0.395
	9/3/2002	0.357
	5/20/2002	0.56
	3/28/2002	0.698
	2/25/2002	1.12
	1/27/2002	0.162
	12/13/2001	0.133
	5/20/1999	0.15
	5/28/1998	0.22
B-Zone		
LLMW-12B	10/8/2002	0.0658
C-Zone		
LLMW-11A	10/8/2002	2.22
LLMW-13B	10/8/2002	6.61
LLMW-14B	10/9/2002	0.488
D-Zone		
LLMW-11B	10/8/2002	NQ (<0.05)

J= estimated value (below laboratory quantitation limit)
ND= Not Detected at or above the limit of detection (LOD)
NQ= Not Quantifiable. Detected at a concentration above the LOD and below the limit of quantification (LOQ).
Note: Analytical method changed as of November 2001 (see Section 2.0 for details).

Table 4.2
Summary of Analytical Results:
C-8 in Surface Water
Local Landfill
Washington, WV

Sample	Date	C-8 (ug/l)
OUTFALL 004 (New)	11/30/2002	No-flow conditions
	10/31/2002	No-flow conditions
	9/30/2002	No-flow conditions
	8/26/2002	No-flow conditions
	7/1/2002	11.2
	6/13/2002	9.29
	5/21/2002	No-flow conditions
	4/29/2002	14.5
	3/26/2002	14.6
OUTFALL 004 (Old)	11/30/2002	No-flow conditions
	10/31/2002	No-flow conditions
	9/30/2002	No-flow conditions
	8/26/2002	No-flow conditions
	7/1/2002	11.6
	6/13/2002	10
	5/21/2002	No-flow conditions
	4/29/2002	15
	3/26/2002	1.54
	2/20/2002	10.9
	1/24/2002	11.4
	12/13/2001	No-flow conditions
	9/27/2000	4.73
	12/10/1999	7.1
	6/3/1999	3.06
	6/2/1998	12
	5/29/1997	13
	4/2/1996	13
	2/16/1994	11
OUTFALL 005 (New)	11/30/2002	No-flow conditions
	10/31/2002	No-flow conditions
	9/30/2002	No-flow conditions
	8/26/2002	No-flow conditions
	7/1/2002	No-flow conditions
	6/13/2002	No-flow conditions
	5/21/2002	No-flow conditions
	4/29/2002	34.3
	3/26/2002	16

Table 4.2
Summary of Analytical Results:
C-8 in Surface Water
Local Landfill
Washington, WV

Sample	Date	C-8 (ug/l)
OUTFALL 005 (Old)/SS1	11/30/2002	No-flow conditions
	10/31/2002	No-flow conditions
	9/30/2002	No-flow conditions
	8/26/2002	No-flow conditions
	7/1/2002	32.1
	6/13/2002	27.3
	5/21/2002	No-flow conditions
	4/29/2002	40.9
	3/26/2002	39
	2/20/2002	46
	1/11/2002	51.4
	12/13/2001	No-flow conditions
	9/27/2000	13.3
	12/10/1999	34
	6/3/1999	6.8
	6/2/1998	39
	5/29/1997	41
	4/2/1996	39
	2/16/1994	35
OUTLET 101	11/19/2002	76.7
	10/31/2002	78.6
	9/30/2002	115
	8/26/2002	70.3
	7/1/2002	63
	6/13/2002	38
	5/21/2002	40
	4/29/2002	48.2
	3/25/2002	36.4
	2/20/2002	63.1
	1/23/2002	81.4
	12/13/2001	82.4
	9/14/2000	12
	6/3/1999	15
	6/2/1998	54
LM1 (Leachate)/Inlet 002	11/21/2002	120

Note: Analytical method changed as of November 2001 (see Section 2.0 of DuPont (2003b)for details).

Table 4.3
Summary of On-site and Off-site Exposure Pathways Evaluation
Local Landfill

Exposure Pathways Evaluation					
		Human Health Exposure Pathways		Ecological Exposure Pathways	
	C-8 Impacted Media	Pathway Assessment (Complete or Incomplete)	Comparison to Screening Criteria*	Pathway Assessment (Complete or Incomplete)	Comparison to Screening Criteria*
On-Site	SWMUs/Landfilled Materials	I	–	I	–
	Soil	I	–	I	–
	Leachate	C	120 ug/l < 150 ug/l	C	115 ug/l < 150 ug/l
	Surface Water	C	115 ug/l < 150 ug/l	C	115 ug/l < 150 ug/l
	Groundwater	I	–	I	
		Exposure Pathways for Human and Ecological Receptors			
	C-8 Impacted Media	Pathway Assessment [Complete (C) or Incomplete (I)]	Comparison to Screening Criteria*		
Off-Site	Drinking Water (wells, springs and/or cisterns) - Local	C	2.8 ug/l << 150 ug/l		
	Non-drinking water (wells, springs and/or cisterns) - Local	C	5.07 ug/l <150 ug/l		
	Unused water sources	I	–		

* Highest value in category is compared to the screening criteria. Screening criteria was established by CATT of 240 mg/kg for soil, 1360 ug/l for aquatic life (surface water), 150 ug/l for drinking water. For complete, all water samples are compared to the drinking water screening criteria to be conservative. No comparison is made for incomplete exposure pathways.

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Table 5.0
Summary of Off-site Sampling Program (C-8 Sampling)
Letart Landfill
Letart, WV

RESIDENTIAL SAMPLING FOR 1-MILE RADIUS		
Homes	Number of homes contacted [1]	48
	Number of homes surveyed [1]	46
Wells	Number of wells identified [2]	42
	Number of wells sampled [2]	30
	Number of wells sampled that are used for drinking water	11
Cisterns	Number of cisterns identified [2]	4
	Number of cisterns sampled [2]	0
	Number of cisterns sampled that are used for drinking water	0
Springs	Number of springs identified [2]	0
	Number of springs sampled [2]	0
	Number of springs sampled that are used for drinking water	0
Samples	Total number of samples	30
	Total number of collected samples used for drinking water	11

Note: Field duplicates not considered in sample count.

(1) During this investigation, homeowners/residents identified within the sampling radius were contacted to determine residential water usage. Up to two contacts were attempted at each residence. After the second contact attempt, a voluntary survey was left at the residence. Because not all homeowners/residences to the survey, the number of residences surveyed is less than the number of homes contacted.

(2) Some water sources (e.g. wells, cisterns, springs) identified during the survey were not sampled. In many cases, sampling of these water sources was refused by the homeowners/residents. In other cases, the water sources were either not accessible or damaged. As a consequence, the number of water sources sampled was less than the number of water sources identified.

Table 5.1
Summary of C-8 Analytical Results in Groundwater (ug/l)
Letart Landfill (Off-site Wells - One Mile Radius)
Letart, WV

Sample ID	Sample Date	C-8 ug/l	Well Use* Comments	Sample ID	Sample Date	C-8 ug/l	Well Use* Comments
OS-BRINKERA	12/11/2001	0.139	Drinking Water	OS-GERLACHBA	1/16/2002	0.636	Unused
OS-DUTYKL	12/12/2001	ND (0.010)	Drinking Water	OS-GERLACHC	12/14/2001	ND (0.010)	Miscelaneous
OS-GERLACHL	12/11/2001	ND (0.010)	Drinking Water	OS-GRIMMR2	1/16/2002	ND (0.010)	Unused
OS-GRIMMG	12/10/2001	ND (0.010)	Drinking Water	OS-JORDANS2	1/17/2002	ND (0.010)	Unused
OS-GRIMMR	12/11/2001	ND (0.010)	Drinking Water	OS-JORDANS3	1/17/2002	ND (0.010)	Unused
OS-JORDANS1	1/17/2002	ND (0.010)	Drinking Water	OS-KEARNSMG	12/10/2001	ND (0.010)	Miscelaneous
OS-JUDGET	12/10/2001	ND (0.010)	Drinking Water	OS-PAINTERJ	12/11/2001	ND (0.010)	Miscelaneous
OS-PARSONSR	12/14/2001	ND (0.010)	Drinking Water	OS-PARSONSR2	2/27/2002	ND (0.010)	Unused
OS-SAYRET	12/11/2001	NQ (<0.050)	Drinking Water	OS-RICHARDSOND	12/11/2001	ND (0.010)	Miscelaneous
OS-SHIELDSD	12/10/2001	ND (0.010)	Drinking Water	OS-ROTTGENRD	1/16/2002	ND (0.010)	Unused
OS-STEWARTA	12/13/2001	NQ (<0.050)	Drinking Water	OS-SLEETHTR	1/17/2002	ND (0.010)	Unused
OS-STEWARTA	12/13/2001	NQ (<0.050)	Drinking Water, duplicate	OS-STEWARTA2	2/27/2002	ND (0.010)	Unused
OS-BIGBENDBHC	1/24/2002	ND (0.010)	Unused	OS-THACKERC	12/12/2001	NQ (<0.050)	Miscelaneous
DUPONT LET1	1/17/2002	NQ (<0.050)	Unused	OS-THOMASC	12/10/2001	ND (0.010)	Miscelaneous
OS-FRIENDW	1/16/2002	ND (0.010)	Unused	OS-THOMASLJ	12/12/2001	ND (0.010)	Miscelaneous
OS-FRIENDW	1/16/2002	ND (0.010)	Unused, duplicate	OS-VAUGHANJ	12/13/2001	ND (0.010)	Miscelaneous

* Drinking Water (highlighted in bold blue) indicates human consumption. Non-drinking Water uses include livestock watering, gardening and any other non-human consumption water uses.

ND = Not Detected at or above the limit of detection (LOD).
The listed LOD is approximate and varies by instrument and over time.

NQ = Not Quantifiable. Detected at a concentration above the LOD and below the limit of quantification (LOQ).

All C-8 results are reported in ug/l.

Miscellaneous water use is not used for drinking.

Table 5.2
Monitoring Well Construction and Groundwater Elevation Data
Letart Landfill
Letart, WV

Monitoring Wells									
Zone	D-E Zone (con't)		F-Zone						Under F-Zone
Parameters	LMW-13A	LMW-14A	LMW-2A	LMW-6	LMW-10	LMW-11	LMW-13B	LMW-14B	LMW-9
Measuring Point Elevation (feet)	766.25	766.91	780.87	755.99	734.37	776.21	765.86	767.10	777.85
Total Depth (feet)	152.35	158.72	182.17	176.43	191.55	166.54	192.27	202.00	230.87
Well Diameter (inches)	4	4	4	4	4	4	4	4	4
Slot Size (inches)	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Screen Length (feet)	20	20	30	30	20	25	20	20	20
Elevation of Screen Interval (feet)	655.10 - 635.10	628.19 - 608.19	628.70 - 598.70	609.56 - 679.56	562.82 - 542.82	634.67 - 609.67	593.59 - 573.59	585.10 - 565.10	566.98 - 546.98
Groundwater Elevation (feet)									
December-01	-	-	NA	NA	NA	NA	-	-	NA
January-02	-	-	622.19	582.26	543.37	619.58	-	-	552.12
February-02	-	-	622.23	581.97	543.36	620.70	-	-	551.96
March-02	-	-	622.44	581.82	543.39	620.99	-	-	551.79
May-02	-	-	622.28	581.97	543.39	621.28	-	-	551.24
August-02	-	-	622.44	582.34	543.26	621.52	-	-	552.51
October-02	621.07	627.04	622.38	582.05	543.35	621.10	582.86	569.31	551.73

NA = Instrument limitations

Table 5.2
Monitoring Well Construction and Groundwater Elevation Data
Letart Landfill
Letart, WV

	Monitoring Wells								
Zone	A-Zone			C-Zone		D/E-Zone			
Parameters	LMW-1	LMW-7	LMW-8	LMW-3	LMW-5A	LMW-3A	LMW-4	LMW-5B	LMW-12
Measuring Point Elevation (feet)	768.93	770.24	777.06	676.47	647.22	674.79	651.58	646.22	742.62
Total Depth (feet)	31.50	36.73	40.60	30.61	30.67	59.59	28.66	71.56	107.52
Well Diameter (inches)	2	4	4	2	4	4	2	4	4
Slot Size (inches)					0.010	0.010		0.010	0.010
Screen Length (feet)	5	10	9	5	10	5	5	20	20
Elevation of Screen Interval (feet)	742.43 - 737.43	743.51 - 733.51	745.46 - 736.46	650.86 - 645.86	626.55 - 616.55	620.20 - 615.20	627.92 - 622.92	594.66 - 574.66	655.10 - 635.10
	Groundwater Elevation (feet)								
December-01	752.62	749.73	745.04	646.82	619.22	617.4	628.08	596.31	-
January-02	752.82	752.25	746.76	648.19	618.76	616.76	642.79	596.64	-
February-02	752.65	751.87	745.05	648.07	618.10	615.37	639.99	596.34	-
March-02	752.10	751.56	746.24	648.47	617.61	614.80	643.30	596.86	-
May-02	750.27	751.16	745.41	646.74	617.50	615.27	643.08	596.66	-
August-02	751.98	751.49	744.95	646.53	617.36	615.54	636.02	596.25	-
October-02	751.02	751.75	745.43	646.77	617.23	615.84	632.47	596.86	635.47

NA = Instrument limitations

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Table 5.3
Summary of Analytical Results: C-8 in Groundwater
Letart Landfill
Letart, WV

A-Zone Wells		
Sample	**Date**	**C-8 (ug/l)**
LMW-1	10/14/2002	25900
	8/29/2002	23000
	5/24/2002	30500
	3/29/2002	20600
	2/24/2002	18400
	1/28/2002	29400
	12/10/2001	24600
	7/19/2001	6100
	1/31/2001	9190
	10/4/2000	10600
	7/24/2000	8990
	4/3/2000	13600
	1/13/2000	17400
	10/21/1999	12600
	7/20/1999	6920
	5/28/1998	24000
	7/23/1997	5100
	4/17/1996	1700
	11/22/1991	68
	3/22/1991	60
LMW-7	10/14/2002	300
	8/27/2002	197
	5/24/2002	567
	3/29/2002	324
	2/24/2002	180
	1/26/2002	496
	12/10/2001	334
	7/20/2001	242
	1/31/2001	249
	10/4/2000	231
	7/25/2000	158
	4/3/2000	211
	1/13/2000	219
	10/20/1999	339
	7/20/1999	78.3
	5/28/1998	260
	7/23/1997	53
	4/17/1996	15
	11/22/1991	0.1
LMW-8	10/14/2002	3480
	8/29/2002	3100
	5/24/2002	4020
	3/29/2002	3520
	2/23/2002	2230
	1/28/2002	3930
	12/10/2001	3240
	7/19/2001	1120
	1/30/2001	2650
	10/4/2000	2300
	7/24/2000	2160
	4/3/2000	2180
	1/13/2000	2100
	10/20/1999	3260
	7/20/1999	1790
	5/28/1998	2700
	7/23/1997	2000
	4/17/1996	2200
	11/22/1991	280

Table 5.3
Summary of Analytical Results: C-8 in Groundwater
Letart Landfill
Letart, WV

C-Zone Wells		
Sample	**Date**	**C-8 (ug/l)**
LMW-3	10/11/2002	NQ (<0.05)
	8/26/2002	Dry no sample
	5/24/2002	2270
	3/27/2002	1760
	2/24/2002	1920
	1/29/2002	1700
	12/13/2001	1520
	11/22/1991	1000
	3/22/1991	390
LMW-5A	10/11/2002	112
	8/26/2002	Dry no sample
	5/21/2002	87.6
	3/27/2002	93.8
	2/23/2002	82.2
	1/26/2002	99.3
	12/11/2001	94.4
	11/22/1991	0.8
	3/22/1991	1.6
D/E-Zone Wells		
Sample	**Date**	**C-8 (ug/l)**
LMW-3A	10/11/2002	204
	8/26/2002	Dry-no sample
	5/24/2002	134
	3/27/2002	132
	2/23/2002	101
	1/26/2002	98.6
	12/11/2001	100
	7/19/1999	60.3
	11/22/1991	350
	3/22/1991	380
LMW-4	10/11/2002	2840
	8/27/2002	1410
	5/21/2002	1690
	3/27/2002	2620
	2/23/2002	2250
	1/26/2002	3060
	12/13/2001	1580
	4/3/2000	272
	1/14/2000	172
	11/22/1991	830
	3/28/1991	690
D/E-Zone Wells		
Sample	**Date**	**C-8 (ug/l)**
LMW-5B	10/11/2002	2230
	10/11/02 (dup)	2280
	8/27/2002	1480
	8/27/02 (dup) *	1340
	5/21/2002	1720
	5/21/02 (dup) *	1630
	3/27/2002	1810
	3/27/02 (dup)	1850
	2/23/2002	1460
	2/23/02(dup)	1490
	1/26/2002	1780
	1/26/02 (dup)	1890
	12/11/2001	1880
	7/20/2001	483
	7/20/01(dup)	592

Table 5.3
Summary of Analytical Results: C-8 in Groundwater
Letart Landfill
Letart, WV

D/E-Zone Wells (Cont.)		
Sample	Date	C-8 (ug/l)
	1/31/2001	615
	10/5/2000	1190. J
	10/5/00 (dup)	780
	7/25/2000	900. J
	4/3/2000	1100
	4/3/00 (dup)	1020
	1/14/2000	1030
	10/21/1999	1750
	10/21/99 (dup)	1700
	7/20/1999	445
	7/23/1997	480
	9/20/1994	530
	3/15/1994	1200
	11/22/1991	380
	3/22/1991	340
LMW-12	10/10/2002	Dry-no sample
LMW-13A	10/10/2002	510
LMW-14A	10/10/2002	974
F-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-2A	10/14/2002	931
	8/27/2002	676
	5/24/2002	922
	3/29/2002	717
	2/24/2002	714
	1/26/2002	740
	12/11/2001	830
	7/19/2001	242
	1/30/2001	423
	10/5/2000	248
	7/25/2000	275
	4/3/2000	306
	1/14/2000	453
	10/21/1999	370
	7/20/1999	350
	5/28/1998	990
	7/23/1997	460
	4/17/1996	480
	9/20/1994	270
	3/15/1994	260
	11/22/1991	63
	3/22/1991	50
F-Zone Wells		
Sample	Date	C-8 (ug/l)
LMW-6	10/14/2002	15.1
	8/27/2002	10.6
	5/24/2002	20.7
	3/29/2002	14.8
	2/24/2002	14.9
	1/26/2002	16.1
	12/11/2001	15.8
	1/13/2000	9.4
	5/28/1998	30
	11/22/1991	24
	3/22/1991	25
LMW-10	10/17/2002	Instrumentation problems-Not sampled
	8/29/2002	Pump problems-Not sampled
	5/21/2002	0.298

Table 5.3
Summary of Analytical Results: C-8 in Groundwater
Letart Landfill
Letart, WV

F-Zone Wells		
Sample	**Date**	**C-8 (ug/l)**
LMW-10 (Cont.)	3/27/2002	0.136
	2/23/2002	0.126
	1/26/2002	0.133
	12/13/2001	0.134
LMW-11	10/14/2002	0.121
	8/27/2002	0.058
	5/21/2002	0.069
	3/29/2002	0.119
	2/24/2002	0.112
	1/26/2002	0.159
	12/11/2001	0.128
LMW-13B	10/10/2002	0.0956
LMW-14B	10/10/2002	105
Under F-Zone Wells		
Sample	**Date**	**C-8 (ug/l)**
LMW-9	10/17/2002	0.907
	8/29/2002	0.479
	5/24/2002	0.715
	3/27/2002	0.631
	2/23/2002	0.617
	1/26/2002	0.875
	12/10/2001	0.845
	10/7/1992	0.2

J = estimated value (below laboratory quantitation limit).
Note: Analytical method changed as of November 2001 (see Section 2.0 of DuPont (2003b) for details).
* Analytical duplicates' values were previously inadvertently omitted from the tables.

Table 5.4
Summary of Analytical Results:
C-8 In Surface Water
Letart Landfill
Letart, WV

Sample	Date	C-8 (ug/l)
002(LEACHATE BASIN)	11/25/2002	939
	10/31/2002	645
	9/27/2002	4.52
	8/30/2002	2050
	7/30/2002	1410
	6/28/2002	Not Analyzed*
	5/30/2002	1630
	4/30/2002	443
	3/28/2002	131
	2/19/2002	355
	1/25/2002	50.1
	12/14/2001	36.1
	11/27/2001	53.2
	7/20/2001	159
	7/25/2000	1350
	4/3/2000	1900
	1/14/2000	920
	10/21/1999	3240
003	11/30/2002	No-Flow Conditions
	10/31/2002	No-Flow Conditions
	9/27/2002	0.17
	8/30/2002	No-Flow Conditions
	7/30/2002	No-Flow Conditions
	6/28/2002	Not Analyzed*
	5/30/2002	0.282
	4/30/2002	0.0653
	3/28/2002	0.198
	2/19/2002	No-Flow Conditions
	1/25/2002	0.148
	12/14/2001	0.39
STORMWATER RUNOFF	9/27/2002	50.9
RT 33 STREAM	10/31/2002	2.83
	9/27/2002	2.24
	8/30/2002	No-Flow Conditions
	5/30/2002	1.57
	4/30/2002	0.845
	3/28/2002	1.26
	2/19/2002	3.92
	1/25/2002	1.9
	7/20/2001	2.01
	7/31/2000	0.573
	7/20/1999	2.23
	7/23/1997	2
	4/17/1996	1.8
BRINKER RUN	10/14/2002	0.0612

Table 5.4
Summary of Analytical Results:
C-8 in Surface Water
Letart Landfill
Letart, WV

Sample	Date	C-8 (ug/l)
CAP RUNOFF	11/25/2002	65.1
	10/31/2002	102
	8/30/2002	No-Flow Conditions
	6/28/2002	Not Analyzed*
	5/30/2002	371
	4/30/2002	279
	3/28/2002	Not Sampled
	2/19/2002	No-Flow Conditions
	1/25/2002	119

Note: Analytical method changed as of November 2001 (see Section 2.0 of DuPont (2003b) for details).
* Samples were taken at the respective surface water locations. However, due to an error by the courier, the samples arrived at the lab warm and were not analyzed.

Table 5.5
Summary of On-site and Off-site Exposure Pathways Evaluation
Letart Landfill
Letart, WV

Exposure Pathways Evaluation					
		Human Health Exposure Pathways		Ecological Exposure Pathways	
	C-8 Impacted Media	Pathway Assessment (Complete or Incomplete)	Comparison to Screening Criteria*	Pathway Assessment (Complete or Incomplete)	Comparison to Screening Criteria*
On-Site	SWMUs/Landfilled Materials	I	--	I	--
	Soil	I	--	I	--
	Leachate **	C	* 2050 ug/l > 150 ug/l	C	* 2050 ug/l > 150 ug/l
	Surface Water	C	371 ug/l > 150 ug/l	C	371 ug/l > 150 ug/l
	Groundwater	I	--	I	--
		Exposure Pathways for Human and Ecological Receptors			
	C-8 Impacted Media	Pathway Assessment [Complete (C) or Incomplete (I)]	Comparison to Screening Criteria*		
Off-Site					
	Drinking Water Wells - Letart	C	0.139 ug/l <<150 ug/l		
	Non-drinking Water Wells - Letart	C	NQ(<0.050) <<150 ug/l		
	Unused water sources - Letart	I	--		
	Ohio River water	C	0.128 ug/l << 150 ug/l		

* Highest value in category is compared to the screening criteria. Screening criteria was established by CATT of 240 mg/kg for soil, 1360 ug/l for aquatic life (surface water), 150 ug/l for drinking water. For complete exposure pathways, all water samples are compared to the drinking water screening criteria to be conservative. No comparison is made for incomplete exposure pathways.
** Highest C-8 concentration (since the landfill cap installation in April 2001) is shown.

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Table 6.0
Summary of Off-site Sampling Program (C-8 Sampling)
Dry Run Landfill
Lubeck, WV

RESIDENTIAL SAMPLING FOR 1-MILE RADIUS		
Homes	Number of homes contacted [1]	75
Homes	Number of homes surveyed [1]	64
Wells	Number of wells identified [2]	41
Wells	Number of wells sampled [2]	37
Wells	Number of wells sampled that are used for drinking water	13
Cisterns	Number of cisterns identified [2]	17
Cisterns	Number of cisterns sampled [2]	8
Cisterns	Number of cisterns sampled that are used for drinking water	1
Springs	Number of springs identified [2]	8
Springs	Number of springs sampled [2]	8
Springs	Number of springs sampled that are used for drinking water	1
Samples	Total number of samples	53
Samples	Total number of collected samples used for drinking water	15

Note: Field duplicates not considered in sample count.

[1] During this investigation, homeowners/residents identified within the sampling radius were contacted to determine residential water usage. Up to two contacts were attempted at each residence. After the second contact attempt, a voluntary survey was left at the residence. Because not all homeowners/residences to the survey, the number of residences surveyed is less than the number of homes contacted.

[2] Some water sources (e.g. wells, cisterns, springs) identified during the survey were not sampled. In many cases, sampling of these water sources was refused by the homeowners/residents. In other cases, the water sources were either not accessible or damaged. As a consequence, the number of water sources sampled was less than the number of water sources identified.

TABLE 6.1

Summary of C-8 Analytical Results In Groundwater and Surface Water (ug/l)
Dry Run Landfill (Off-site Wells, Springs, and Cisterns - One Mile Radius)
Lubeck, WV

Sample ID	Sample Date	C-8 ug/l	Water Use * Comments	Sample Type
OS-ABBOTTRL	12/11/2001	0.0606	Drinking Water	Well
OS-ABBOTTRL	4/11/2002	NQ (<0.050)	Drinking Water	Well
OS-ABBOTTS	12/12/2001	0.22	Drinking Water	Well
OS-ABBOTTS	4/11/2002	0.422	Drinking Water	Well
OS-ANDERSONCD	12/13/2001	ND (0.010)	Drinking Water	Well
OS-ATKINSONJ2	1/9/2002	0.149	Drinking Water	Well
OS-ATKINSONJ2	4/12/2002	0.264	Drinking Water	Well
OS-ATKINSONM	12/12/2001	ND (0.010)	Drinking Water	Well
OS-BAKERH	12/14/2001	0.339	Drinking Water	Well
OS-HOPKINSKE	12/11/2001	NQ (<0.050)	Drinking Water	Well
OS-HORNBECKJW	12/13/2001	ND (0.010)	Drinking Water	Well
OS-MORRISONM	2/4/2002	ND (0.010)	Drinking Water	Well
OS-NICHOLSONDH	12/11/2001	0.0505	Drinking Water	Well
OS-PARKERJL	12/10/2001	0.177	Drinking Water	Well
OS-SHEPHERDM	2/4/2002	NQ (<0.050)	Drinking Water	Well
OS-WESTBROOKLM	12/12/2001	ND (0.010)	Drinking Water	Well
OS-SEEBAUGHR	2/26/2002	0.273	Drinking Water	Spring
OS-NICHOLSONDH2	2/4/2002	0.242	Drinking Water	Cistern
OS-ATKINSONJ1	1/9/2002	ND (0.010)	Misc.	Well
OS-BAKERHK2	2/20/2002	NQ (<0.050)	Unused	Well
OS-CHANEYG	2/14/2002	0.164	Unused	Well
OS-COBBAJ	12/11/2001	0.0639	Misc.	Well
OS-COBBAJ2	1/15/2002	ND (0.010)	Unused	Well
OS-DAVISA2	2/13/2002	NQ (<0.050)	Unused	Well
OS-GRIENERD1	2/5/2002	NQ (<0.050)	Misc.	Well
OS-GROSED	2/15/2002	ND (0.010)	Unused	Well
OS-HARRISRE	12/12/2001	ND (0.010)	Unused	Well
OS-HOFMANNDE	12/12/2001	0.354	Unused	Well
OS-HOPEWELL 2	1/26/2002	ND (0.010)	Unused	Well
OS-JONESDR	12/13/2001	0.0614	Misc.	Well
OS-KAUFMAND	1/11/2002	ND (0.010)	Unused	Well
OS-LOBBINSJ	2/12/2002	0.078	Unused	Well
OS-ROBERTSDR	1/18/2002	ND (0.010)	Unused	Well

* Drinking Water (highlighted in bold blue) indicates human consumption. Non-drinking Water uses include livestock watering, gardening and any other non-human consumption water uses.
ND = Not Detected at or above the limit of detection (LOD).

The listed LOD is approximate and varies by instrument and over time.
NQ = Not Quantifiable. Detected at a level above the LOD and below the limit of quantification (LOQ).
All C-8 results are reported in ug/l.
Misc. = Miscellaneous water use is not used for drinking.
Data highlighted in yellow are results for water sources located in the one-mile radius that were resampled during the two-mile radius sampling event.

TABLE 6.1
Summary of C-8 Analytical Results In Groundwater and Surface Water (ug/l)
Dry Run Landfill (Off-site Wells, Springs, and Cisterns - One Mile Radius)
Lubeck, WV

Sample ID	Sample Date	C-8 ug/l	Water Use Comments	Sample Type
OS-SHEPHERDP	12/14/2001	NQ (<0.050)	Misc.	Well
OS-VANDYNEHR	12/13/2001	ND (0.010)	Unused	Well
OS-VANDYNEHR	12/13/2001	ND (0.010)	duplicate	Well
OS-VANDYNEHR1	1/11/2002	0.694	Unused	Well
OS-WHITEEE	2/20/2002	NQ (<0.050)	Unused	Well
OS-WIGALR	1/14/2002	NQ (<0.050)	Unused	Well
OS-WIGALR1A	1/26/2002	0.127	Unused	Well
OS-WIGALCA	4/3/2002	NQ (<0.05)	Unused	Well
OS-WINTERSJ	12/11/2001		Misc.	Well
OS-WRIGHTLE	4/29/2002	0.166	Unused	Well
DUPONT DR2	1/2/2002	0.839	Unused	Well
DUPONT DR3	1/2/2002	0.68	Unused	Well
OS-ATKINSONJ3	4/12/2002	0.625	Non-drinking water	Spring
OS-CAMPG3	2/28/2002	0.0998	Water Cattle	Spring
OS-CAMPG2	2/28/2002	0.081	Water Cattle	Spring
OS-DOWLERE2	1/28/2002	0.347	Water Cattle	Spring
OS-DOWLERE2	1/28/2002	0.35	duplicate	Spring
OS-RHODESR	2/4/2002	0.0748	Misc., Water Cattle	Spring
OS-SEEBAUGHV	2/26/2002	0.278	Unused	Spring
OS-TENNANTJD	2/8/2002	0.107	Unused	Spring
OS-CAMPG1	2/28/2002	0.338	Misc.	Cistern
OS-DALEL	2/28/2002	0.54	Misc.	Cistern
OS-DAVISA1	2/8/2002	0.446	Unused	Cistern
OS-DOWLERE1	1/28/2002	0.307	Misc.	Cistern
DUPONT DR3A	1/28/2002	0.175	Unused	Cistern
OS-GRIENERD2	2/5/2002	0.409	Misc.	Cistern
OS-HOPEWELL 1	1/11/2002	0.743	Unused	Cistern
OS-MOYERSV	2/28/2002	0.974	Unused	Cistern

* Drinking Water (highlighted in bold blue) indicates human consumption. Non-drinking Water uses include livestock watering, gardening and any other non-human consumption water uses.
ND = Not Detected at or above the limit of detection (LOD).

The listed LOD is approximate and varies by instrument and over time.
NQ = Not Quantifiable. Detected at a level above the LOD and below the limit of quantification (LOQ).
All C-8 results are reported in ug/l.
Misc. = Miscellaneous water use is not used for drinking.

Table 6.2
Monitoring Well Construction and Groundwater Elevation Data
Dry Run Landfill
Lubeck, WV

Monitoring Wells								
Zone	Overburden					A-Zone		
Parameters	DRMW-6A	DRMW-12A	DRMW-12B	DRMW-13A	DRMW-21A	DRMW-16B	DRMW-17B	DRMW-18B
Measuring Point Elevation (feet)	744.46	732.41	732.85	722.57	707.62	792.98	853.56	925.87
Total Depth (feet)	11.89	17.17	20.24	13.33	19.79	61.61	127.09	202.05
Well Diameter (inches)	2	4	4	4	2	4	4	4
Slot Size (inches)	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010
Screen Length (feet)		5	10	5	10	20	20	20
Screen Interval (feet)		720.24 - 715.24	722.61 - 712.61	714.24 - 709.24	697.83 - 687.83	751.37 - 731.57	746.47 - 726.47	743.82 - 723.82
Groundwater Elevation (feet)								
December-01	737.81	727.30	728.11	714.35	-	-	-	-
January-02	738.29	728.50	729.14	716.97	-	-	-	-
February-02	738.26	727.99	728.70	714.16	-	-	-	-
March-02	738.75	728.89	729.58	716.68	-	-	-	-
May-02	738.25	728.97	729.67	716.70	-	-	-	-
August-02	735.61	725.51	726.24	713.62	-	-	-	-
October-02	736.92	725.91	726.64	713.97	703.00	736.49	737.19	757.47

Monitoring Wells							
Zone	A-Zone (con't)		B-Zone			C-Zone	Above A-Zone
Parameters	DRMW-19B	DRMW-20B	DRMW-12	DRMW-13	DRMW-15	DRMW-21B	DRMW-14
Measuring Point Elevation (feet)	881.99	868.79	733.1	722.68	734.28	707.67	938.08
Total Depth (feet)	151.76	136.41	37.82	37.54	48.60	177.20	239.91
Well Diameter (inches)	4	4	4	4	2	4	10
Slot Size (inches)	0.010	0.010	0.010	0.010	0.010	0.010	NA
Screen Length (feet)	20	20	15	15	20	20	NA
Screen Interval (feet)	750.23 - 730.23	752.38 - 732.38	710.28 - 695.28	700.14 - 685.14	705.68 - 685.68	550.47 - 530.47	NA
Groundwater Elevation (feet)							
December-01	-	-	724.40	711.81	716.10	-	754.09
January-02	-	-	725.25	712.17	716.50	-	757.99
February-02	-	-	725.40	711.46	716.33	-	754.87
March-02	-	-	725.74	712.21	717.02	-	755.45
May-02	-	-	725.99	712.54	716.88	-	755.12
August-02	-	-	723.65	710.65	715.82	-	755.31
October-02	750.94	752.95	723.54	711.65	716.02	613.01	755.13

Table 6.3
Summary of Analytical Results:
C-8 in Groundwater
Dry Run Landfill
Lubeck, WV

Sample	Date	C-8 (ug/l)
Overburden		
DRMW-6A	10/9/2002	1.13
	8/28/2002	0.785
	5/22/2002	1.24
	3/30/2002	0.843
	2/20/2002	0.822
	1/27/2002	0.824
	12/12/2001	1.04
	7/20/2000	0.212
	7/21/1999	0.096
	5/26/1998	0.27
	7/22/1997	0.36
	4/10/1996	0.19
DRMW-12A	10/9/2002	0.181
	8/28/2002	0.088
	5/22/2002	0.0832
	3/30/2002	0.0785
	2/20/2002	0.125
	1/25/2002	0.168
	12/12/2001	0.158
	7/19/2000	0.128
	7/21/1999	0.081 J
	5/26/1998	<0.10
	7/22/1997	<0.1
	4/10/1996	<0.1
DRMW-12B	10/9/2002	0.258
	10/9/02 (dup)	0.242
	8/28/2002	NQ
	5/22/2002	NQ
	3/30/2002	NQ
	3/30/02 (dup)	NQ
	2/20/2002	NQ
	1/25/2002	0.073
	1/25/02 (dup)	0.085
	12/12/2001	0.215
	7/20/2000	ND (0.029)
	7/21/1999	5.4
	6/16/1998	<0.1

Table 6.3
Summary of Analytical Results:
C-8 in Groundwater
Dry Run Landfill
Lubeck, WV

Sample	Date	C-8 (ug/l)
Overburden		
DRMW-13A	10/9/2002	6.66
	8/28/2002	5.14
	5/22/2002	2.31
	3/30/2002	4
	2/20/2002	3.73
	1/25/2002	5.97
	12/12/2001	6.4
	7/20/2000	9.9
	7/21/1999	0.070 J
	5/26/1998	8.7
	7/22/1997	15
	4/10/1996	8.2
	4/10/1996 (dup)	11
DRMW-21A	10/9/2002	0.27
A-Zone Wells		
DRMW-16B	10/8/2002	NQ (<0.05)
DRMW-17B	10/8/2002	0.155
DRMW-18B	10/7/2002	ND (<0.01)
DRMW-19B	10/7/2002	NQ (<0.05)
DRMW-20B	10/8/2002	NQ (<0.05)
Above A-Zone Wells		
DRMW-14	10/15/2002	NQ (<0.05)
	8/28/2002	NQ
	5/22/2002	NQ
	3/30/2002	NQ
	2/20/2002	NQ
	1/27/2002	NQ
	12/12/2001	NQ
	7/20/2000	0.115
	7/21/1999	2.5
	6/16/1998	<0.1
	7/21/1997	<0.1
	4/10/1996	<0.1
B-Zone Wells		
DRMW-12	10/9/2002	0.109
	8/28/2002	0.0626
	5/22/2002	0.0817
	3/30/2002	0.0929
	2/20/2002	0.11

Table 6.3
Summary of Analytical Results:
C-8 in Groundwater
Dry Run Landfill
Lubeck, WV

Sample	Date	C-8 (ug/l)
B-Zone Wells (Cont.)		
	1/25/2002	0.116
	12/12/2001	0.086
	7/19/2000	0.16
	7/21/1999	0.134
	5/26/1998	<0.10
	7/22/1997	<0.1
	4/10/1996	<0.1
DRMW-13	10/9/2002	20.9
	8/28/2002	13.1
	8/28/02 (dup) *	14.6
	5/22/2002	16.9
	3/30/2002	12.6
DRMW-13 (Cont.)	2/20/2002	11.5
	1/25/2002	16.5
	12/12/2001	9.86
	7/20/2000	9.8
	7/21/1999	3.6
	5/26/1998	9.2
	7/22/1997	7
B-Zone Wells		
DRMW-15	10/15/2002	4.92
	8/28/2002	3.99
	5/22/2002	5
	5/22/02 (dup) *	4.66
	3/30/2002	4.91
	2/20/2002	3.65
	1/27/2002	4.35
	12/12/2001	4.94
	7/20/2000	0.763
	7/21/1999	0.263
C-Zone Wells		
DRMW-21B	10/9/2002	NQ (<0.05)

ND = Not Detected at or above the limit of detection (LOD).
The listed LOD is approximate and varies by instrument and over time.
NQ = Not Quantifiable. Detected a quantification (LOQ).
J = estimated value (below laboratory quantitation limit).
Note: Analytical method changed as of November 2001 (see Section 2.0 of DuPont (2003b) for details).
* Analytical duplicates' values were previously inadvertently omitted from the tables.

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Table 6.4
Summary of Analytical Results:
C-8 in Surface Water
Dry Run Landfill
Lubeck, WV

Sample	Date	C-8 (ug/l)
OUTLET 001	11/21/2002	64.6
	10/30/2002	81.7
	9/30/2002	No-flow conditions
	8/30/2002	No-flow conditions
	7/31/2002	No-flow conditions
	7/1/2002	No-flow conditions
	6/28/2002	No-flow conditions
	5/28/2002	30.9
	4/24/2002	41
	3/25/2002	71.6
	2/25/2002	43.9
	1/28/2002	41.6
	12/12/2001	No-flow conditions
	10/3/2000	31.5
	12/29/1999	68
	5/19/1998	17
	4/9/1996	86
OUTLET 003	11/30/2002	No-flow conditions
	10/30/2002	No-flow conditions
	9/30/2002	No-flow conditions
	8/30/2002	No-flow conditions
	7/1/2002	25.3
	6/28/2002	No-flow conditions
	5/28/2002	No-flow conditions
	4/29/2002	20.1
	3/26/2002	6.77
	2/25/2002	No-flow conditions
	1/28/2002	No-flow conditions
	12/12/2001	No-flow conditions
OUTLET 004	11/30/2002	No-flow conditions
	10/30/2002	No-flow conditions
	9/30/2002	No-flow conditions
	8/30/2002	No-flow conditions
	7/1/2002	0.7
	6/28/2002	No-flow conditions
	5/28/2002	No-flow conditions
	4/27/2002	No-flow conditions
	3/26/2002	158
	2/25/2002	No-flow conditions
	1/28/2002	No-flow conditions
	12/12/2001	No-flow conditions

Table 6.4
Summary of Analytical Results:
C-8 in Surface Water
Dry Run Landfill
Lubeck, WV

Sample	Date	C-8 (ug/l)
PROPERTY BOUNDARY	10/30/2002	3.8
	8/30/2002	No-flow conditions
	5/28/2002	9.41
	4/24/2002	6.69
	3/25/2002	22.8
	2/25/2002	3.81
	1/28/2002	11.1
	12/12/2001	3.99
	10/3/2000	10.3
	12/29/1999	39
	7/14/1998	0.88
	4/9/1996	9.9
STREAM SAMPLING POINT#1 (SS-1)	10/30/2002	1.63
	8/30/2002	No-flow conditions
	5/28/2002	1.63
	4/24/2002	0.932
	3/25/2002	1.06
	2/25/2002	0.85
	1/28/2002	0.893
	12/12/2001	1.19
	10/3/2000	0.758
	12/29/1999	0.54
	5/19/1998	1
STREAM SAMPLING POINT#2 (SS-2)	10/30/2002	29.2
	8/20/2002	No-flow conditions
	5/28/2002	51
	4/24/2002	28.9
	3/25/2002	66.6
	2/25/2002	24.3
	1/28/2002	42.4
	12/12/2001	20.5
	10/3/2000	27.6
	12/29/1999	87
	5/19/1998	4.6

Table 6.4
Summary of Analytical Results:
C-8 in Surface Water
Dry Run Landfill
Lubeck, WV

Sample	Date	C-8 (ug/l)
DR LEACHATE	10/30/2002	704
	5/28/2002	150
	4/24/2002	237
	3/25/2002	334
	2/25/2002	256
	1/28/2002	398
	12/12/2001	109
	10/3/2000	27.4
	12/29/1999	34
	5/19/1998	56
	7/22/1997	62
POND UNDERDRAIN	10/30/2002	38.8
	5/28/2002	67.4
	4/24/2002	33.4
	3/25/2002	66.7
	2/25/2002	37.1
	1/28/2002	29.3
	12/12/2001	35.4

Note: Analytical method changed as of November 2001 (see Section 2.0 of DuPont (2003b) for details).

Table 6.5
Summary of On-site and Off-site Exposure Pathways Evaluation
Dry Run Landfill
Lubeck, WV

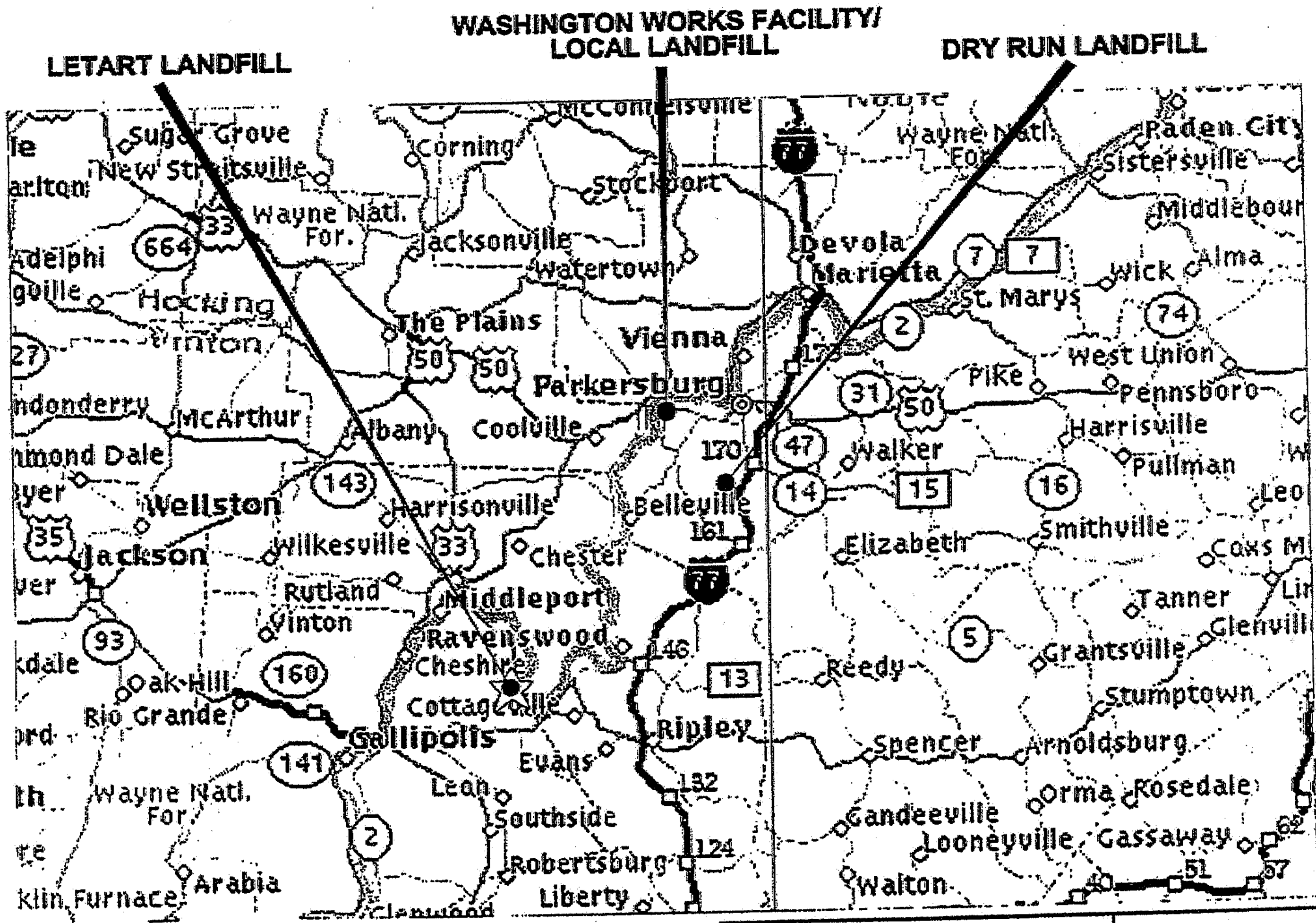
Exposure Pathway Evaluation					
		Human Health Exposure Pathways		Ecological Exposure Pathways	
	C-8 Impacted Media	Pathway Assessment (Complete or Incomplete)	Comparison to Screening Criteria*	Pathway Assessment (Complete or Incomplete)	Comparison to Screening Criteria*
On-Site	SWMUs/Landfilled Materials	C	--	C	--
	Soil	C	--	C	--
	Leachate (captured & treated)	I	--	I	--
	Surface Water	C	87 ug/l < 150 ug/l	C	87 ug/l < 150 ug/l
	Groundwater	I	--	I	--
		Exposure Pathways for Human and Ecological Receptors			
	C-8 Impacted Media	Pathway Assessment [Complete (C) or Incomplete (I)]	Comparison to Screening Criteria*		
Off-Site	Drinking Water (wells, springs and/or cisterns) - Dry Run	C	0.422 ug/l <<150 ug/l		
	Non-drinking water (wells, springs and/or cisterns) - Dry Run	C	0.54 ug/l <<150 ug/l		
	Unused water sources - Dry Run	I	--		

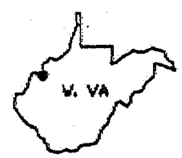
* Highest value in category is compared to the screening criteria. Screening criteria was established by CATT of 240 mg/kg for soil, 1360 ug/l for aquatic life (surface water), 150 ug/l for drinking water. For complete exposure pathways, all water samples are compared to the drinking water screening criteria to be conservative. No comparison is made for incomplete exposure pathways.

ASH021755

EID639987

FIGURES





DuPont

Corporate Remediation Group

An Alliance between DuPont and URS Diamond

Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

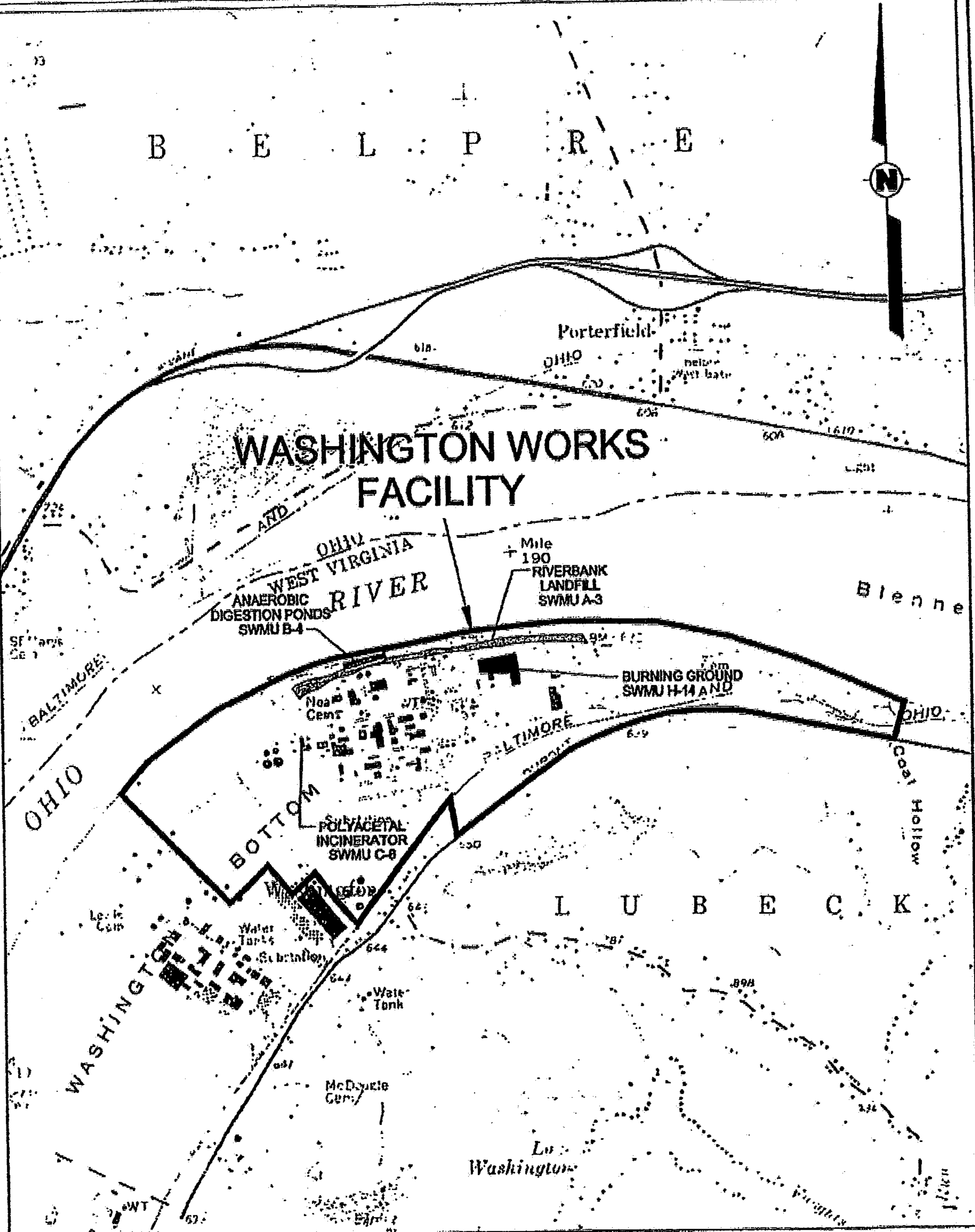
DuPont Washington Works Properties

DuPont Washington Works
Washington, West Virginia

Scale	Designed	Drawn	CAD File No.
Not to Scale		DEL	7423A006
Date	Checked	Approved	Figure
1/13/03	KLD		1.0

ASH021757

EID639989



Source: MAP TAKEN FROM THE LUBECK, WV USGS QUADRANGLE

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Wilmington, Delaware 19805

SITE LOCATION MAP

DuPont Washington Works Facility
Washington, West Virginia

SCALE Not to scale	DEL	DRAWN DEL	CAD FILE NO. 7422A001
DATE 9/27/01	CHECKED M. HOULDAY	APPROVED	FIGURE 3.0

ASH021758

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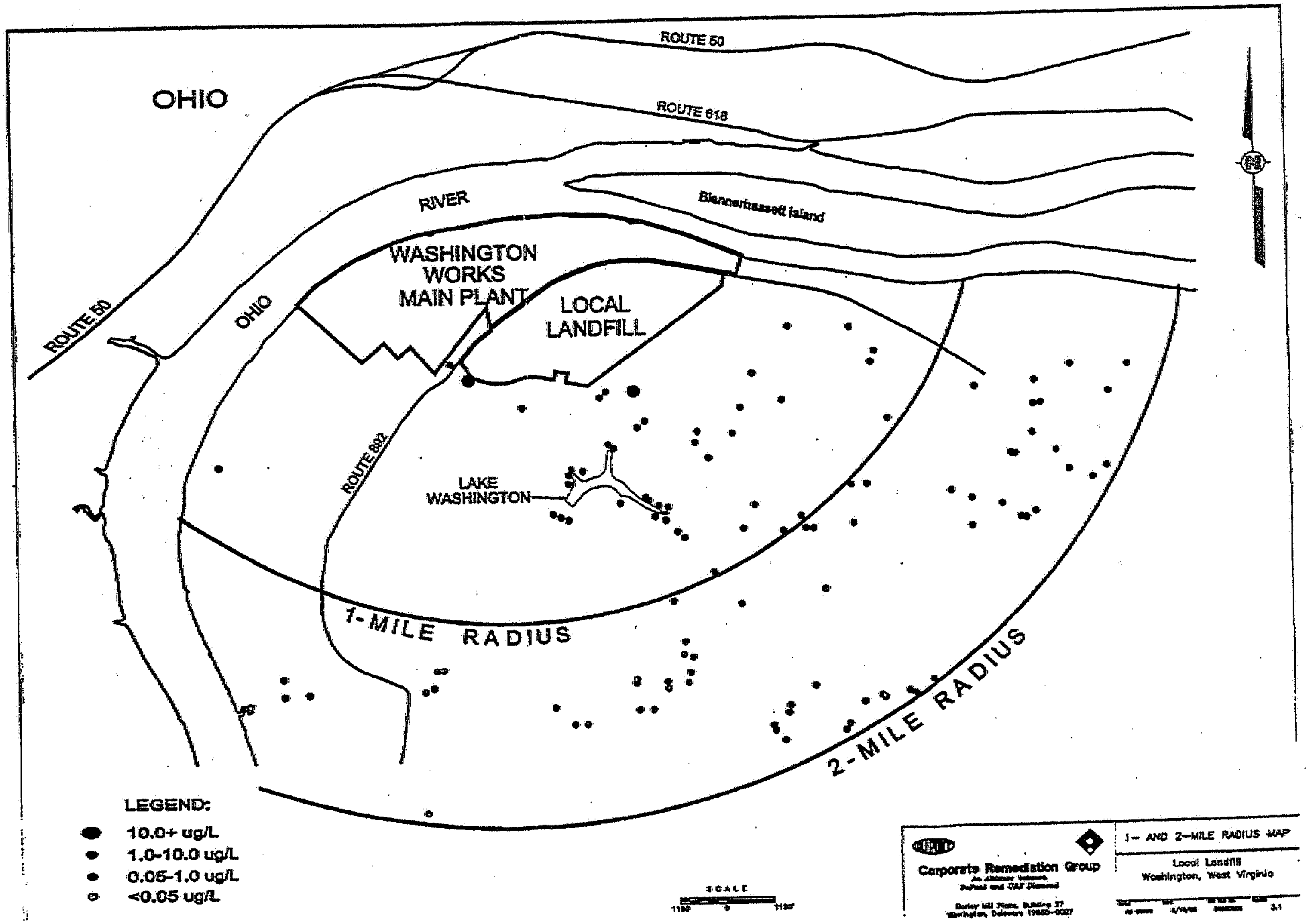

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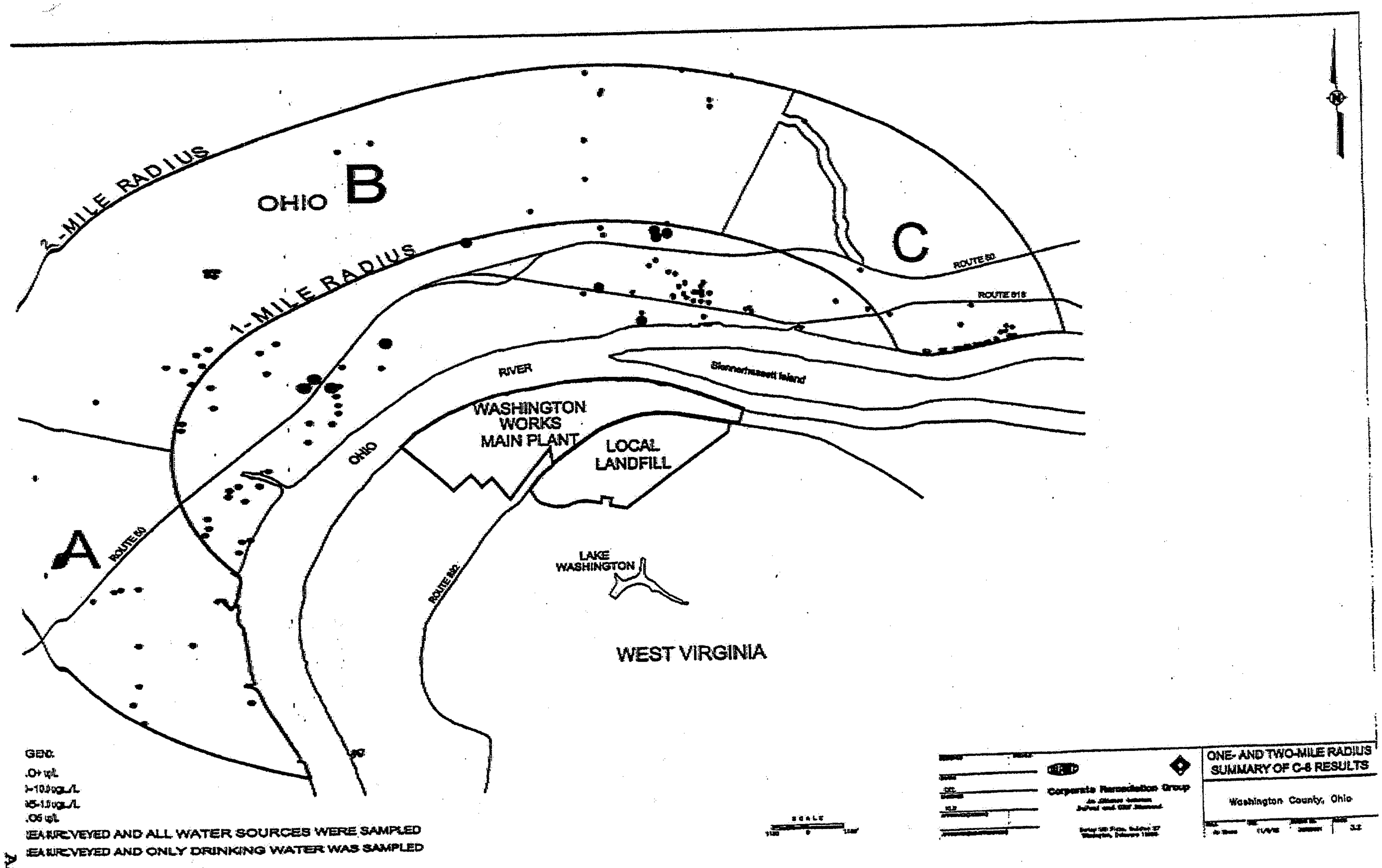

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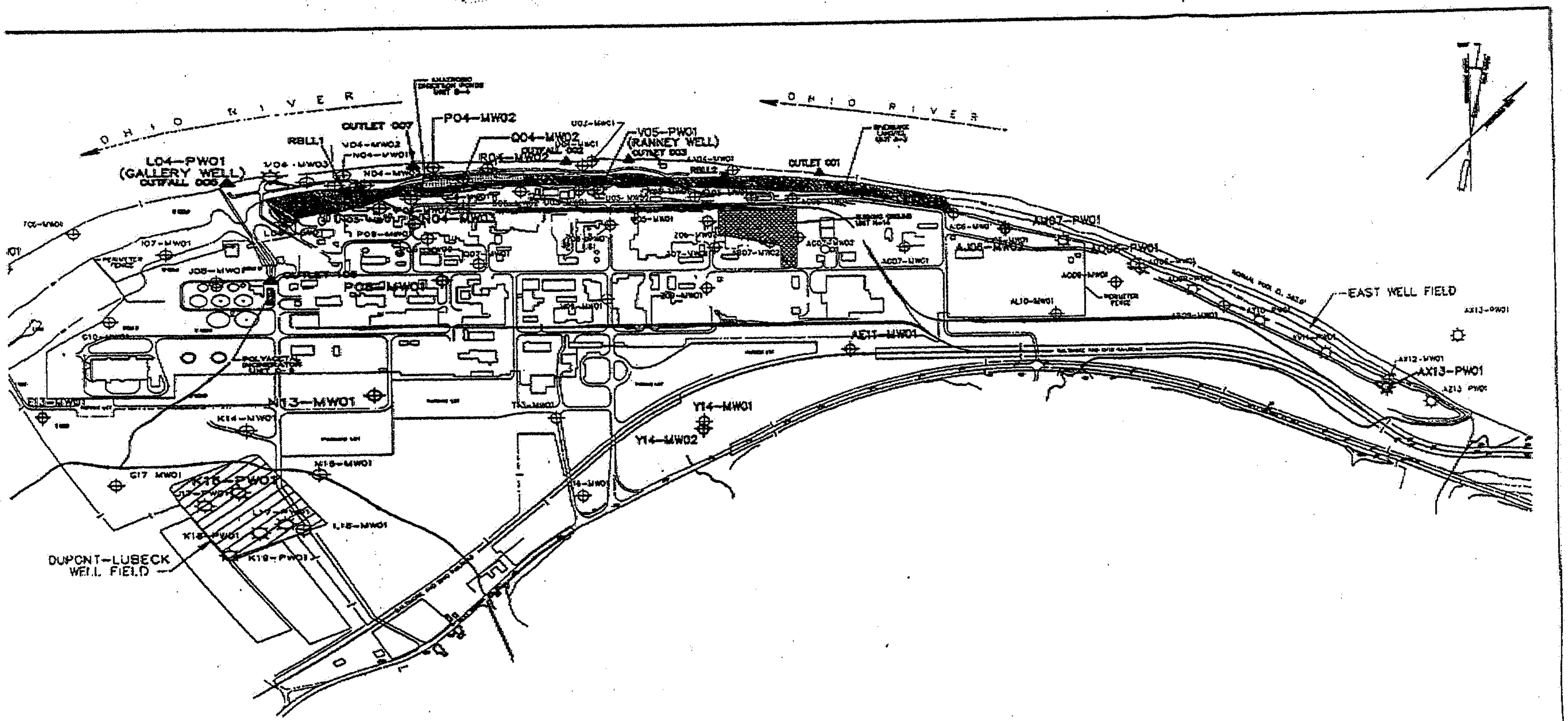

LEGEND

- = MONITORING WELL
- = PRODUCTION WELL
- = OUTFALL SAMPLING POINT
- = RIVERBANK LANDFILL SEEP AREAS

SCALE

700 0 700'

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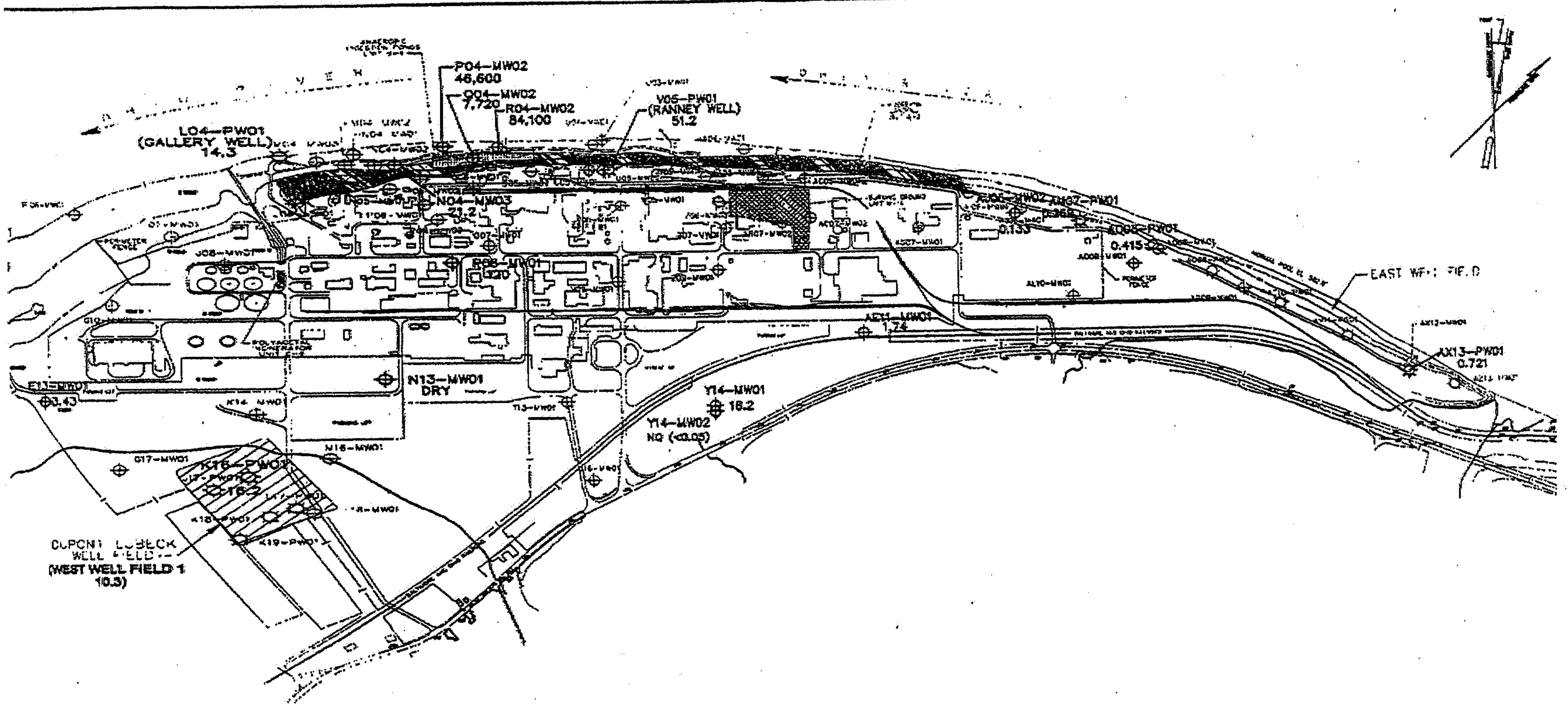
An Alliance between DuPont and URS Diamond
Barley Mill Plaza, Building 27

MONITORING WELL AND SURFACE WATER SAMPLE LOCATION MAP
DuPont Washington Works Facility
Washington, West Virginia

ASH021761

EID639993



LEGEND

- = MONITORING WELL
- = PRODUCTION WELL
- 10.3 = CONCENTRATION OF C-8 (ug/L) IN GROUNDWATER

SCALE

700. 0 700'

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An Alliance between DuPont and URS Diamond

Barley Mill Plaza, Building 27

C-8 IN GROUNDWATER - 4Q02

DuPont Washington Works Facility
Washington, West Virginia

ASH021762

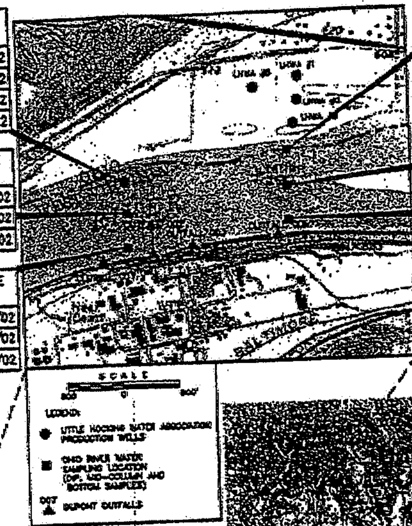
EID639994

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
5	OH-side	bottom	WWK-R-TS-5-3B	ND (<0.010)	6/28/02
5	OH-side	mid-column	WWK-R-TS-5-3M	ND (<0.010)	6/28/02
5	OH-side	dip	WWK-R-TS-5-3S	ND (<0.010)	6/28/02
5	OH-side	dip	WWK-R-TS-5-3S-2*	ND (<0.010)	6/28/02

*DUPLICATE

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
5	center	bottom	WWK-R-TS-5-2B	ND (<0.010)	6/28/02
5	center	mid-column	WWK-R-TS-5-2M	ND (<0.010)	6/28/02
5	center	dip	WWK-R-TS-5-2S	ND (<0.010)	6/28/02

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
5	WV-side	bottom	WWK-R-TS-5-1B	ND (<0.010)	6/28/02
5	WV-side	mid-column	WWK-R-TS-5-1M	ND (<0.010)	6/28/02
5	WV-side	dip	WWK-R-TS-5-1S	ND (<0.050)	6/28/02



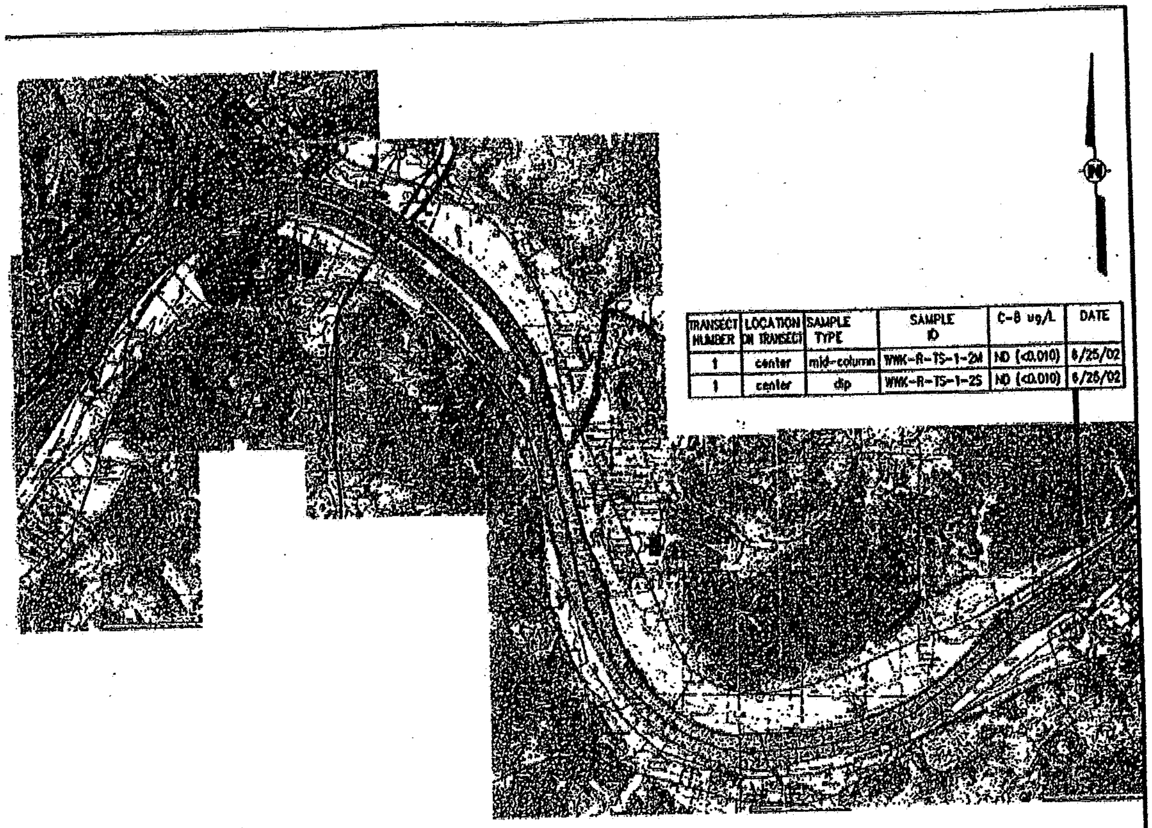
TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
4	OH-side	bottom	WWK-R-TS-4-3B	ND (<0.010)	6/28/02
4	OH-side	mid-column	WWK-R-TS-4-3M	ND (<0.010)	6/28/02
4	OH-side	dip	WWK-R-TS-4-3S	ND (<0.010)	6/28/02

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
4	center	bottom	WWK-R-TS-4-2B	ND (<0.010)	6/28/02
4	center	mid-column	WWK-R-TS-4-2M	ND (<0.010)	6/28/02
4	center	dip	WWK-R-TS-4-2S	ND (<0.010)	6/28/02

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
4	WV-side	bottom	WWK-R-TS-4-1B	ND (<0.010)	6/28/02
4	WV-side	mid-column	WWK-R-TS-4-1M	ND (<0.010)	6/28/02
4	WV-side	dip	WWK-R-TS-4-1S	ND (<0.010)	6/28/02

ASH021763

EID639995



TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
1	center	mid-column	WHK-R-TS-1-2M	ND (<0.010)	6/25/02
1	center	dip	WHK-R-TS-1-2S	ND (<0.010)	6/25/02

ASH021764

EID639996

OHIO RIVER WATER SAMPLING
LOCATIONS–UPSTREAM

DuPont Washington Works Facility
Washington, West Virginia

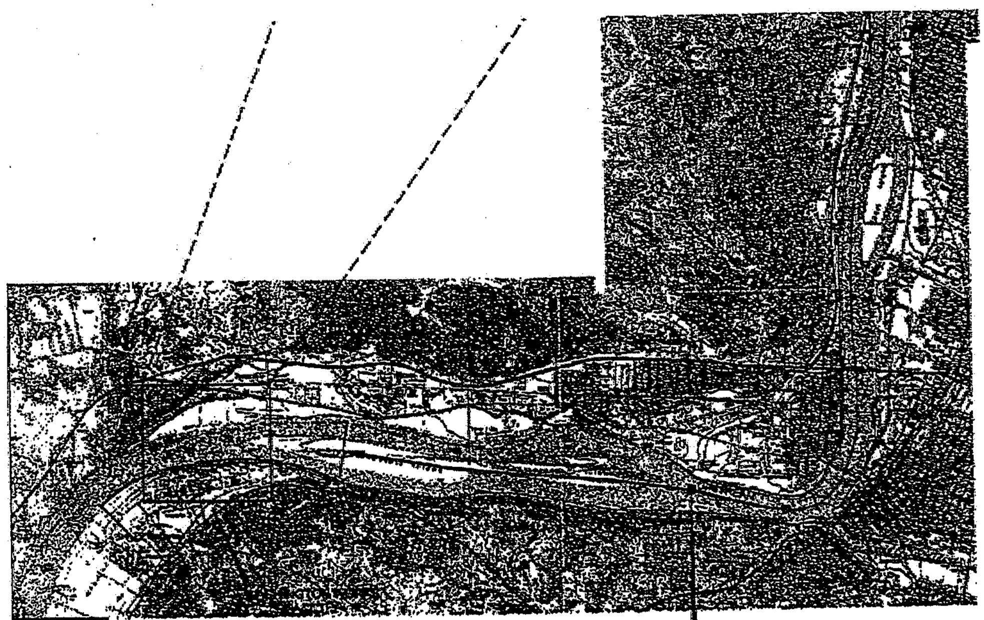
3.5

Corporate Remediation Group

ASH021765

EID639997

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
2	center	mid-column	WWK-R-TS-2-2M	ND (<0.010)	6/26/02
2	center	dip	WWK-R-TS-2-2S	ND (<0.010)	6/26/02



TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
3	center	bottom	WWK-R-TS-3-2B	ND (<0.050)	10/24/02
3	center	mid-column	WWK-R-TS-3-2M	ND (<0.010)	6/26/02
3	center	dip	WWK-R-TS-3-2S	ND (<0.010)	6/26/02

LEGEND:

◆ OHIO RIVER WATER SAMPLING LOCATION (DIP AND MID-COLUMN SAMPLES)

■ OHIO RIVER WATER SAMPLING LOCATION (BOTTOM, DIP AND MID-COLUMN SAMPLES)

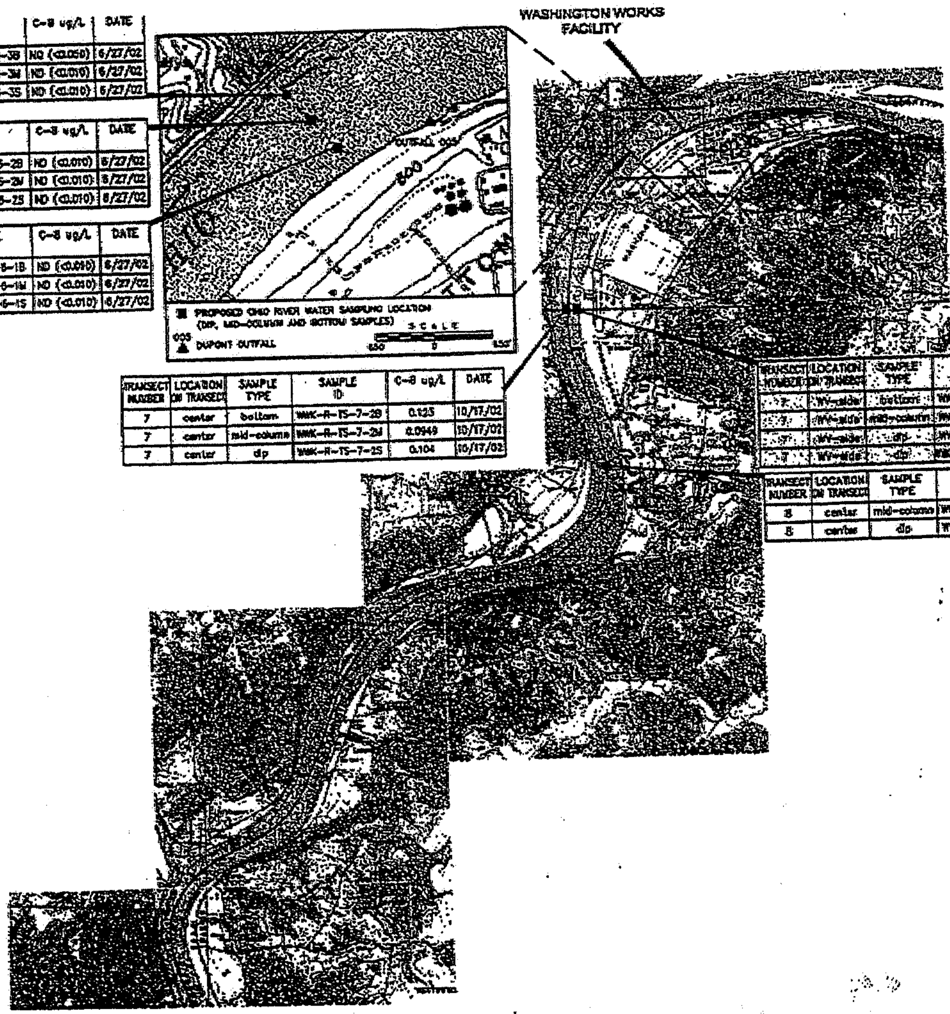
SCALE

2500 0 2500' 5000'

NO.

ASH021766

EID639998



TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
6	OH-side	bottom	WWK-R-TS-6-3B	ND (<0.050)	6/27/02
6	OH-side	mid-column	WWK-R-TS-6-3M	ND (<0.010)	6/27/02
6	OH-side	dip	WWK-R-TS-6-3S	ND (<0.010)	6/27/02

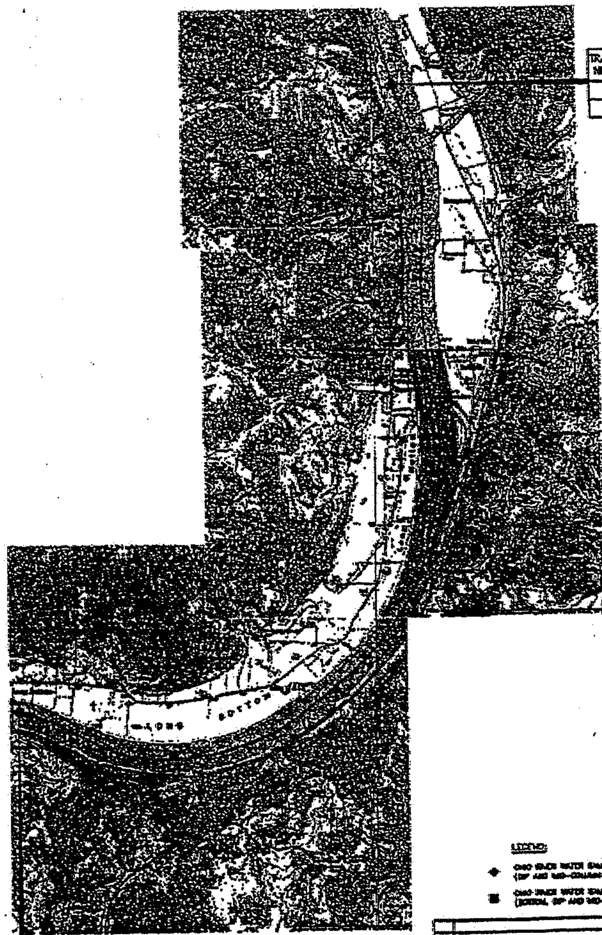
TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
6	center	bottom	WWK-R-TS-6-2B	ND (<0.010)	6/27/02
6	center	mid-column	WWK-R-TS-6-2M	ND (<0.010)	6/27/02
6	center	dip	WWK-R-TS-6-2S	ND (<0.010)	6/27/02

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
6	WV-side	bottom	WWK-R-TS-6-1B	ND (<0.010)	6/27/02
6	WV-side	mid-column	WWK-R-TS-6-1M	ND (<0.010)	6/27/02
6	WV-side	dip	WWK-R-TS-6-1S	ND (<0.010)	6/27/02

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
7	center	bottom	WWK-R-TS-7-2B	0.125	10/17/02
7	center	mid-column	WWK-R-TS-7-2M	0.0949	10/17/02
7	center	dip	WWK-R-TS-7-2S	0.104	10/17/02

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
7	WV-side	bottom	WWK-R-TS-7-1B	0.113	10/17/02
7	WV-side	mid-column	WWK-R-TS-7-1M	0.131	10/17/02
7	WV-side	dip	WWK-R-TS-7-1S	0.113	10/17/02
7	WV-side	dip	WWK-R-TS-7-1S-2(DUP)	0.138	10/17/02

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
8	center	mid-column	WWK-R-TS-8-2M	0.999	7/10/02
8	center	dip	WWK-R-TS-8-2S	1.09	7/10/02



TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
9	center	mid-column	WWK-R-TS-9-2M	0.292	7/10/02
9	center	dip	WWK-R-TS-9-2S	0.295	7/10/02

TRANSECT NUMBER	LOCATION OF TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
10	center	[illegible]	[illegible]	[illegible]	[illegible]

LEGEND:

◆ OHIO RIVER WATER SAMPLING LOCATION (DIP AND MID-COLUMN SAMPLES)

■ OHIO RIVER WATER SAMPLING LOCATION (BOTTOM, DIP AND MID-COLUMN SAMPLES)

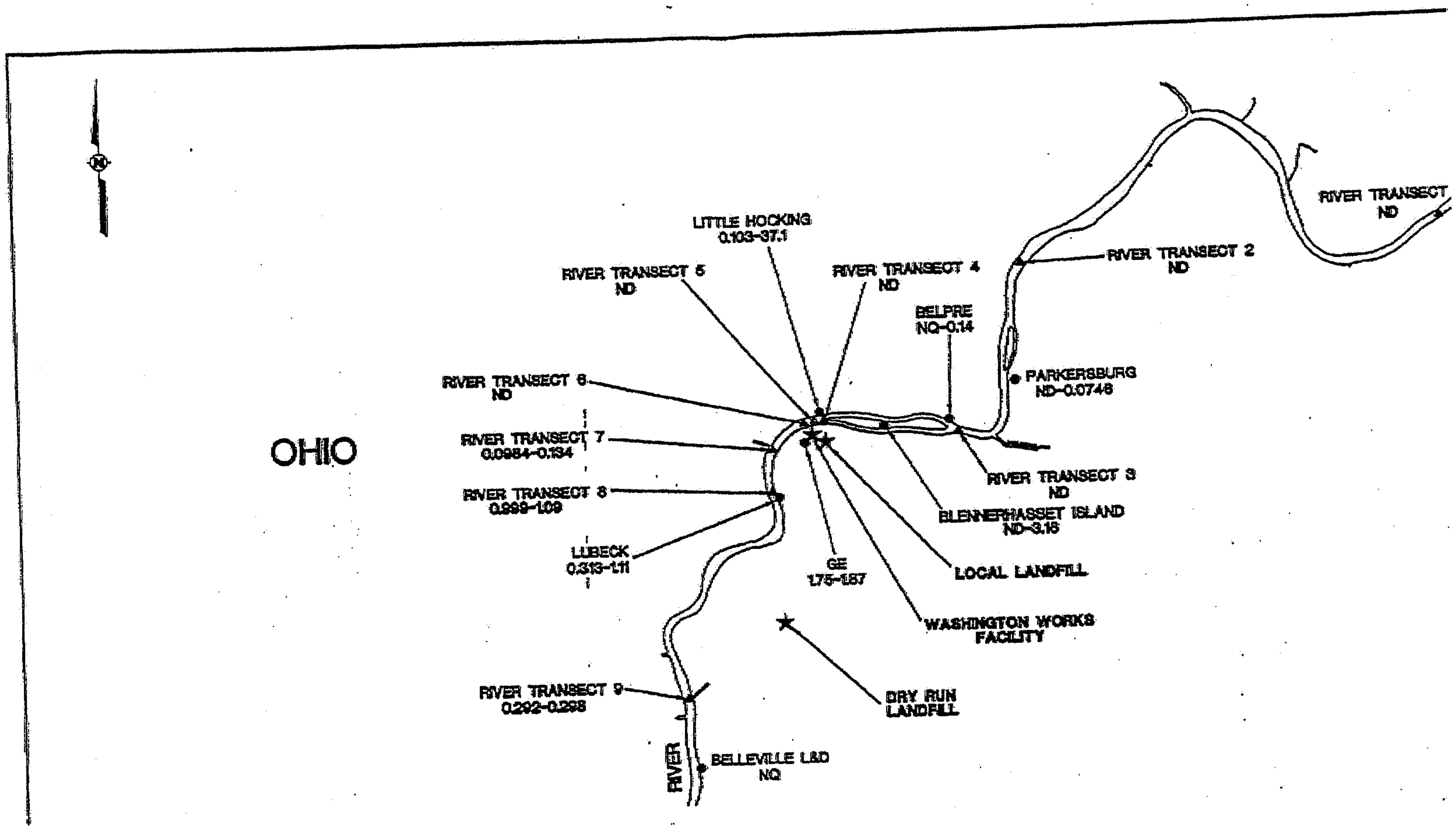
SCALE

1900 0 1900' 3800'

Corporate Remediation Group

OHIO RIVER WATER SAMPLING LOCATIONS-DOWNSTREAM

DuPont Washington Works Facility
Washington, West Virginia



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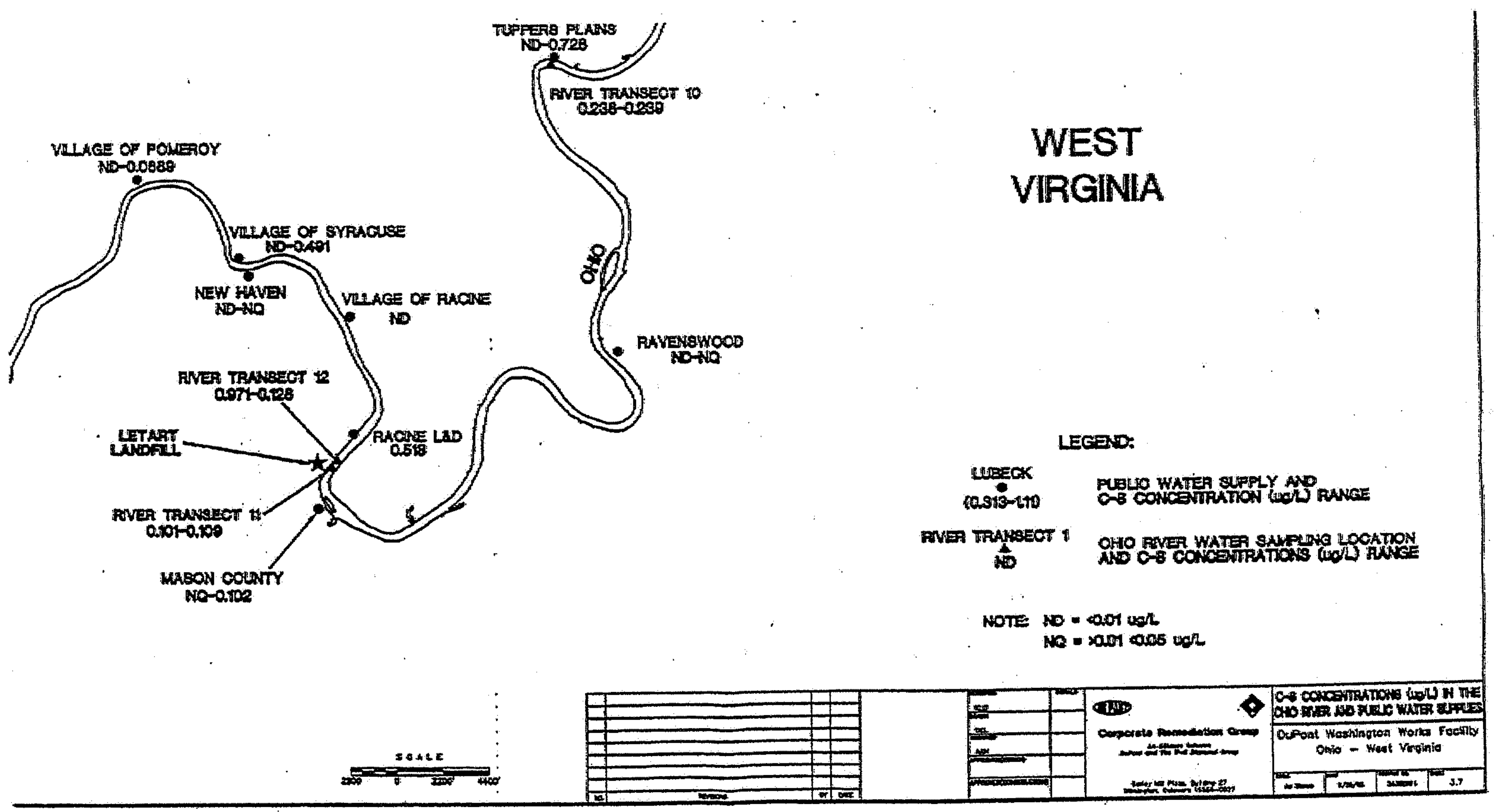

ASH021770

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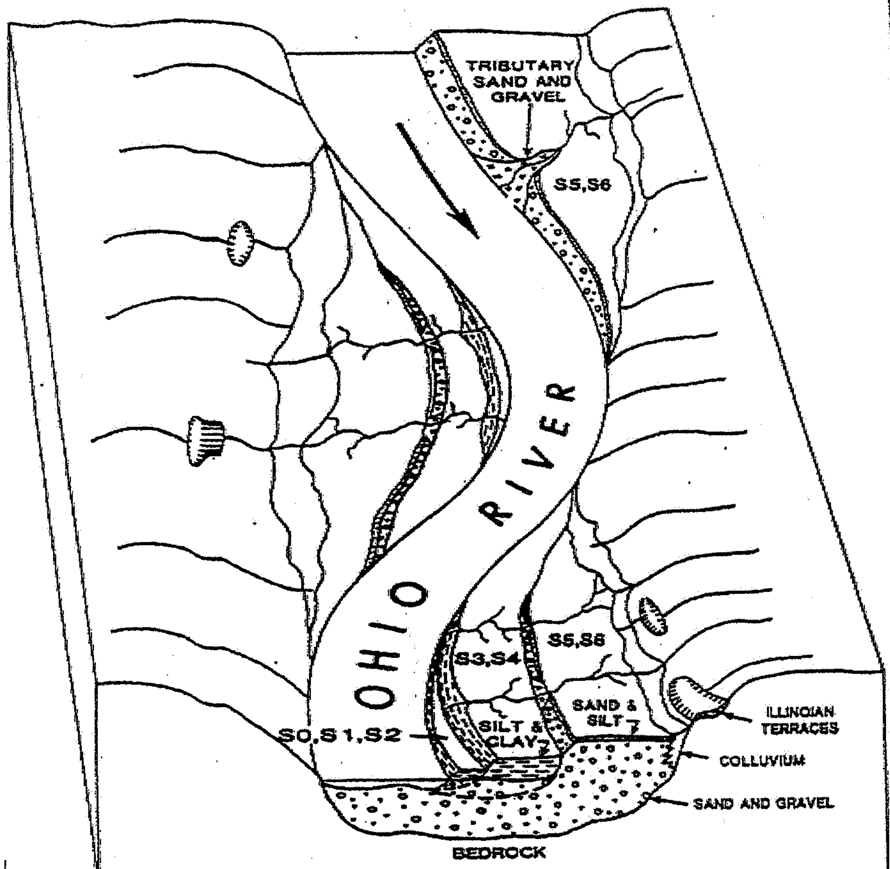
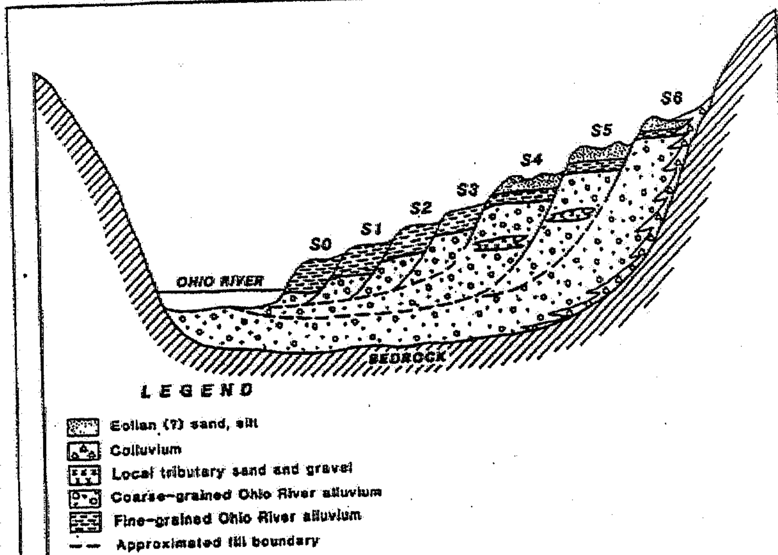
Remote User

Job 184
07/16/04 10:30 AM





ILLUSTRATIONS TAKEN FROM SIMARD, 1989.

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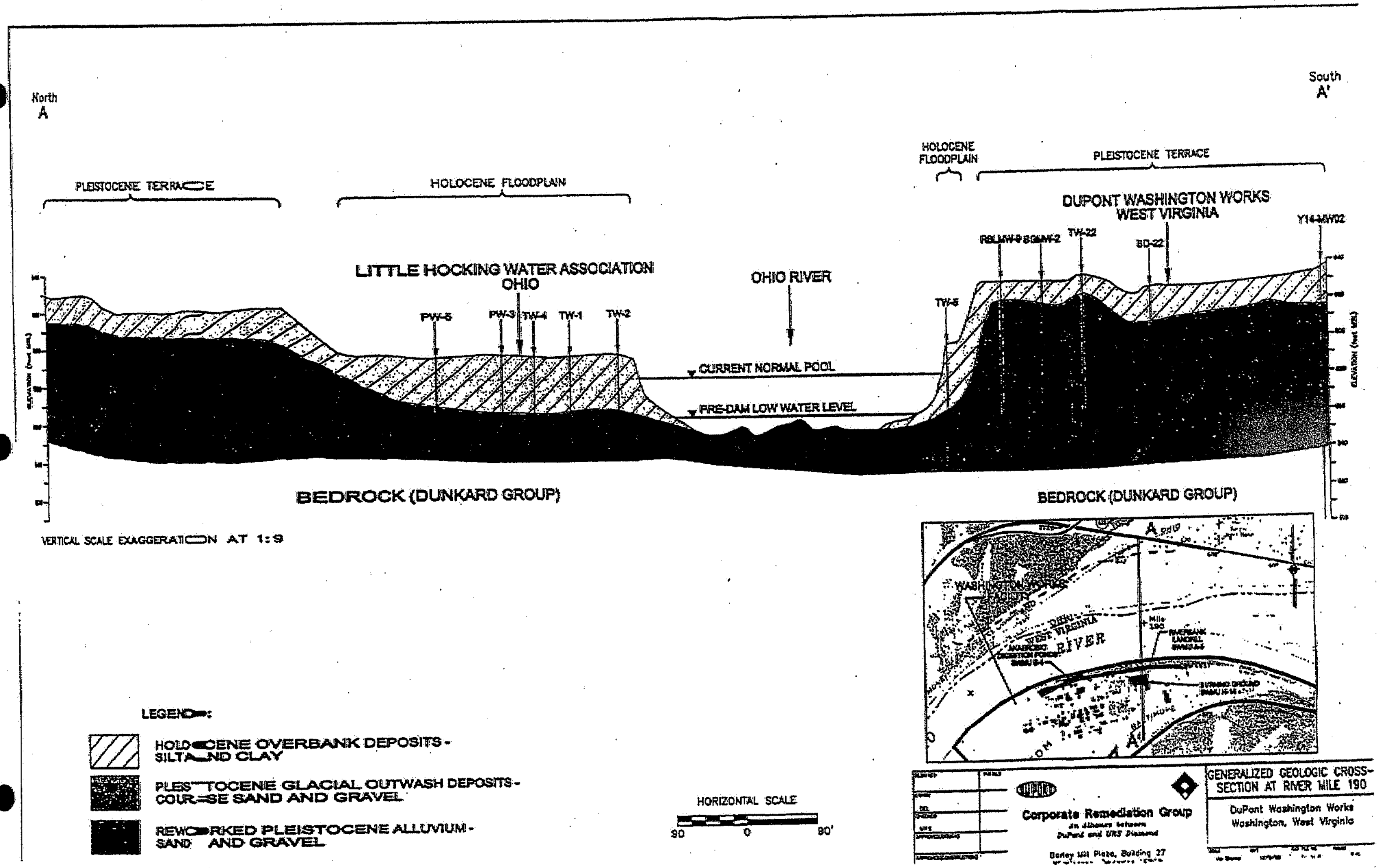
An Alliance between DuPont and URS Diamond
Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

IDEALIZED OHIO RIVER VALLEY CROSS-SECTION AND BLOCK DIAGRAM

DuPont Washington Works
Washington, West Virginia

ASH021771

EID640003



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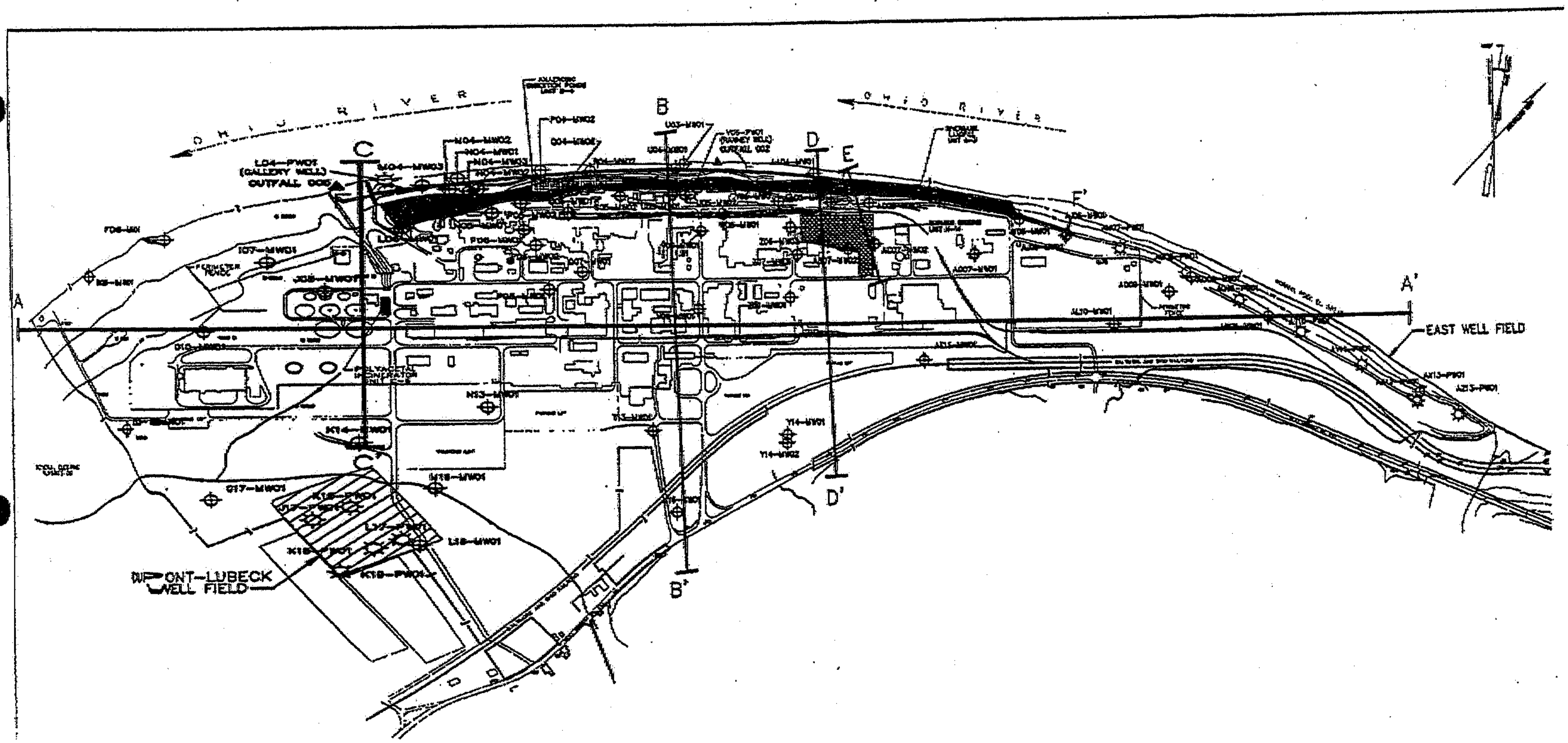

LEGEND

- = MONITORING WELL
- = PRODUCTION WELL
- = OUTFALL SAMPLING POINT
- A A' = CROSS SECTION LINE

SCALE

700 0 700'

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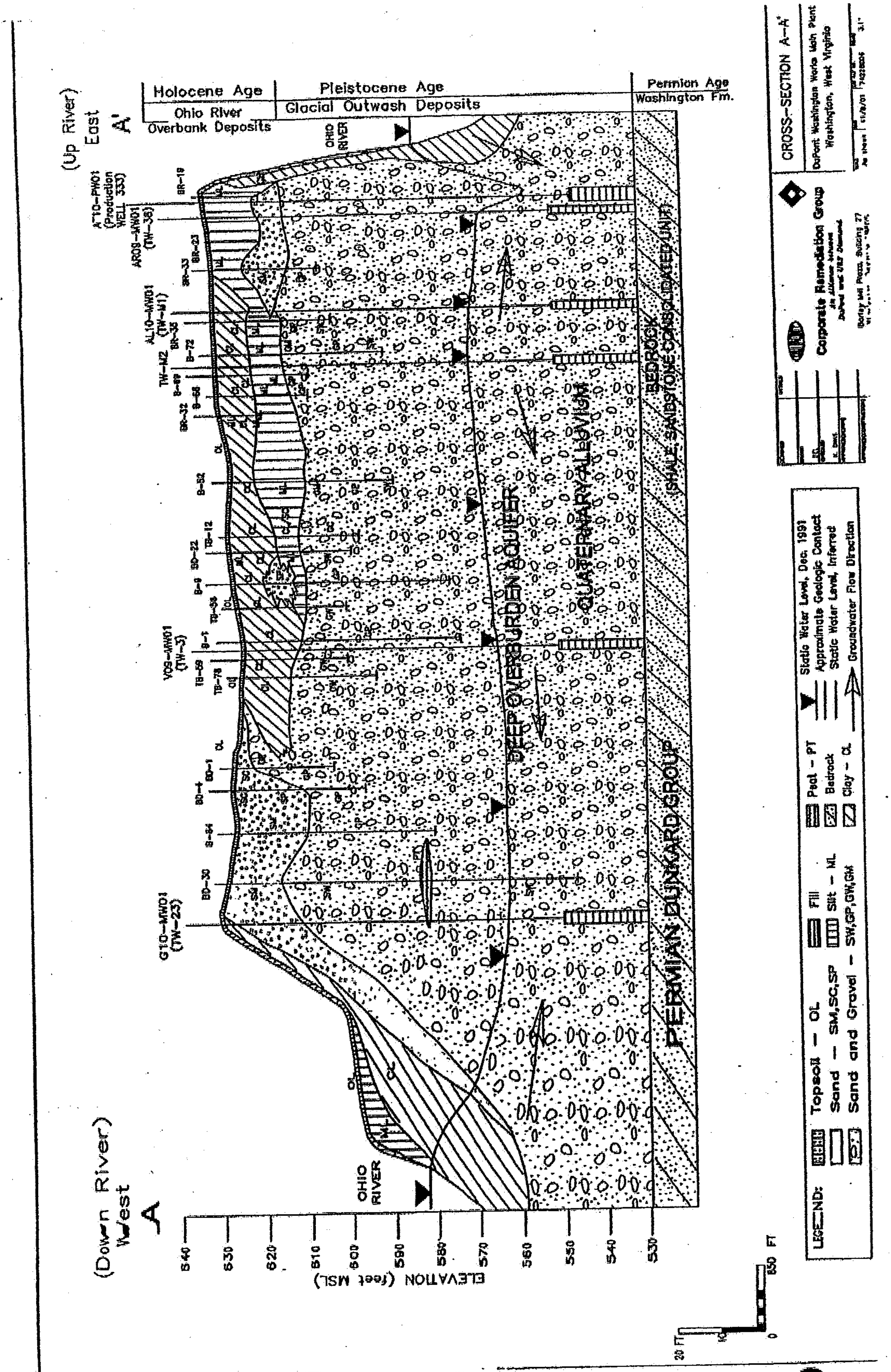
An Alliance between DuPont and URS Diamond
Barley Mill Plaza, Building 27

CROSS-SECTION LOCATION MAP

DuPont Washington Works Main Plant
Washington, West Virginia

ASH021773

EID640005



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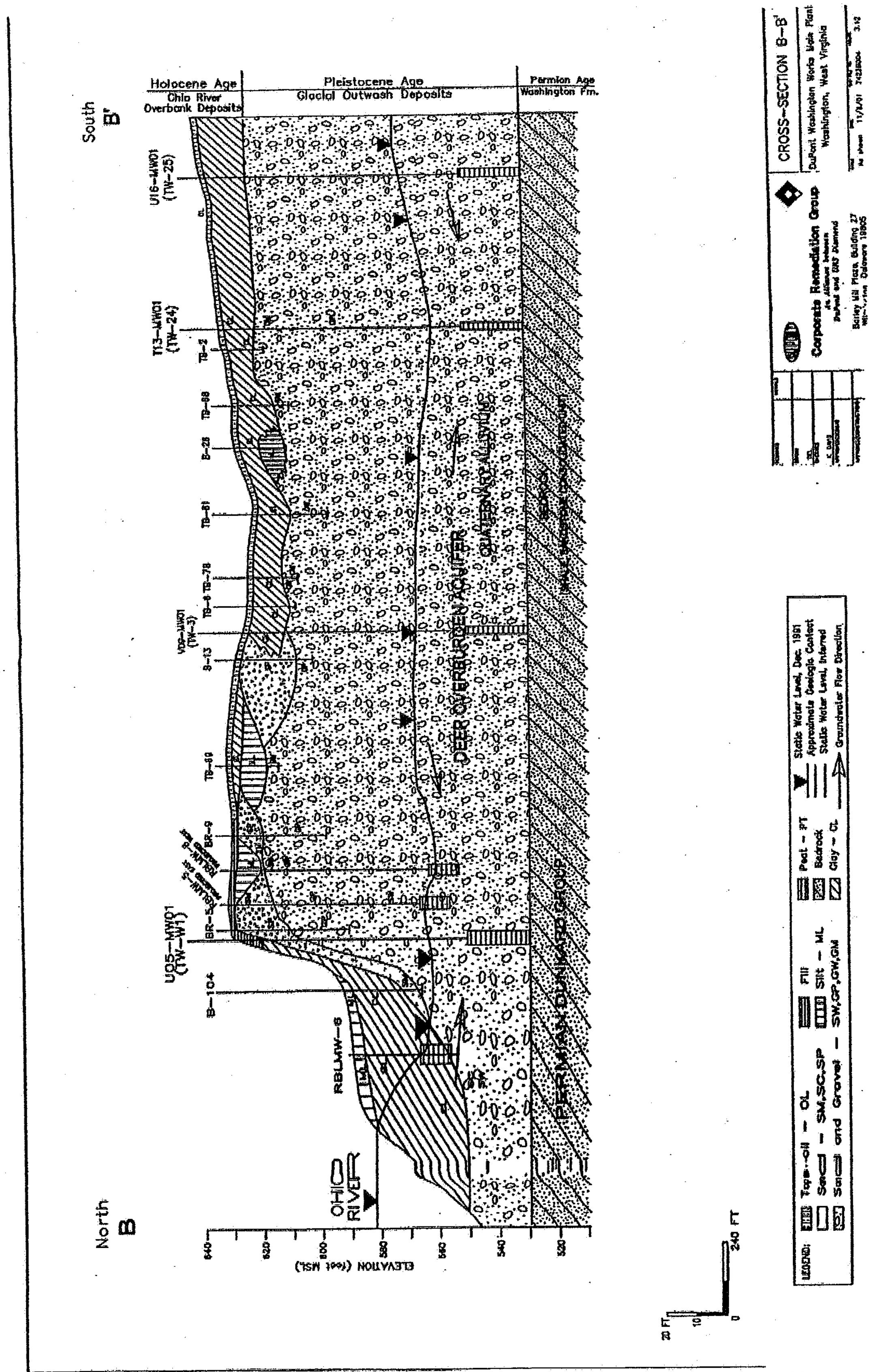

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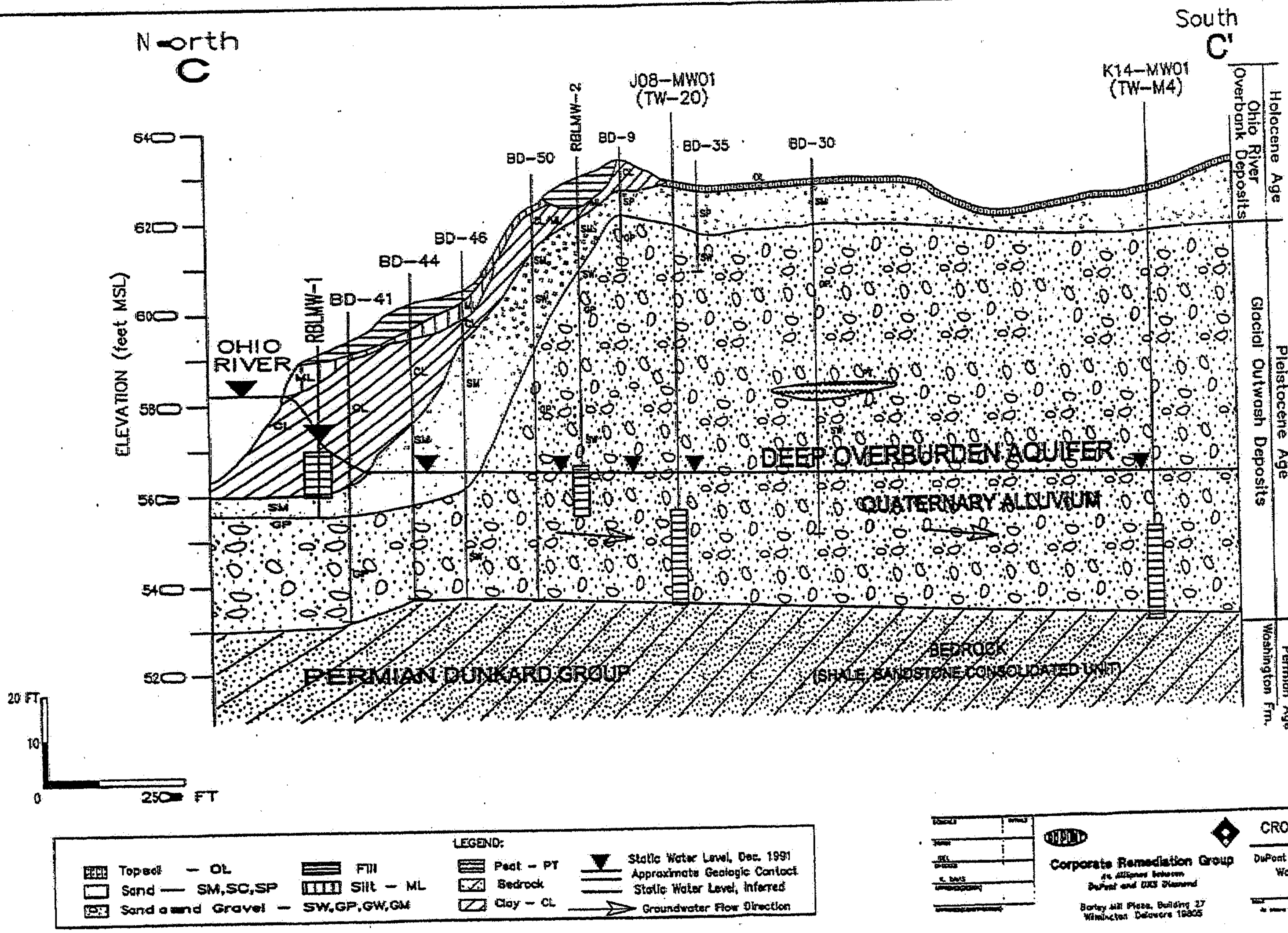

Corporate Remediation Group
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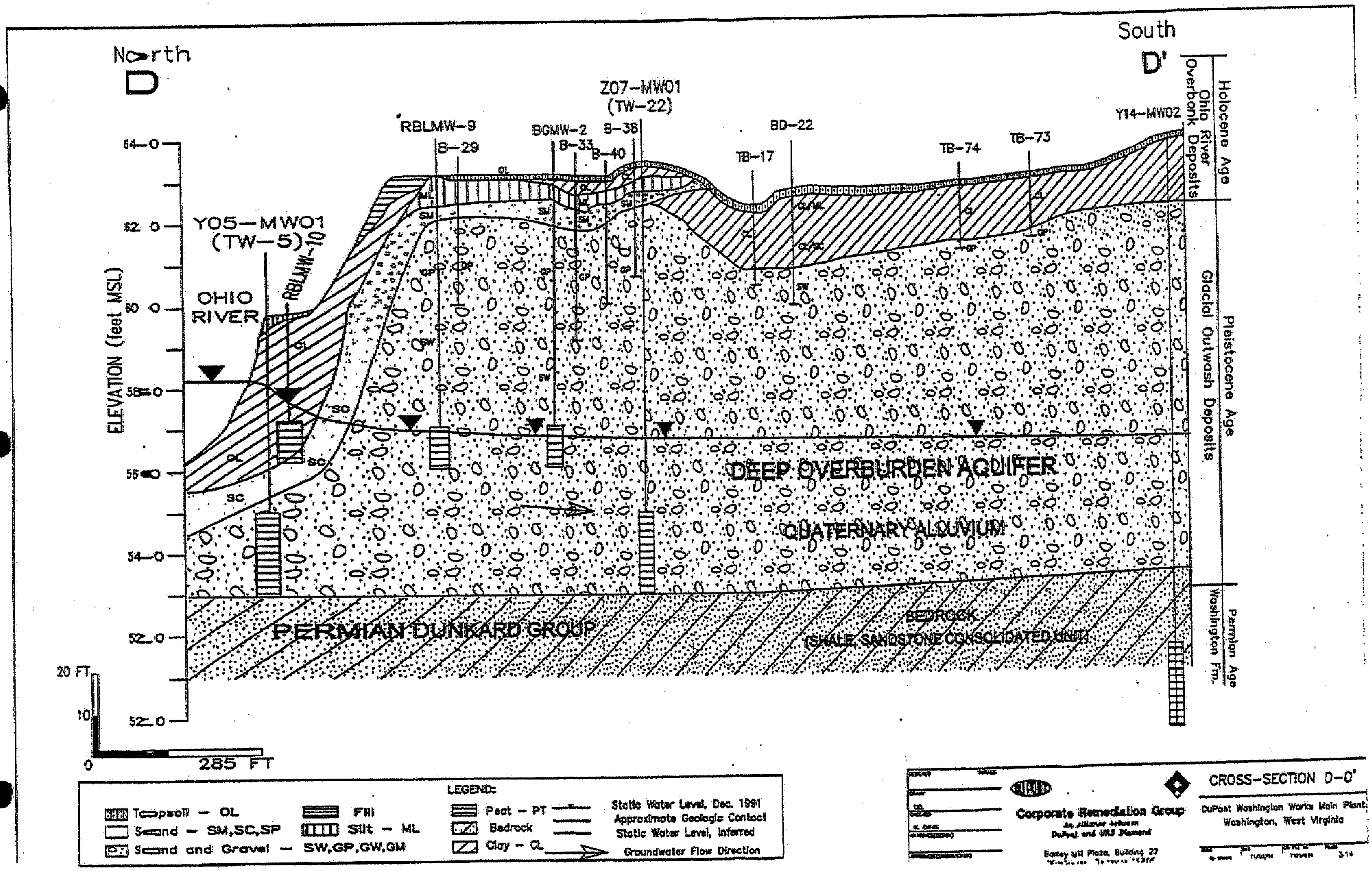
Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

CROSS-SECTION C-C'
DuPont Washington Works Main Plant
Washington, West Virginia

ASH021776

EID640008



CROSS-SECTION D-D'

DuPont Washington Works Main Plant
Washington, West Virginia

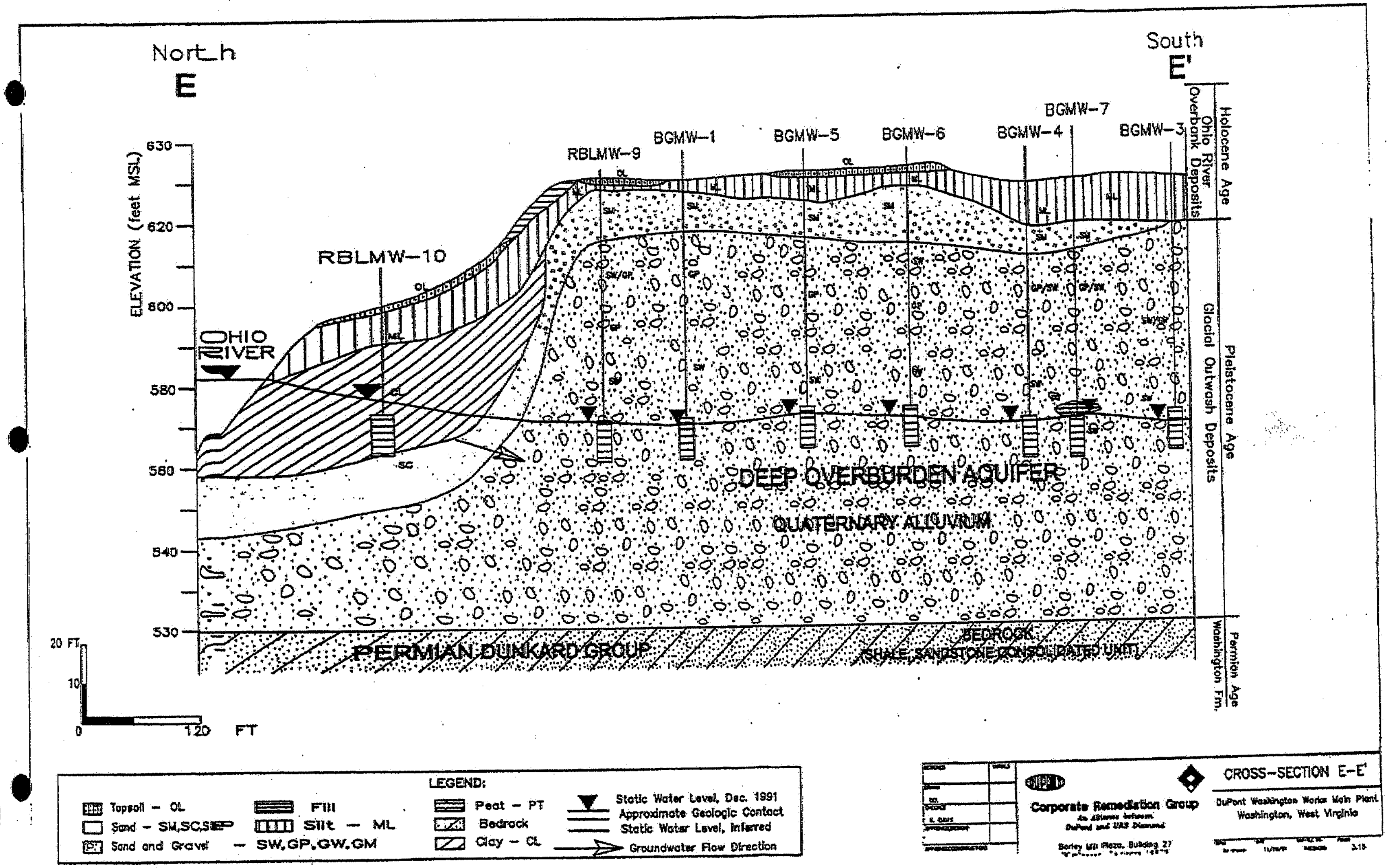
Corporate Remediation Group

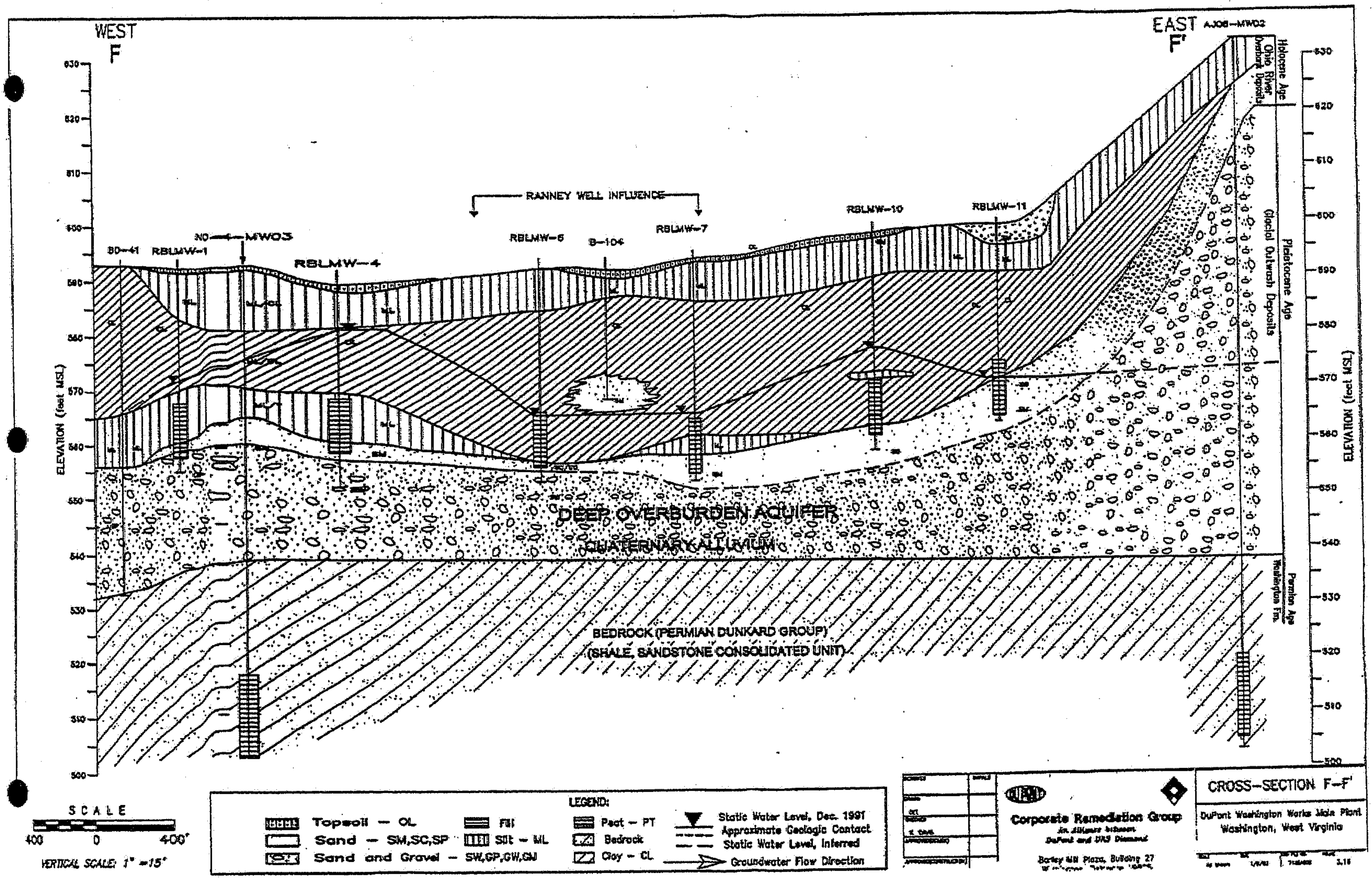
An Alliance between DuPont and URS Diamond

3-14

ASH021777

EID640009


North
E
South
E'
ELEVATION (feet MSL)
630
620
600
580
560
540
530
OHIO RIVER
RBLMW-10
RBLMW-9
BGMW-1
BGMW-5
BGMW-6
BGMW-4
BGMW-7
BGMW-3
DEEP OVERBURDEN AQUIFER
QUATERNARY ALLUVIUM
PERMIAN DUNKARD GROUP
BEDROCK
(SHALE, SANDSTONE CONSOLIDATED UNIT)
Holocene Age
Ohio River Overbank Deposits
Pleistocene Age
Glacial Outwash Deposits
Permian Age
Washington Fm.
20 FT
10
0
120 FT
LEGEND:
Topsoil - OL
Sand - SM,SC,SP
Sand and Gravel - SW,GP,GW,GM
Fill
Silt - ML
Peat - PT
Bedrock
Clay - CL
Static Water Level, Dec. 1991
Approximate Geologic Contact
Static Water Level, Inferred
Groundwater Flow Direction
Corporate Remediation Group
CROSS-SECTION E-E'
DuPont Washington Works Main Plant
Washington, West Virginia



ASH021779

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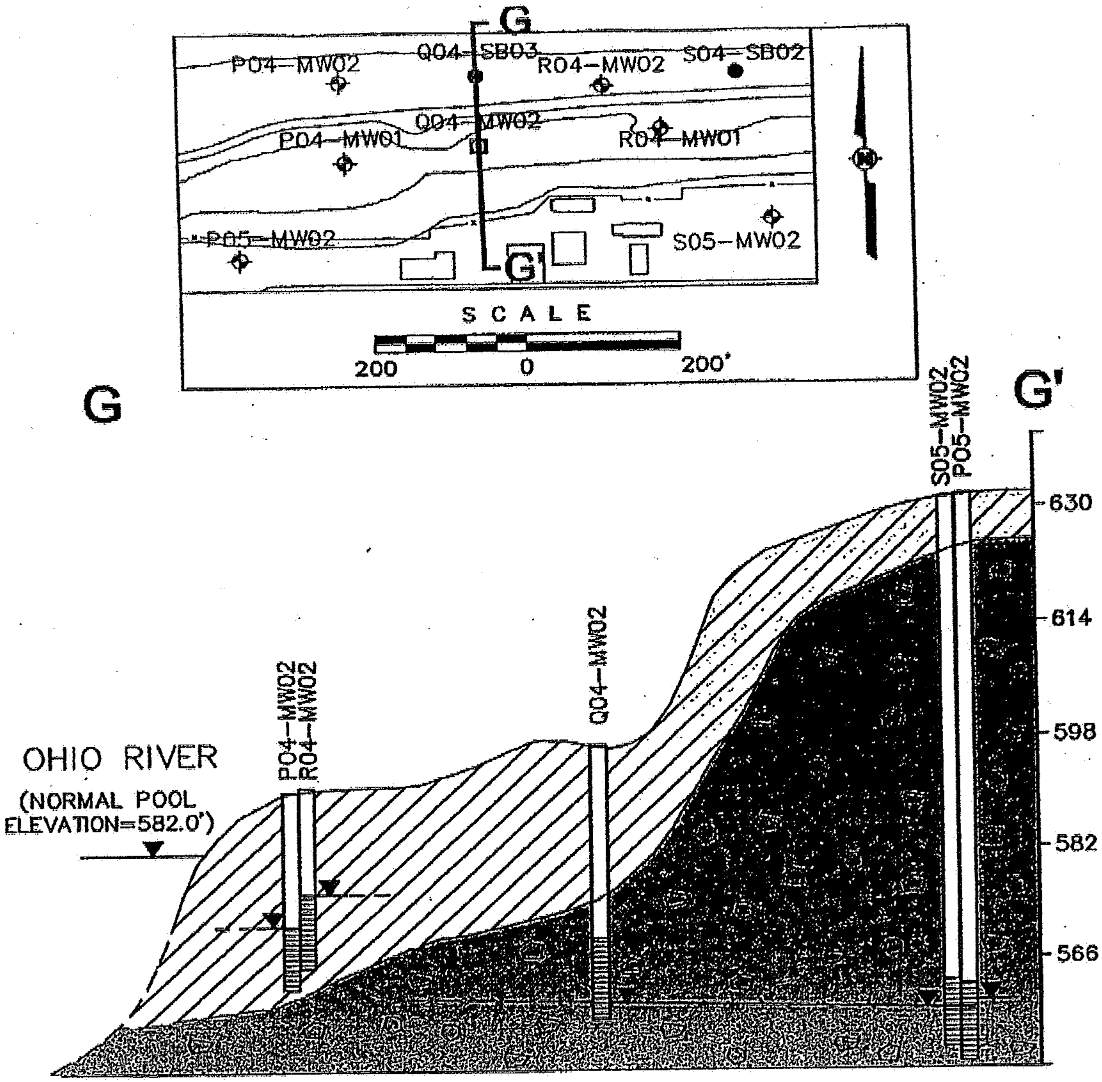


LEGEND:

HOLOCENE OVERBANK DEPOSITS – SILT AND CLAY

PLEISTOCENE GLACIAL OUTWASH DEPOSITS – COARSE SAND AND GRAVEL

HORIZONTAL SCALE: 1"=40'
VERTICAL SCALE: 1"=20'

DUPONT

Corporate Remediation Group
An Alliance between DuPont and URS Diamond

Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

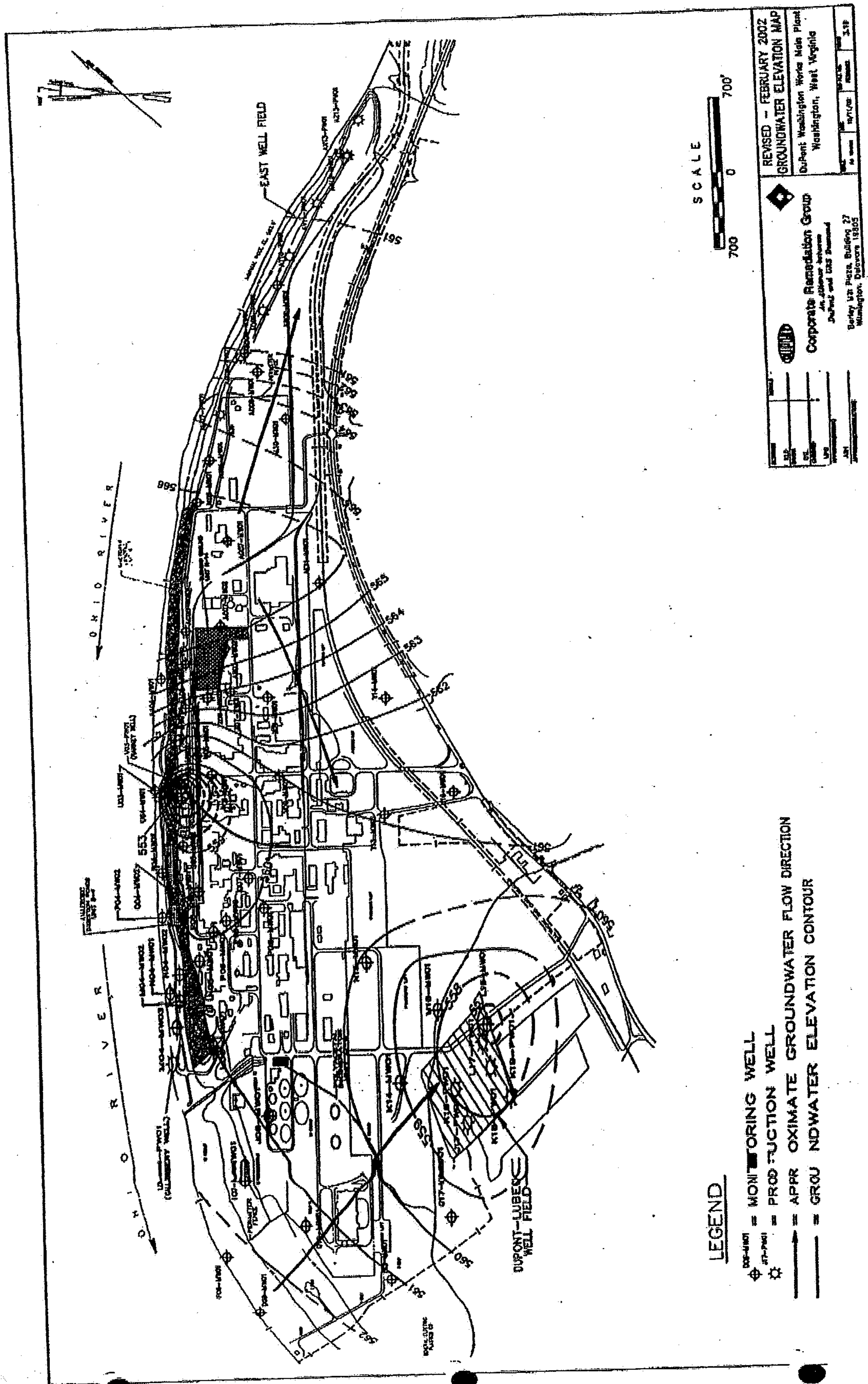
SECTION G–G'

DuPont Washington Works
Washington, West Virginia

SCALE	DESIGNED	DRAWN	CAD FILE NO.
As shown		DEL	38358001
DATE 9/4/02	CHECKED MLD	APPROVED	FIGURE 3.17

ASH021780

EID640012



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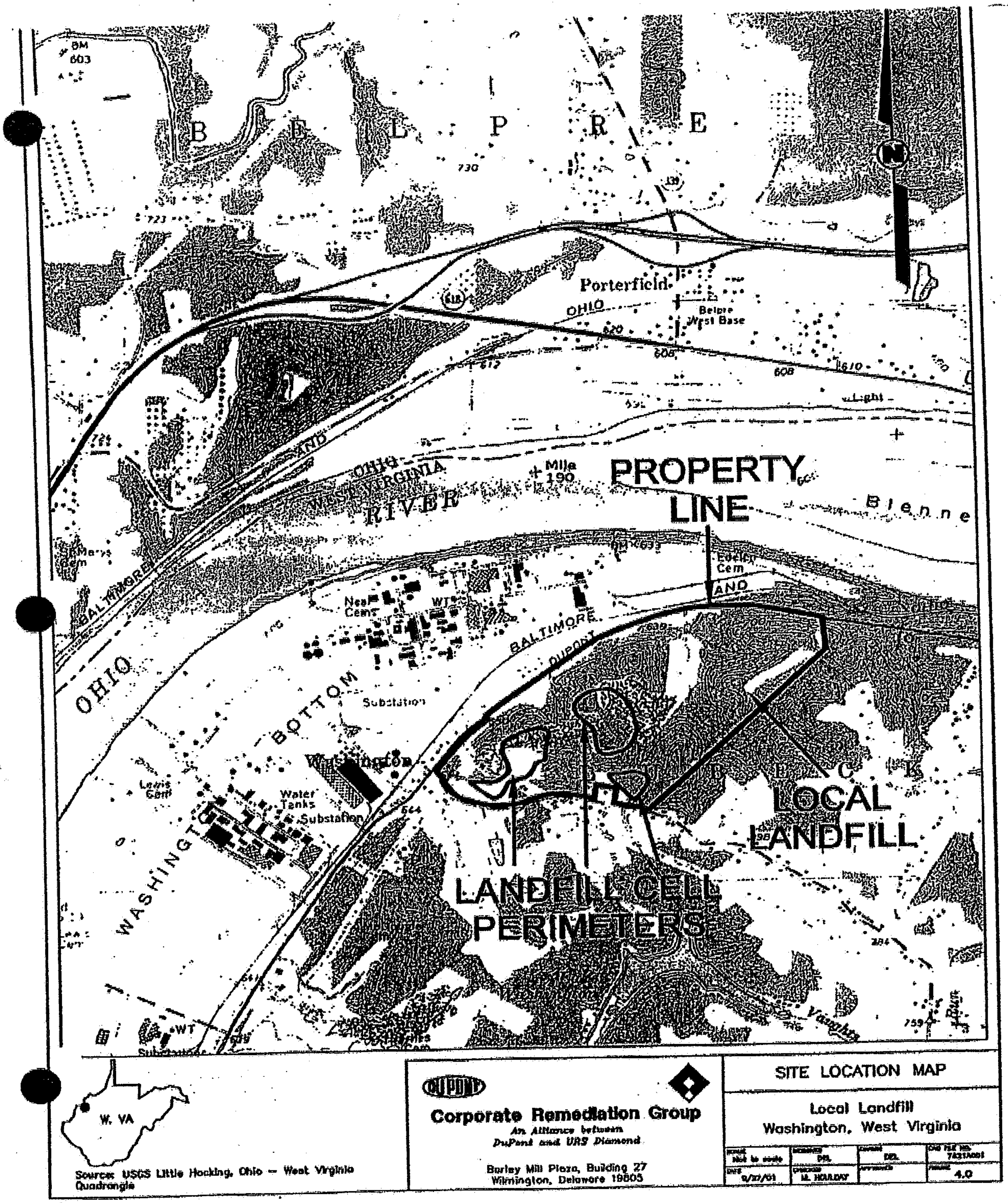

ASH021782

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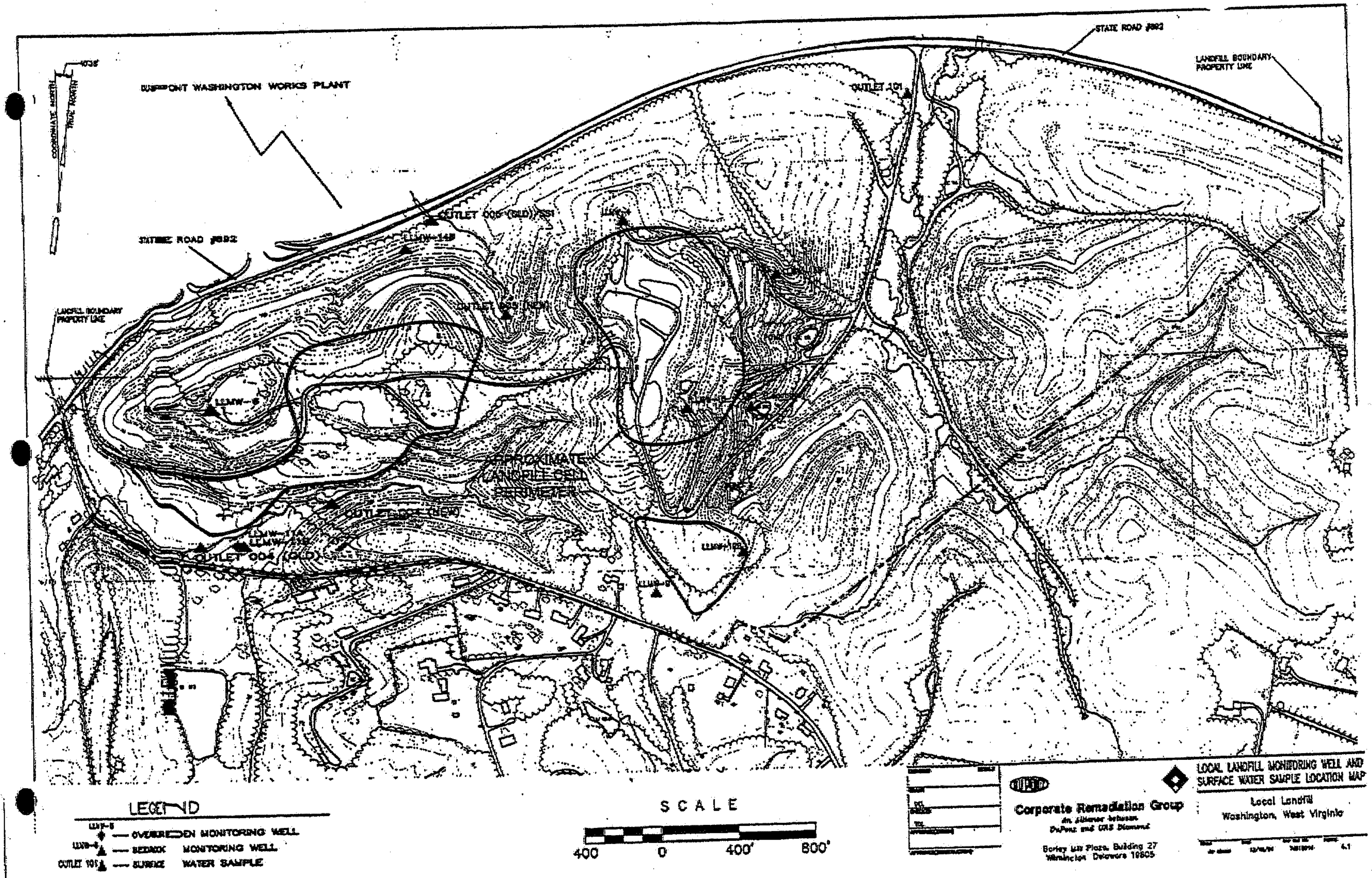

ASH021783

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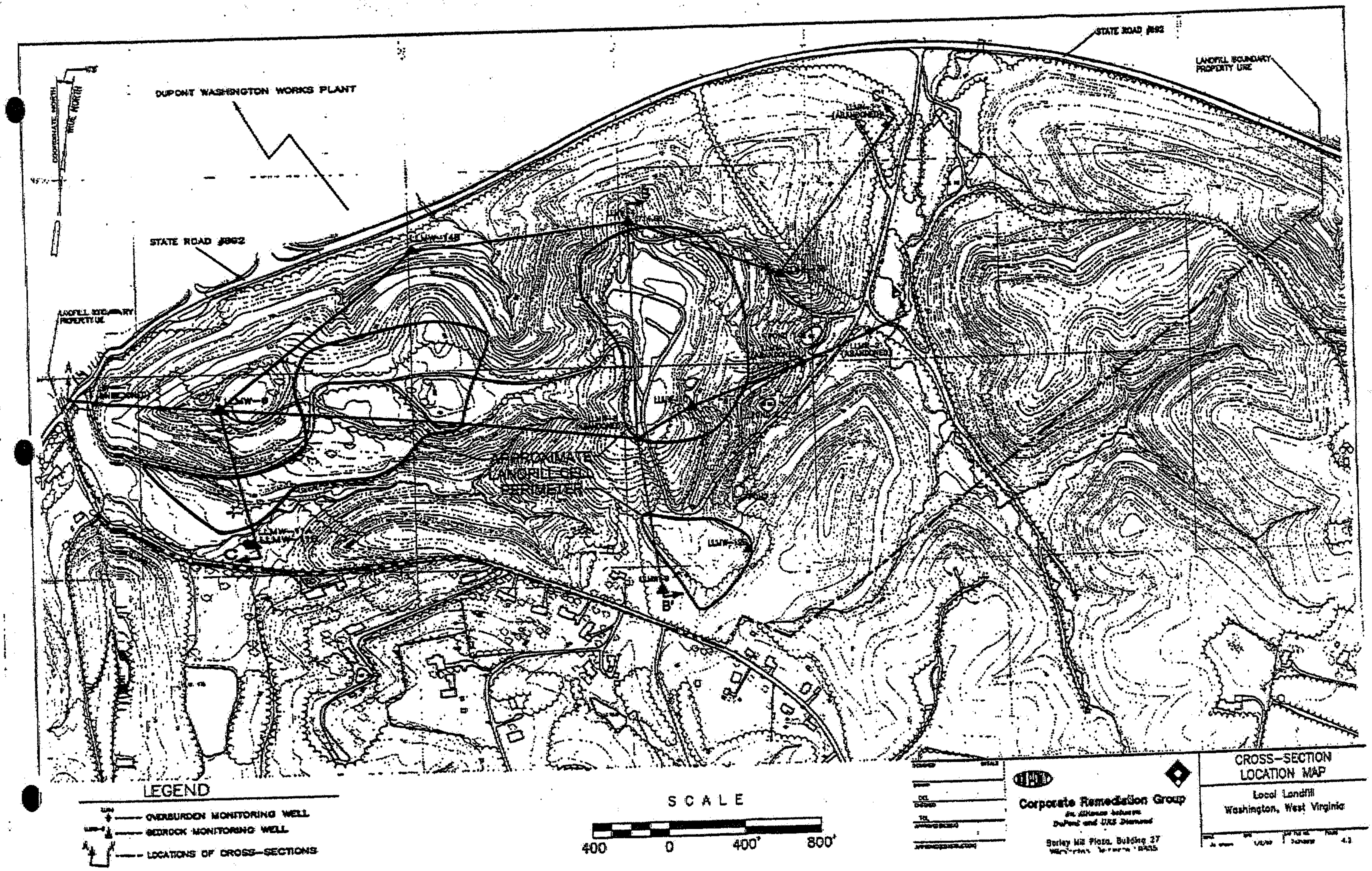

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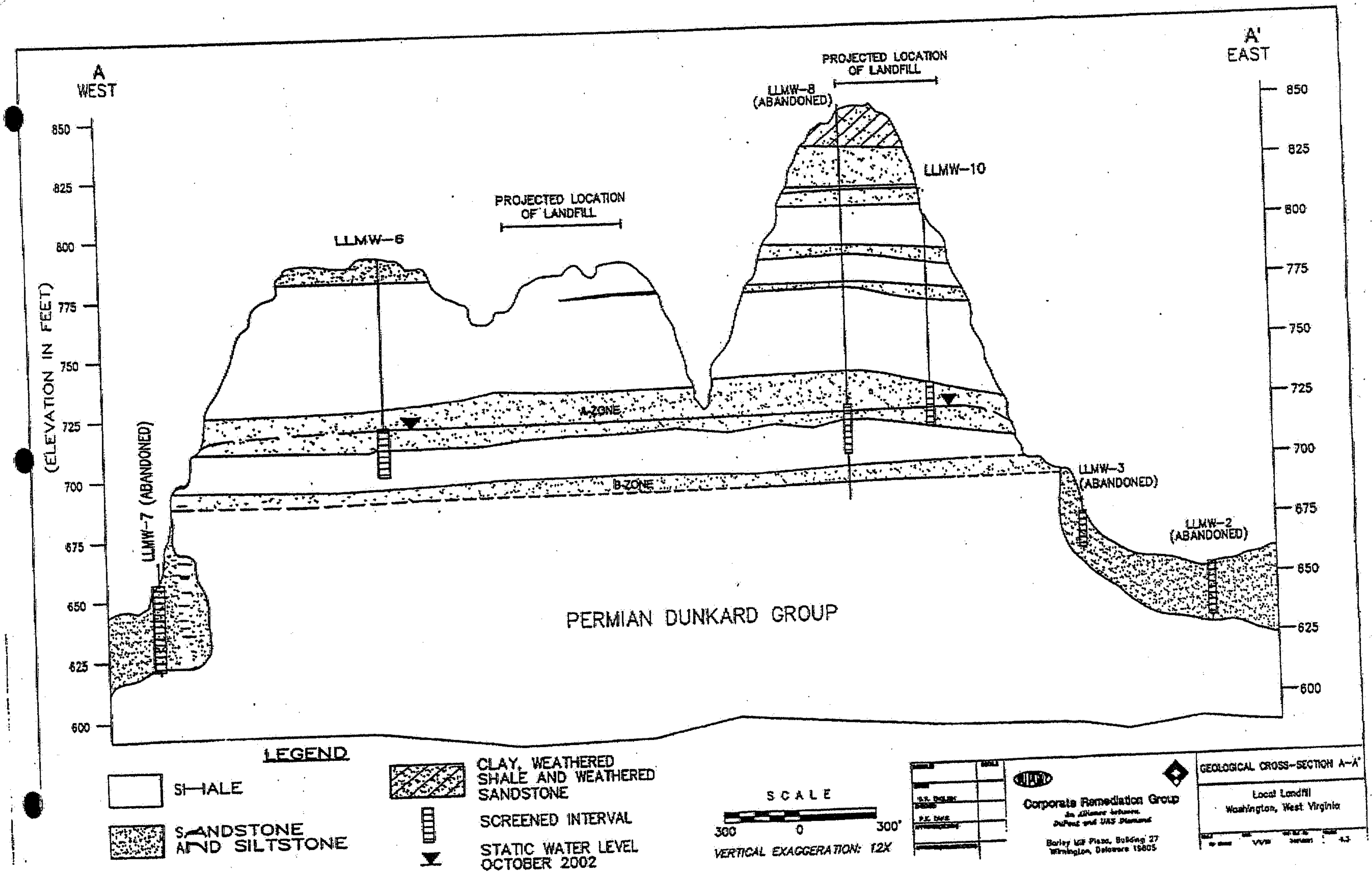

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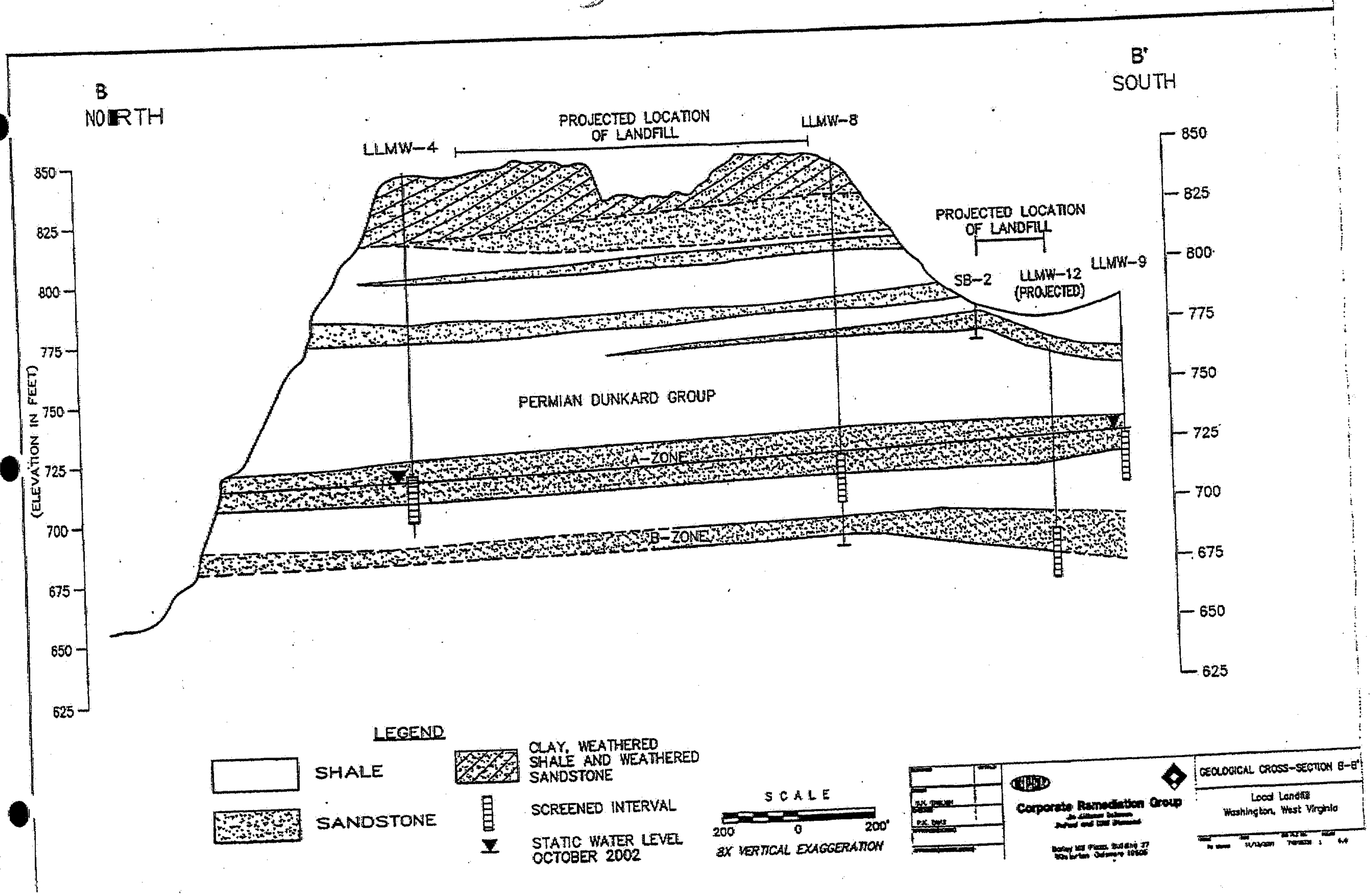

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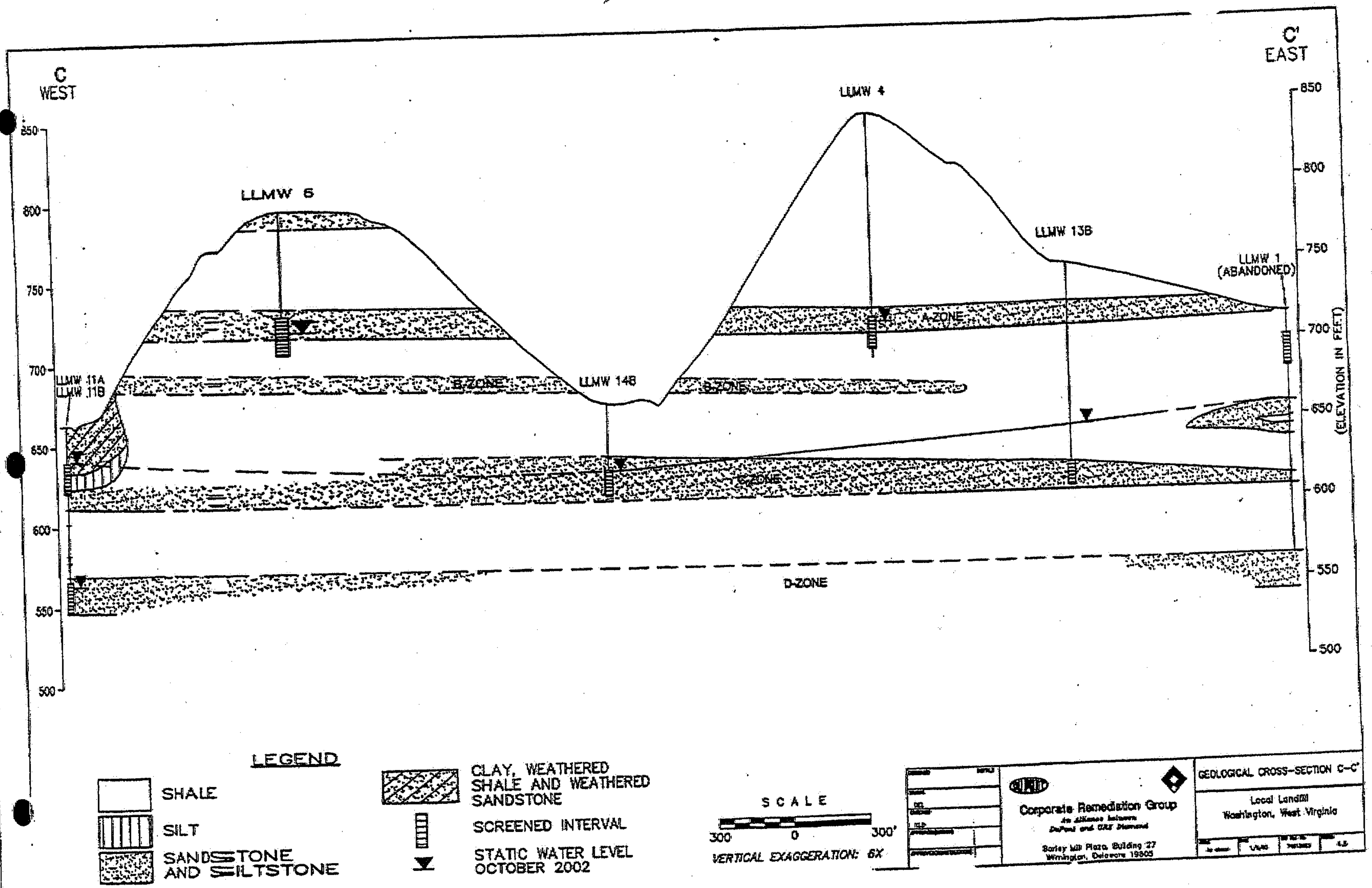

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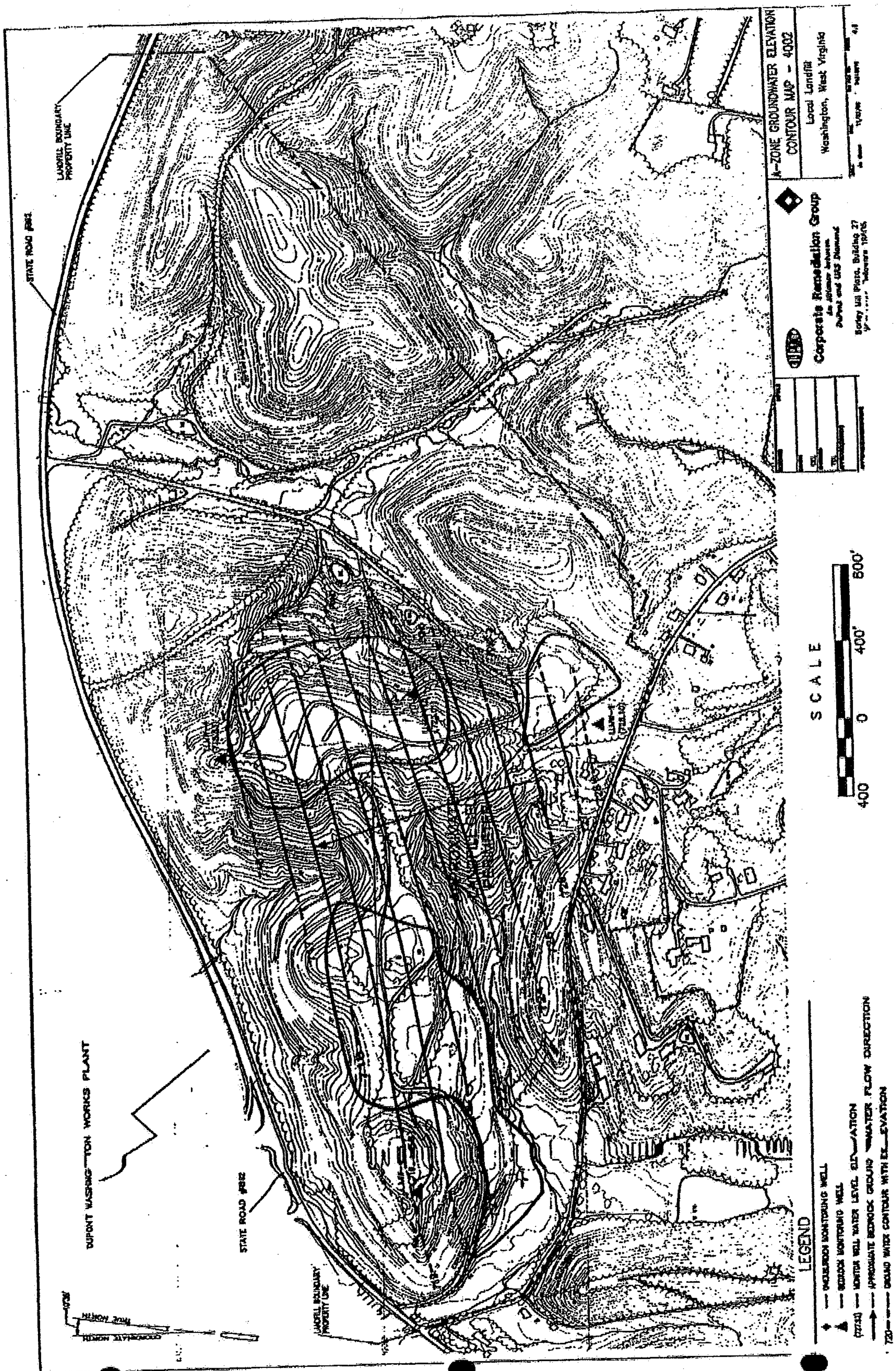

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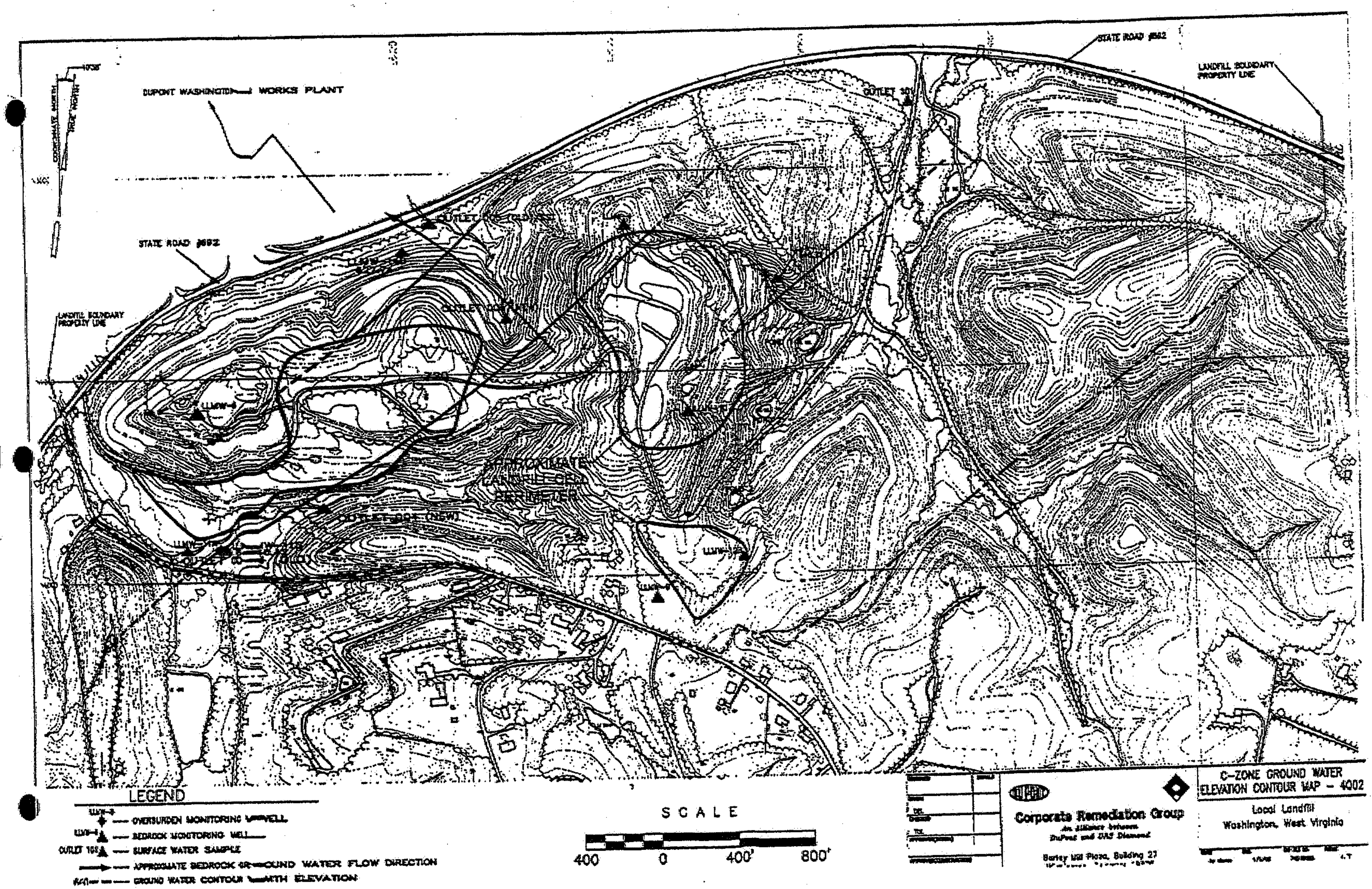

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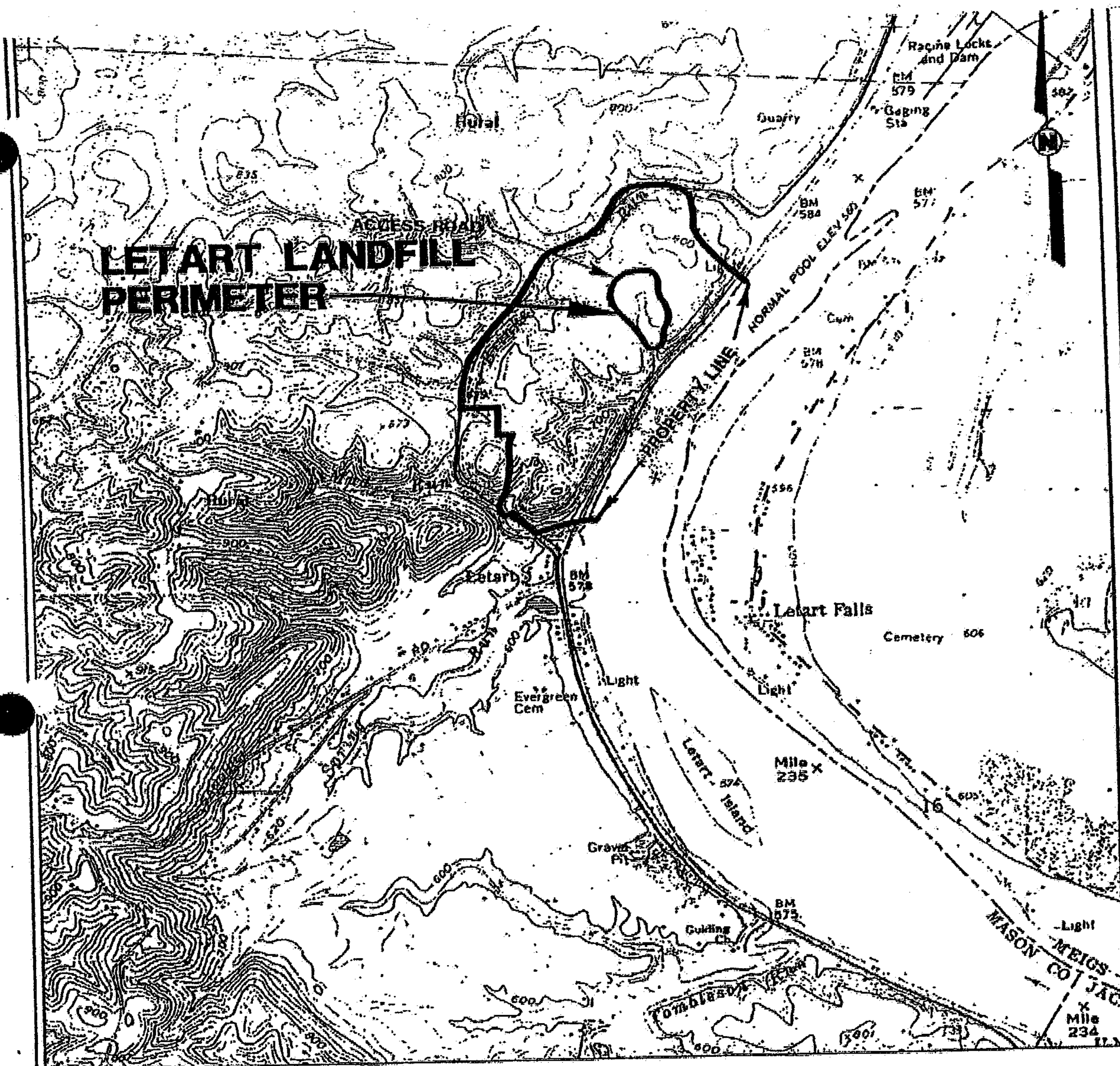


SCALE

2000 0 2000'

SOURCE: NEW HAVEN, WV-OHIO QUADRANGLE 7.5' SERIES

DUPONT

Corporate Remediation Group

An Alliance between DuPont and The W-C Diamond Group

Barley Mill Plaza, Building 27
Wilmington, Delaware 19880-0027

SITE LOCATION MAP

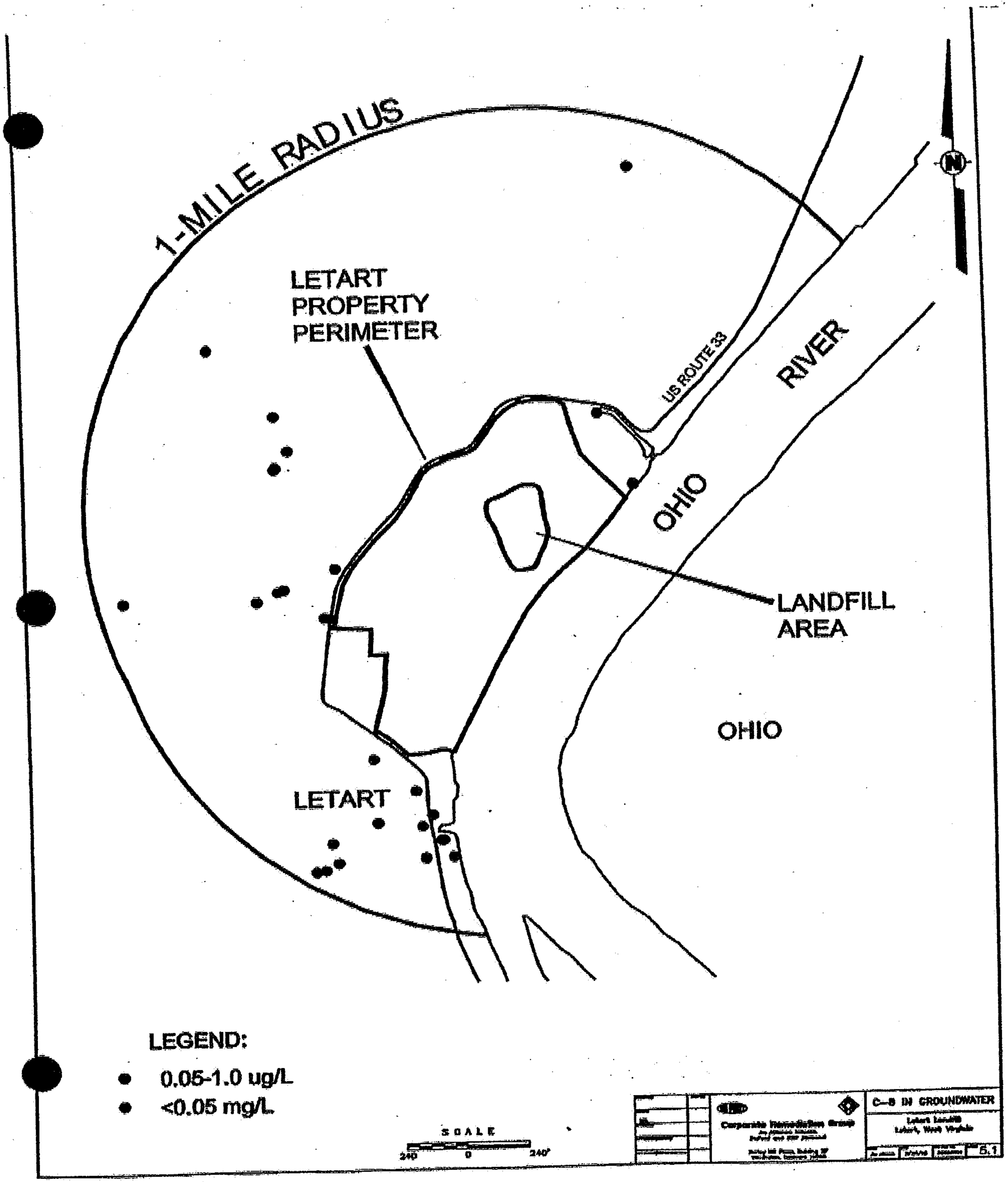
Letart Landfill Site
Letart, WV

12/21/9

5.0

ASH021790

EID640022



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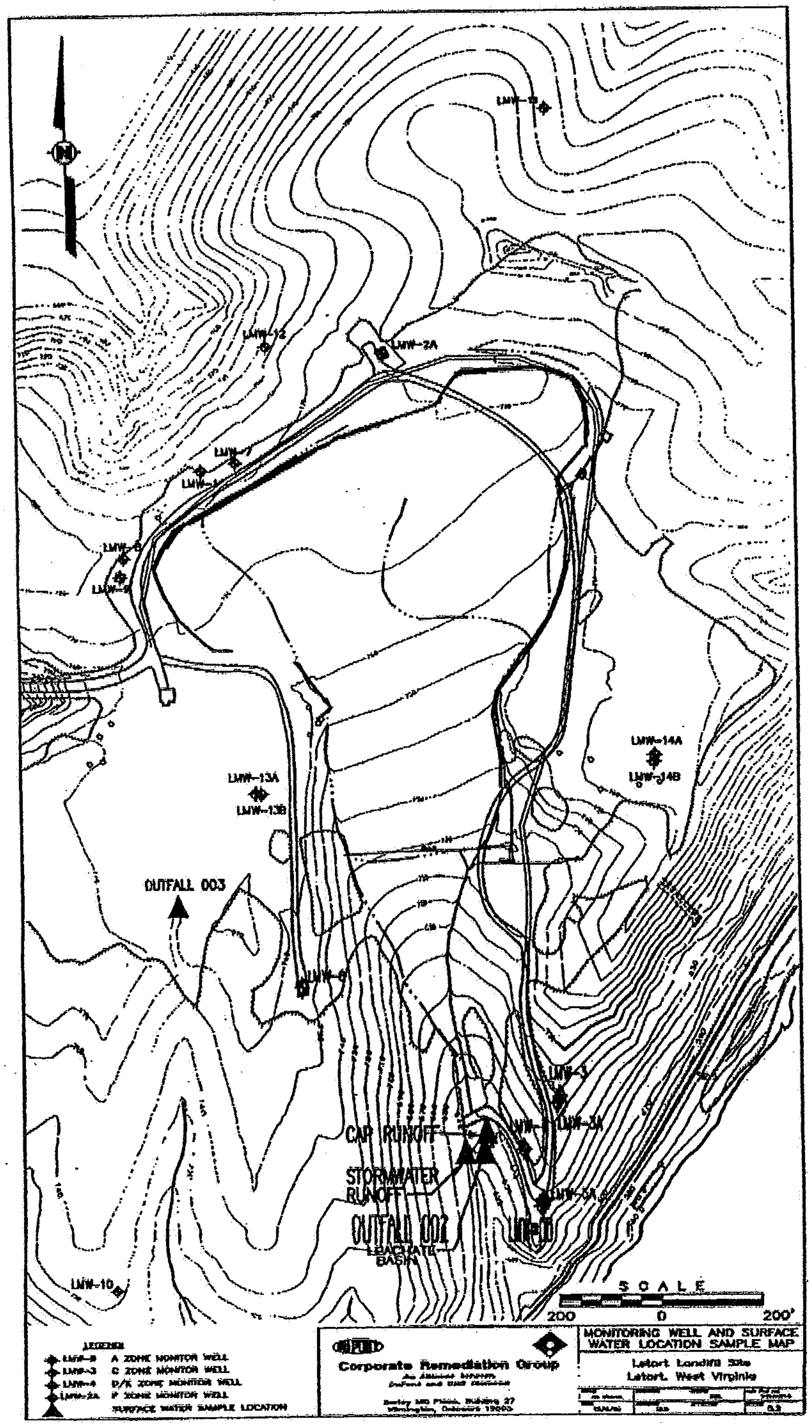

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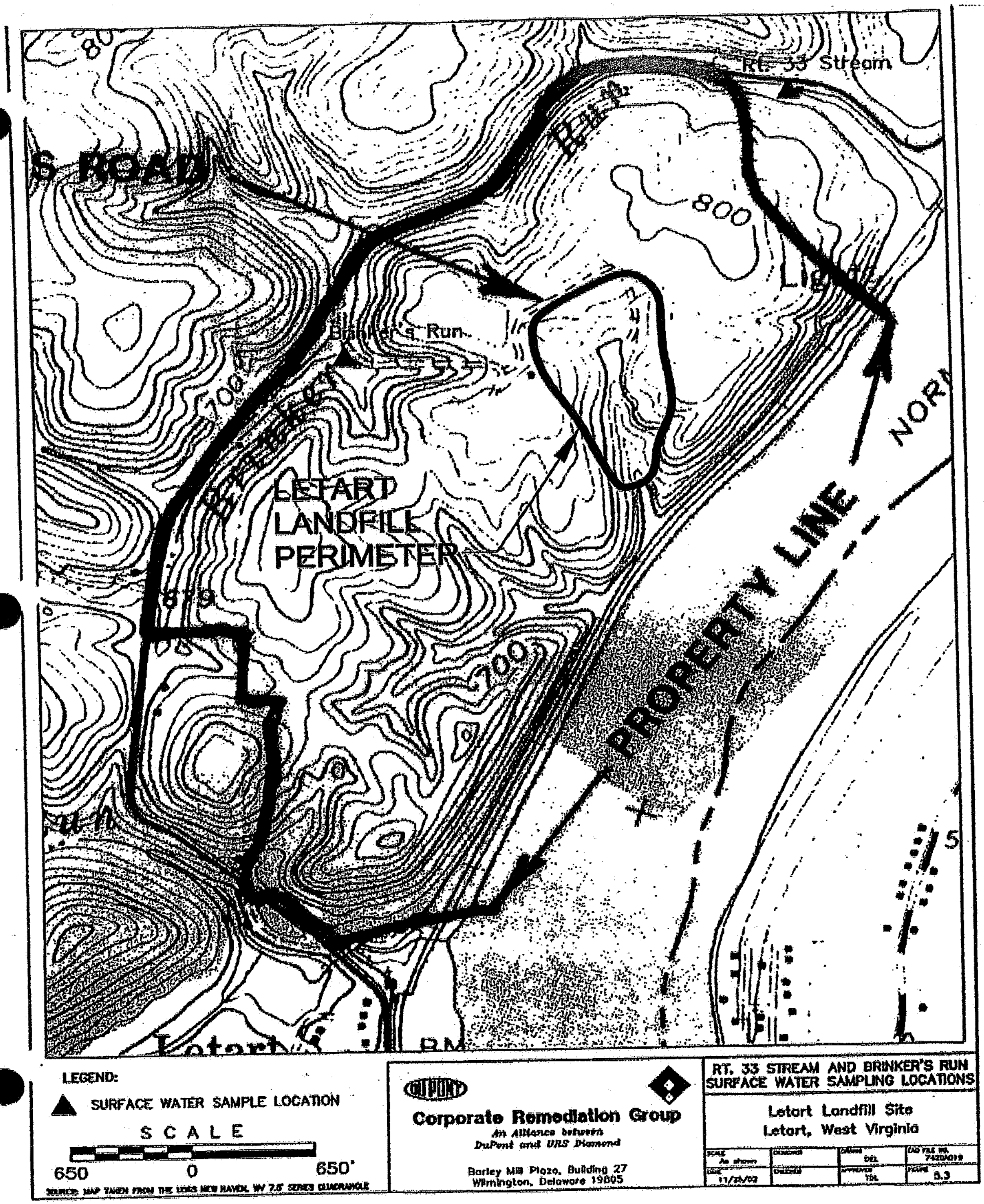

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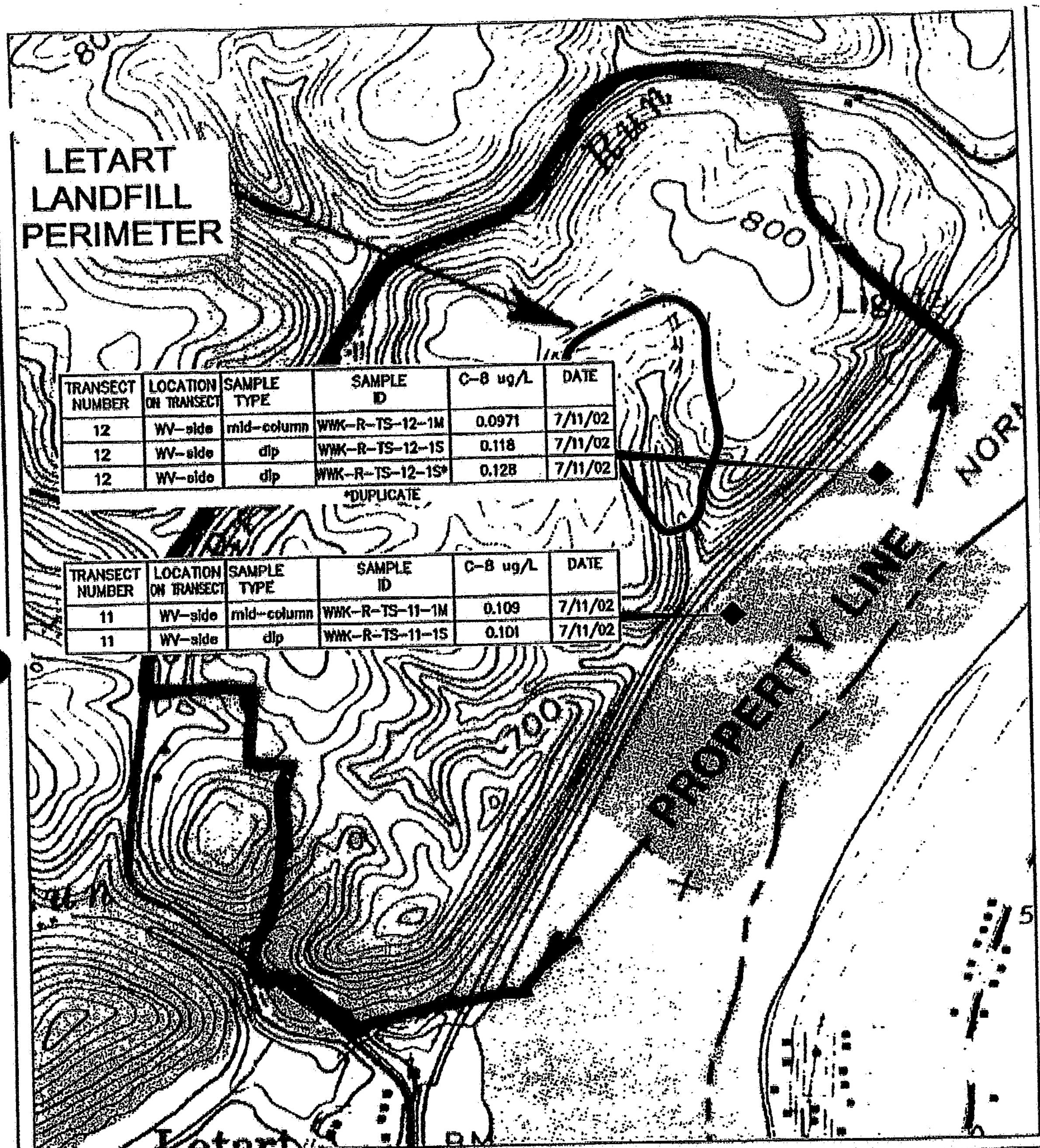


TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
12	WV-side	mid-column	WWK-R-TS-12-1M	0.0971	7/11/02
12	WV-side	dip	WWK-R-TS-12-1S	0.118	7/11/02
12	WV-side	dip	WWK-R-TS-12-1S*	0.128	7/11/02

*DUPLICATE

TRANSECT NUMBER	LOCATION ON TRANSECT	SAMPLE TYPE	SAMPLE ID	C-8 ug/L	DATE
11	WV-side	mid-column	WWK-R-TS-11-1M	0.109	7/11/02
11	WV-side	dip	WWK-R-TS-11-1S	0.101	7/11/02

LEGEND:

◆ OHIO RIVER WATER SAMPLING LOCATION, (DIP AND MID-COLUMN SAMPLES)

SCALE

650 0 650'

SOURCE: MAP TAKEN FROM THE USGS NEW HAVEN, WV 7.5' SERIES QUADRANGLE

DUPONT

Corporate Remediation Group

An Alliance between DuPont and URS Diamond

Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

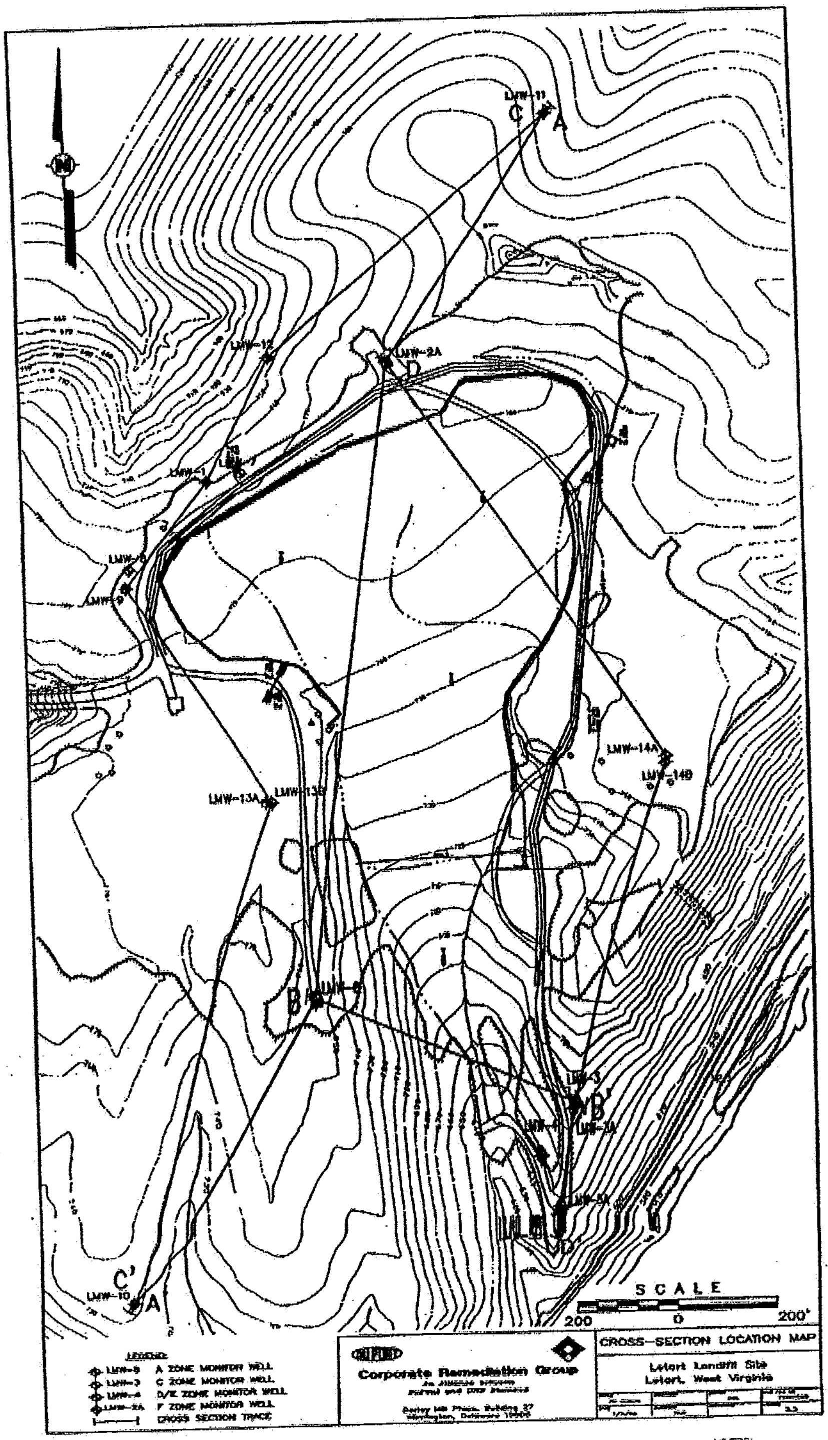
OHIO RIVER WATER SAMPLING LOCATIONS

Letart Landfill Site
Letart, West Virginia

SCALE	DESIGNED	DRAWN	CAD FILE NO.
As shown		DEL	7420A01B
DATE 1/30/02	CHECKED	APPROVED TDL	FIGURE 5.4

ASH021794

EID640026



ASH021795

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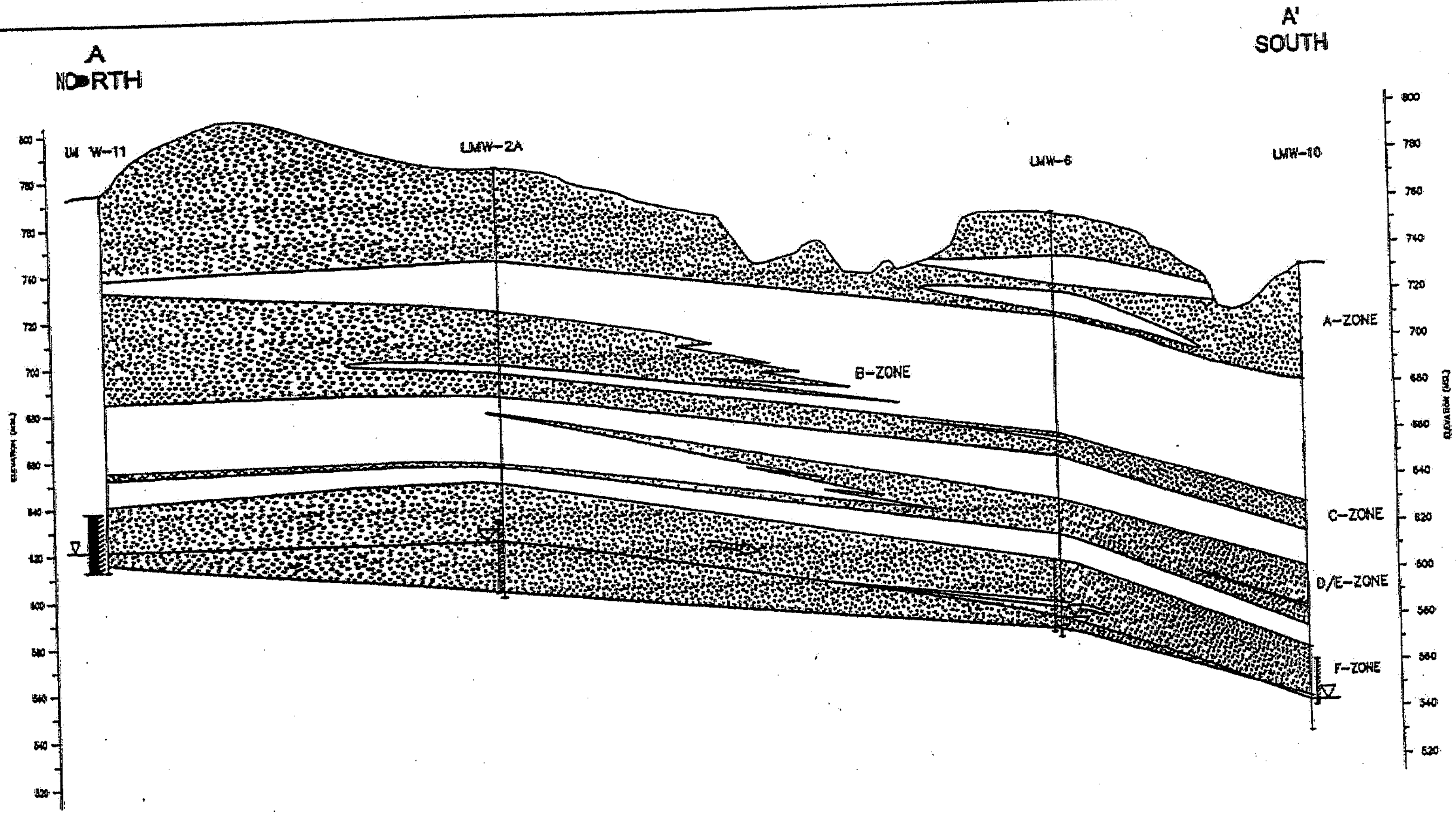


LEGEND

SANDSTONE AND SILTSTONE

SHALE

A-ZONE AQUIFER ZONE

GROUNDWATER FLOW DIRECTION

GROUNDWATER ELEVATION (OCTOBER, 2002)

SCREENED INTERVAL

HORIZONTAL SCALE: 1"=100'
VERTICAL SCALE: 1"=40'

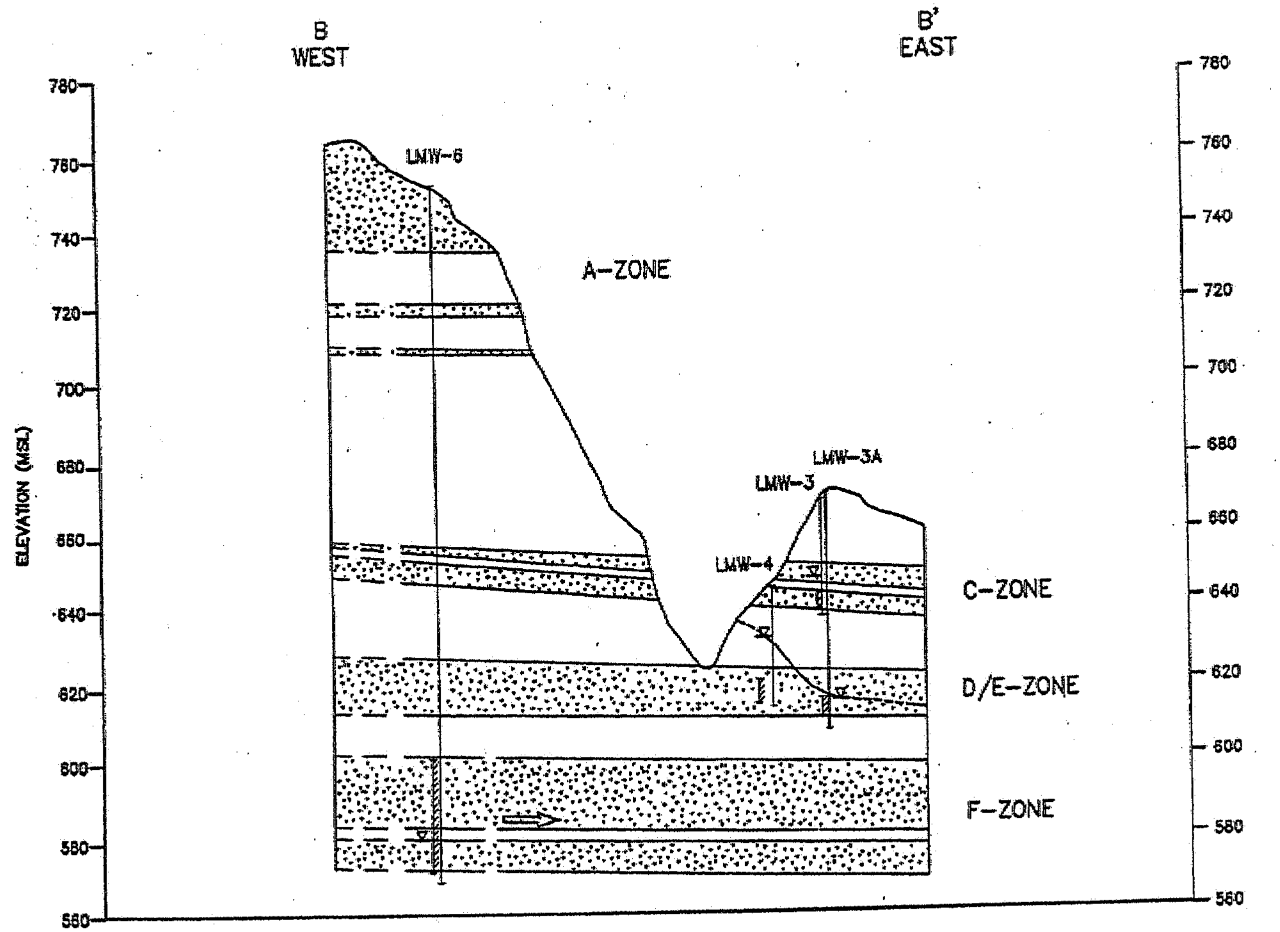
Corporate Remediation Group
An Alliance between DuPont and URS Diamond
Barley Mill Plaza, Building 27

CROSS-SECTION A-A'
Letart Landfill Site
Letart, West Virginia

NOTE: ... are not shown as a separate geologic unit.

ASH021796

EID640028



LEGEND

SANDSTONE AND SILTSTONE

SHALE

GROUNDWATER ELEVATION (October, 2002)

GROUNDWATER FLOW DIRECTION

SCREENED INTERVAL

SCALE

0 100 200 FT

NOTE: Surface soils are not shown as a separate geologic unit.

DUPONT

Corporate Remediation Group

An Alliance between DuPont and URS Diamond

Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

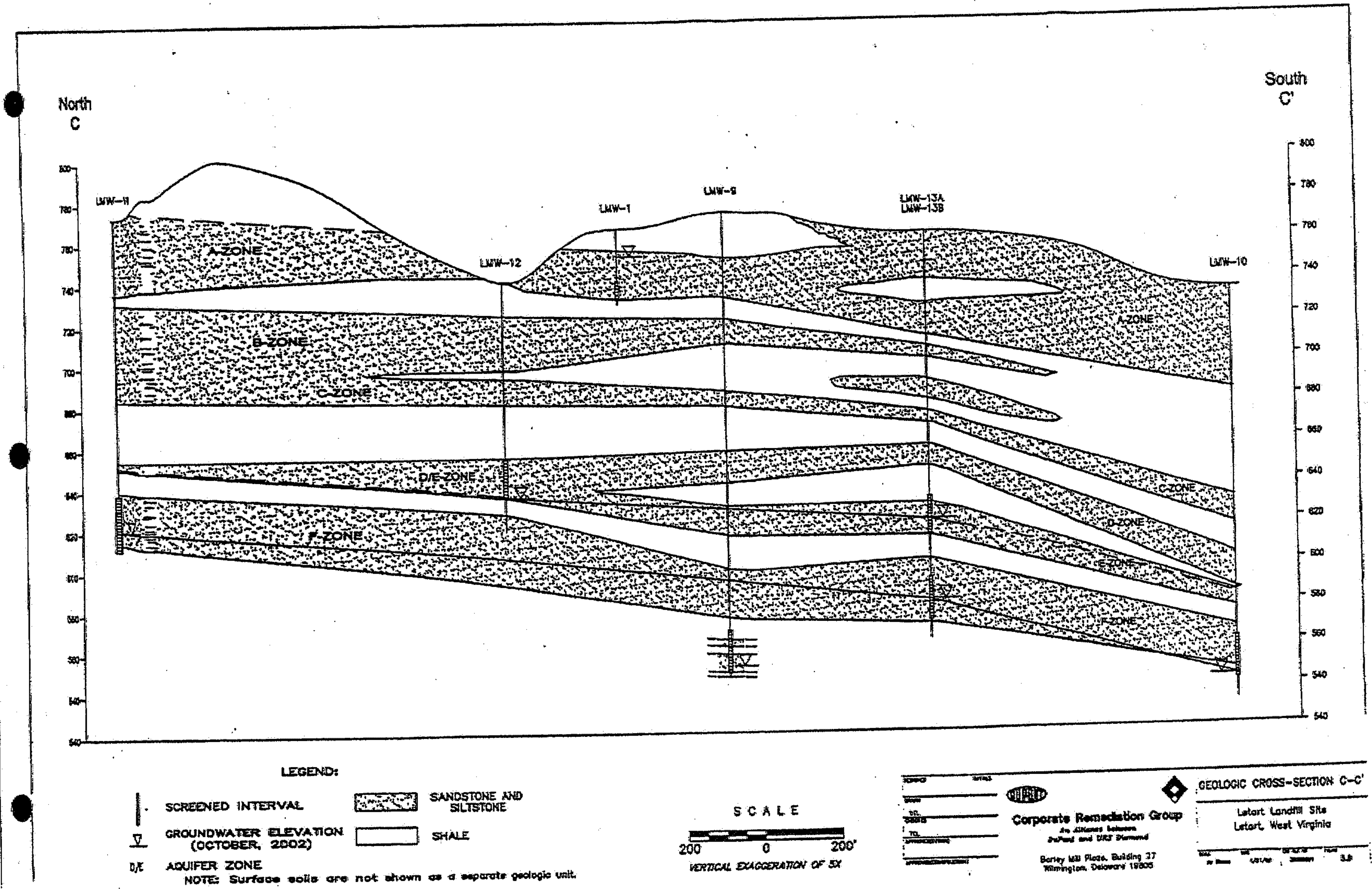
CROSS-SECTION B-B'

Letart Landfill Site
Letart, WV

SCALE As shown	DESIGNED	DRAWN DEL	DO FILE NO. 7420400
DATE 11/7/01	CHECKED TDL	APPROVED	FIGURE 5.7

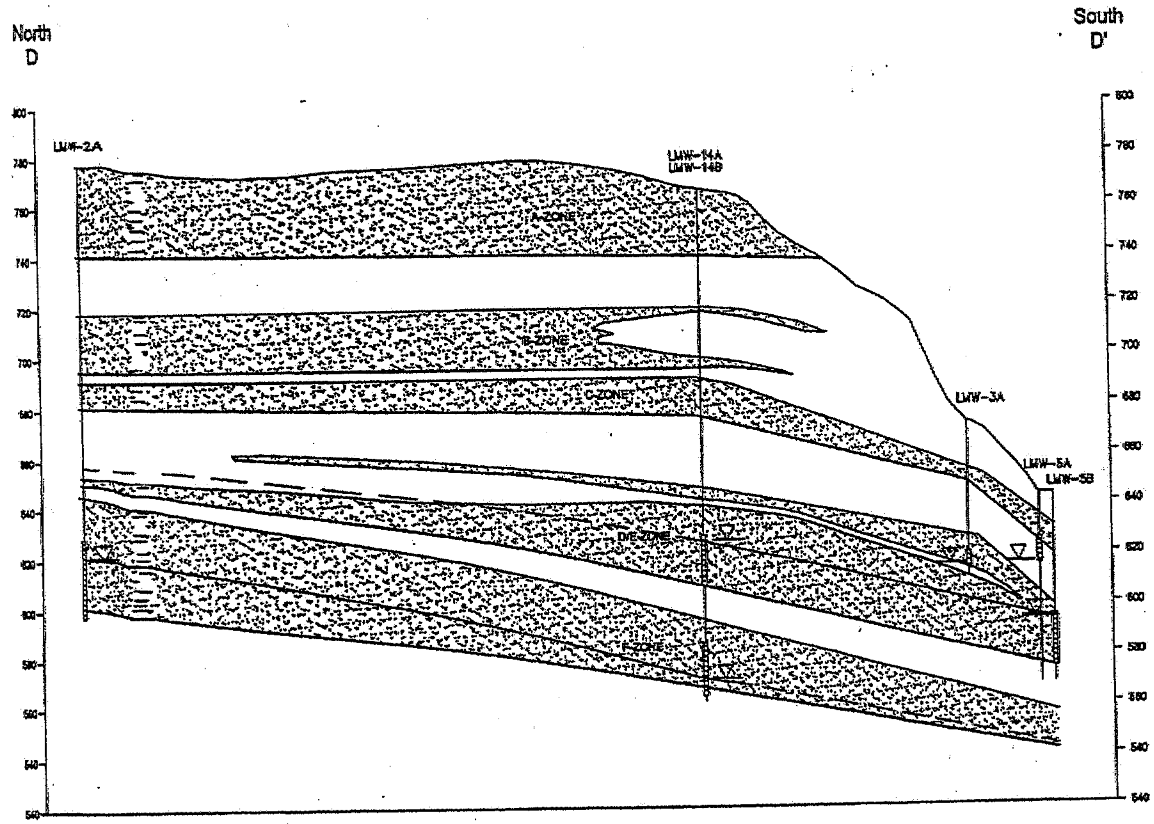
ASH021797

EID640029



ASH021798

EID640030



LEGEND:

WELL SCREENED INTERVAL

SANDSTONE AND SILTSTONE

GROUNDWATER ELEVATION (OCTOBER, 2002)

SHALE

D/E AQUIFER ZONE

NOTE: Surface soils are not shown as a separate geologic unit.

SCALE

200 0 200'

VERTICAL EXAGGERATION OF 5X

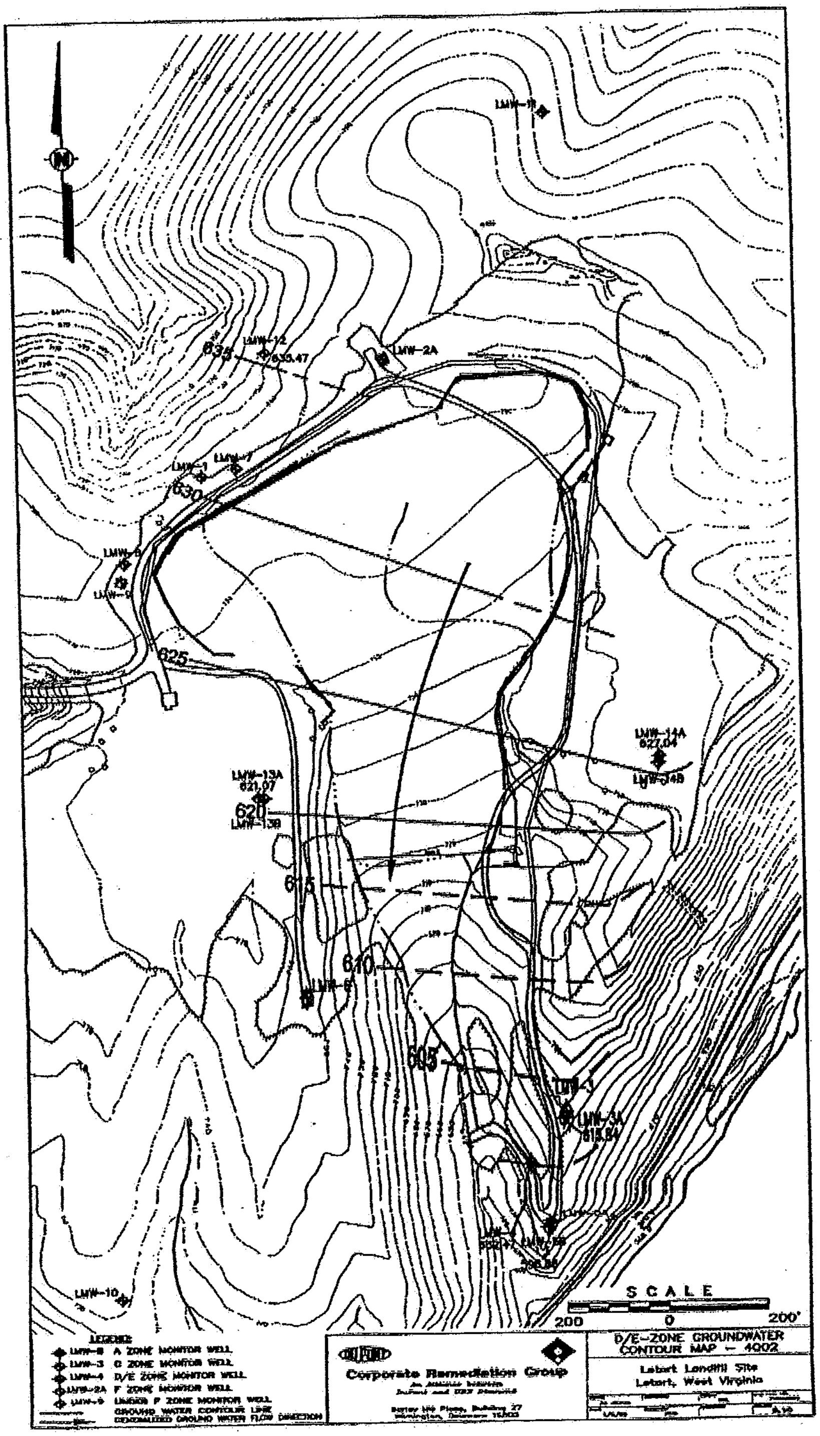
Corporate Remediation Group
An Alliance between DuPont and URS Diamond
Barley Mill Plaza, Building 27
Wilmington, Delaware 19805

GEOLOGIC CROSS-SECTION D-D'

Letort Landfill Site
Letort, West Virginia

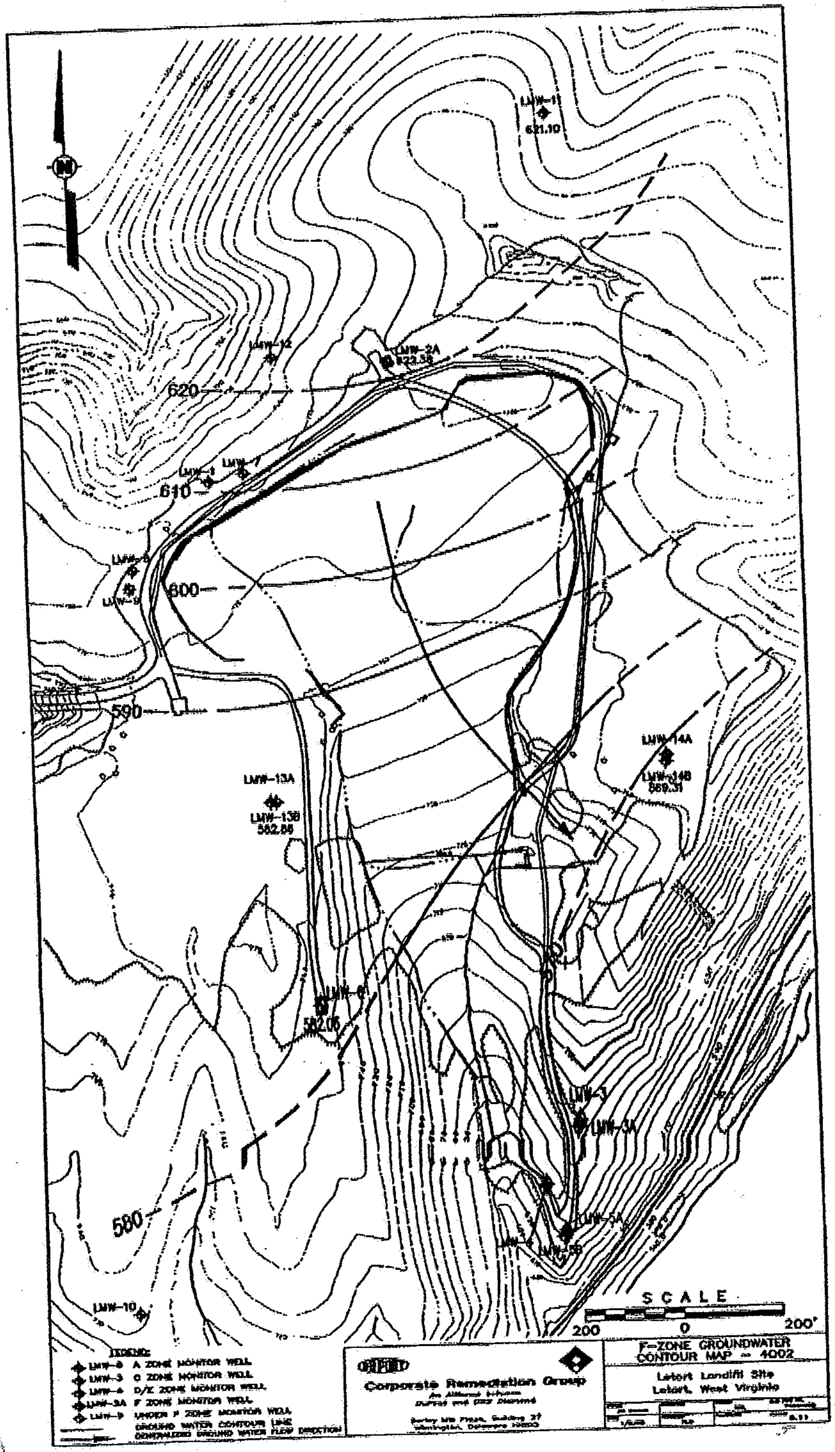
ASH021799

EID640031



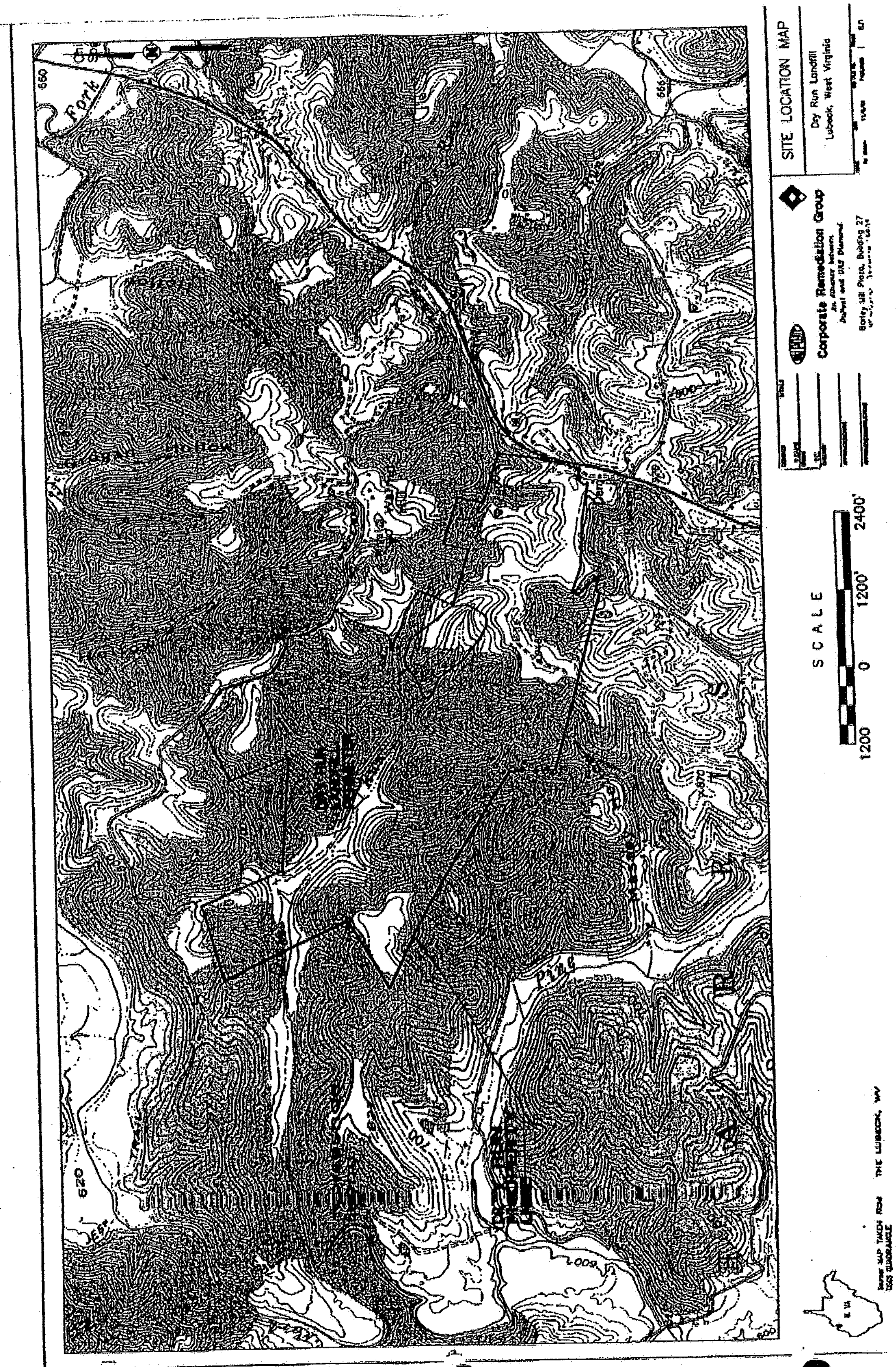
ASH021800

EID640032



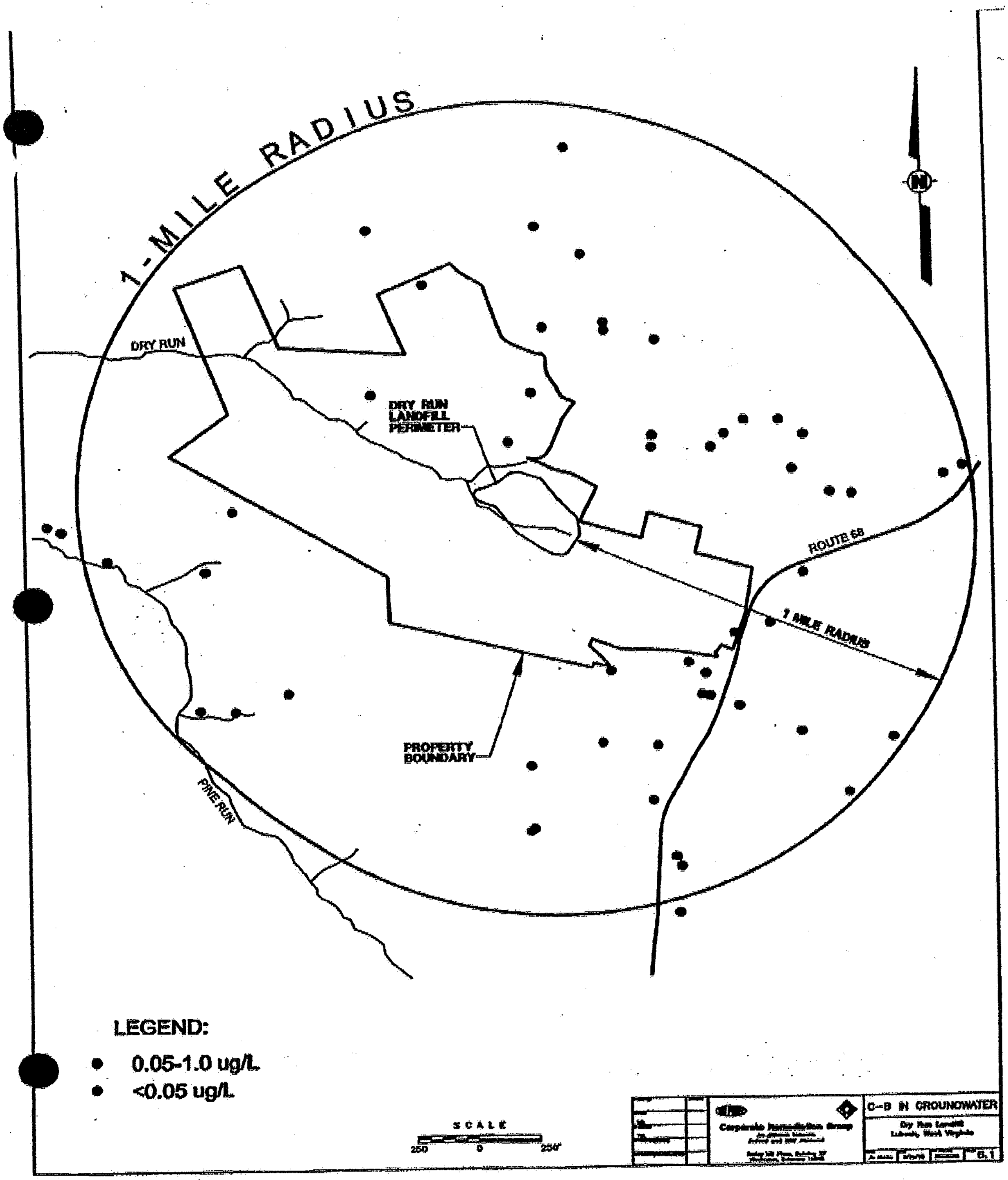
ASH021801

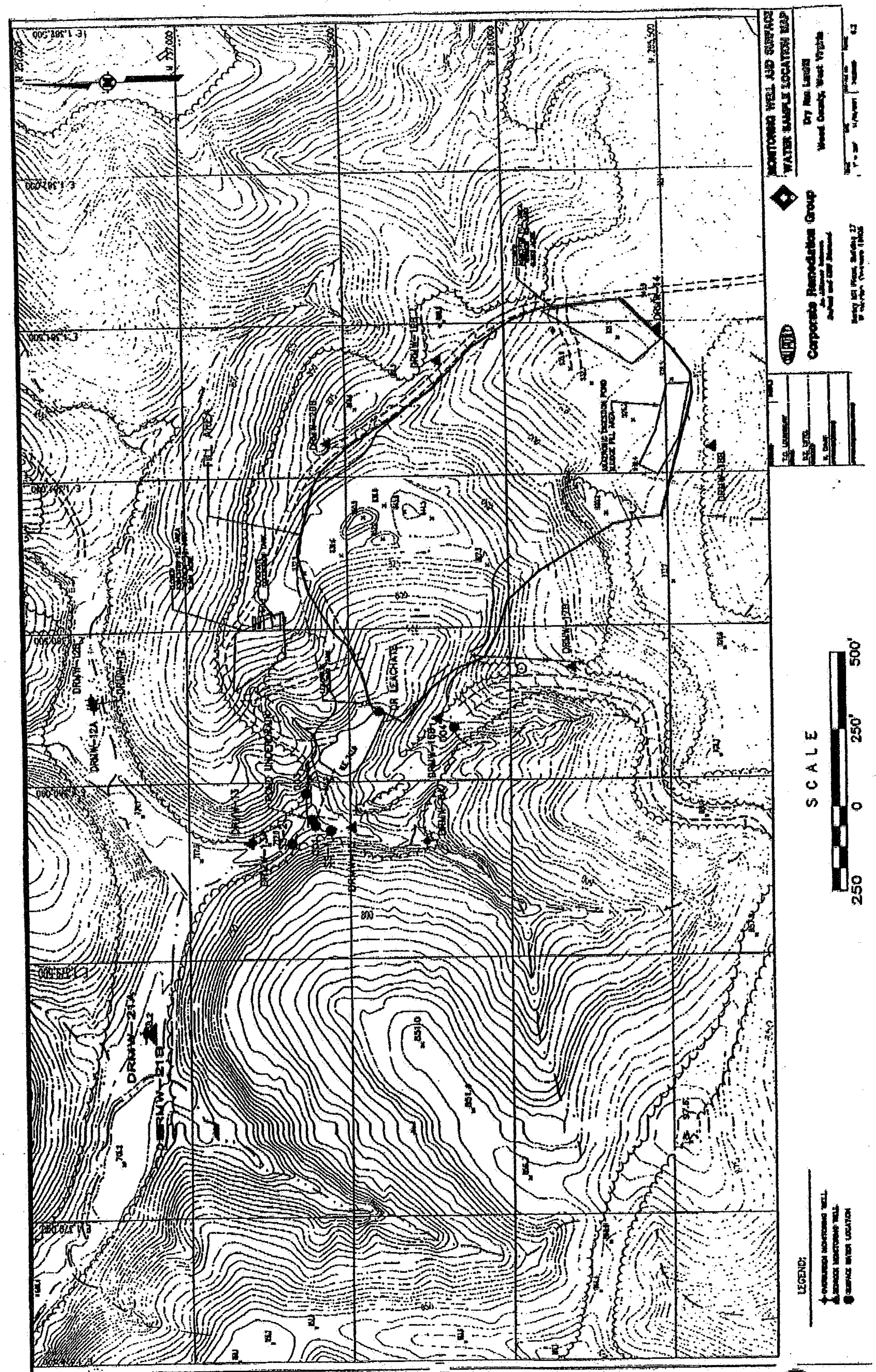
EID640033



ASH021802

EID640034


1-MILE RADIUS
N
DRY RUN
DRY RUN LANDFILL PERIMETER
ROUTE 68
1 MILE RADIUS
PROPERTY BOUNDARY
PINE RUN
LEGEND:
0.05-1.0 ug/L
<0.05 ug/L
SCALE
250 0 250'
Corporate Remediation Group
C-8 IN GROUNDWATER
Dry Run Landfill
Lubeck, West Virginia
8.1



ASH021804

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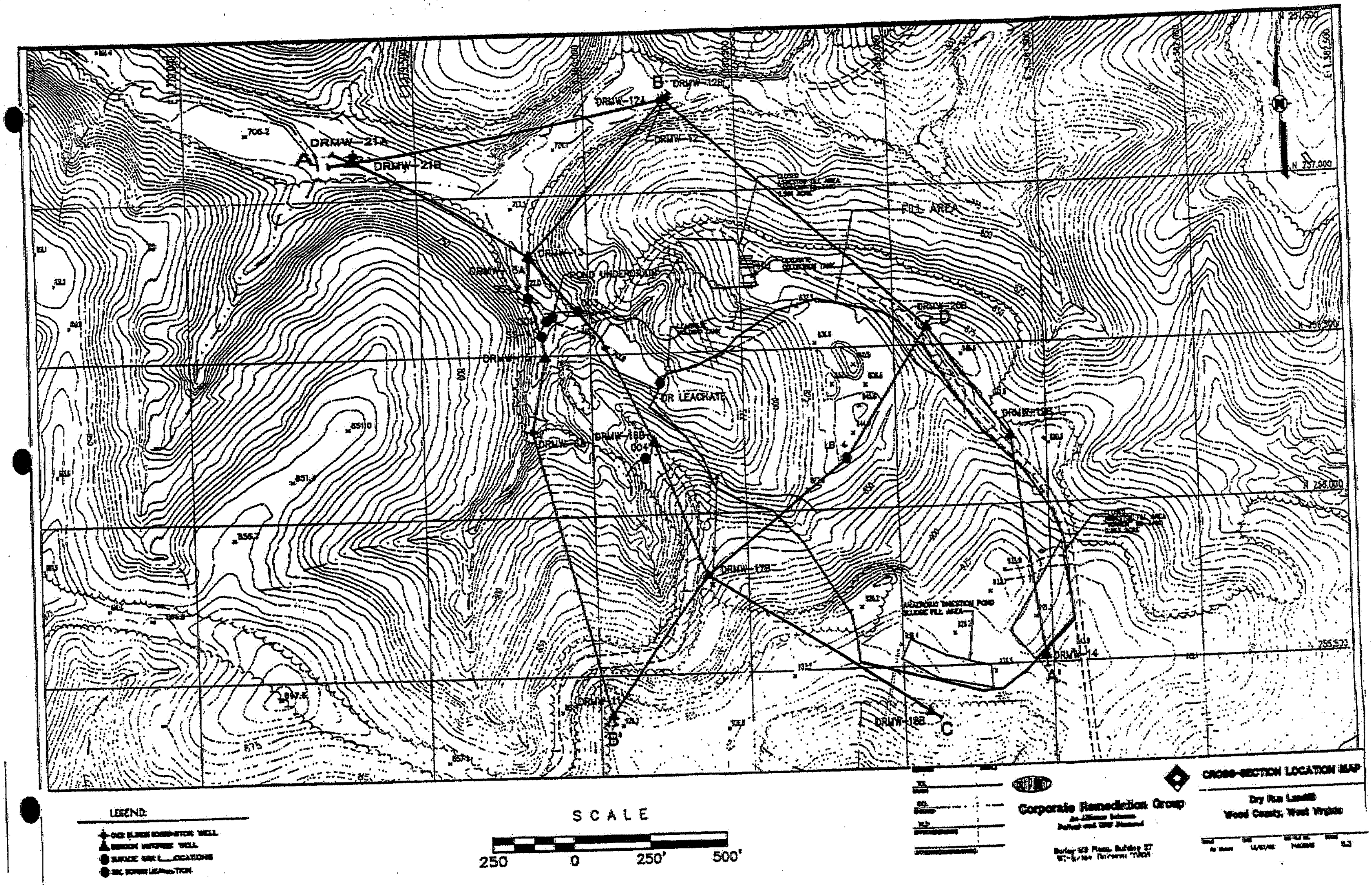

ASH021805

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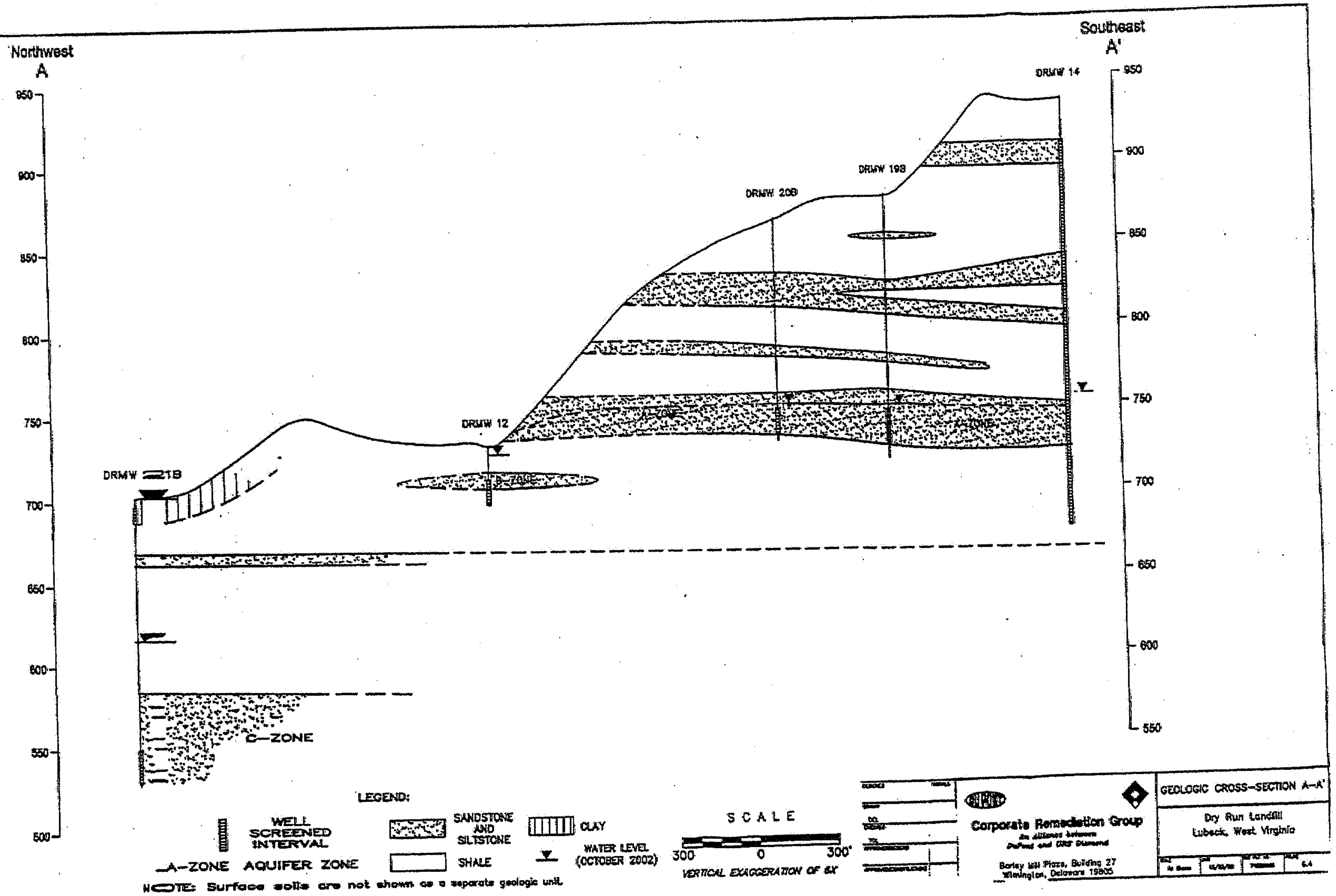

ASH021806

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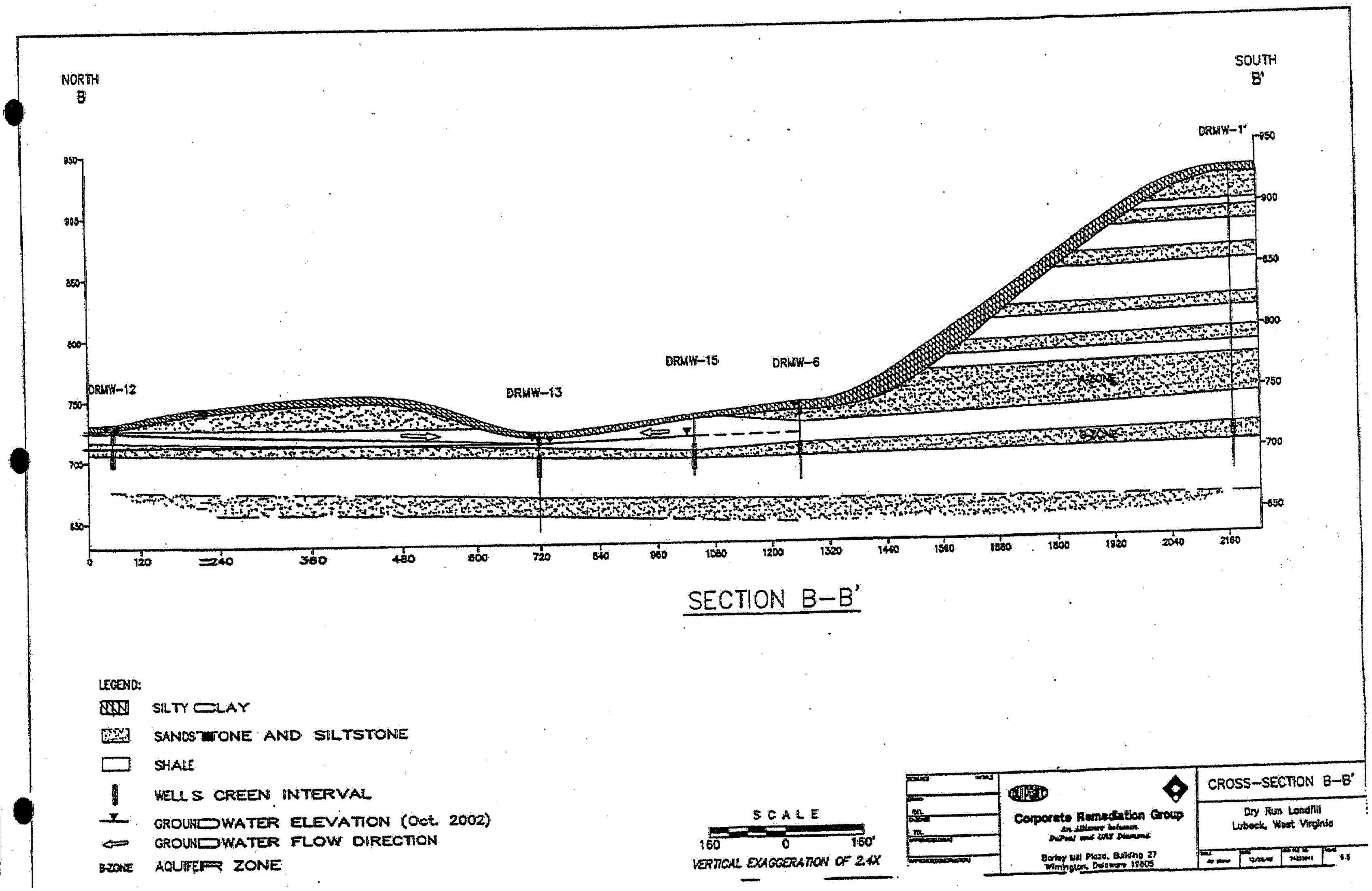

ASH021807

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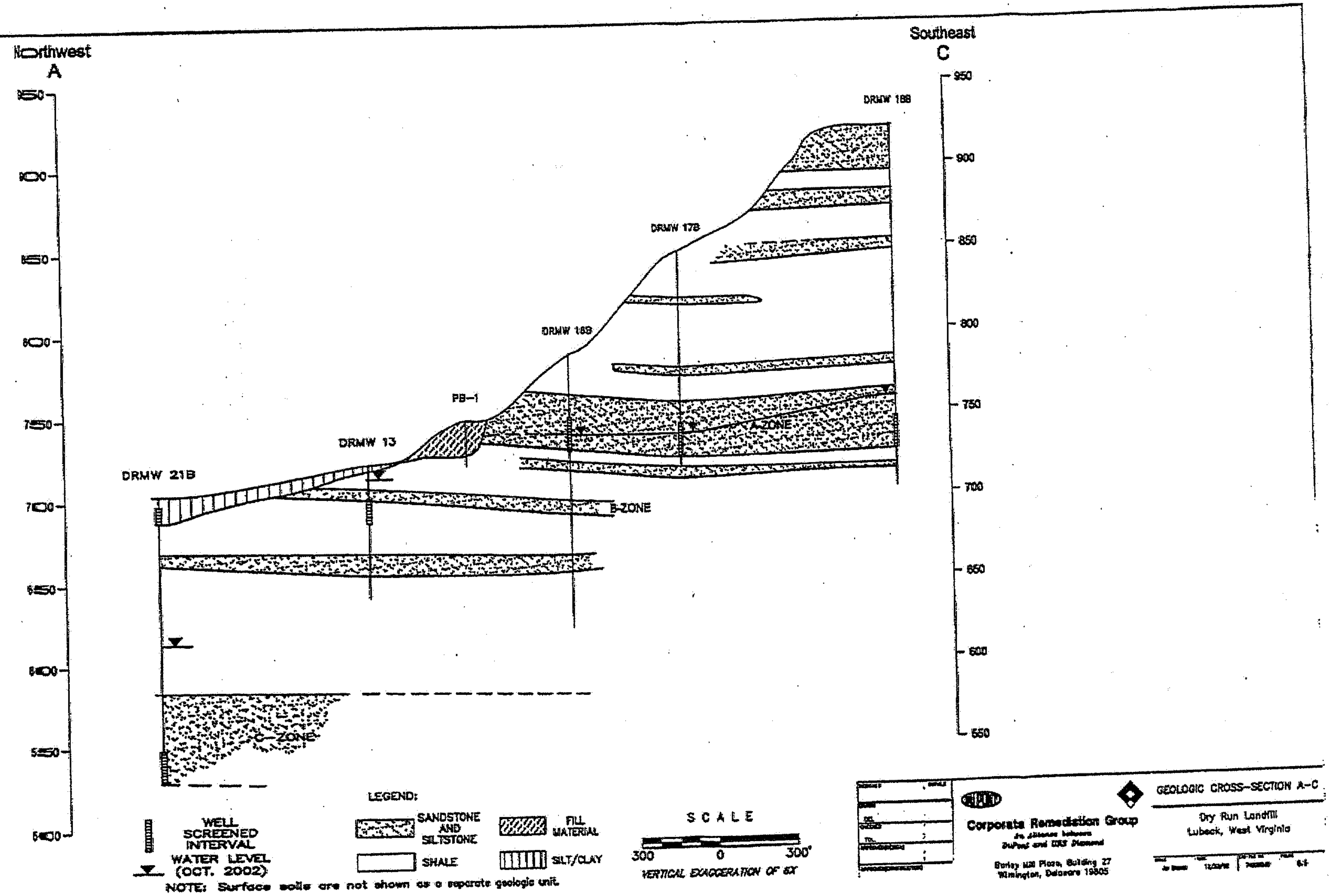

ASH021808

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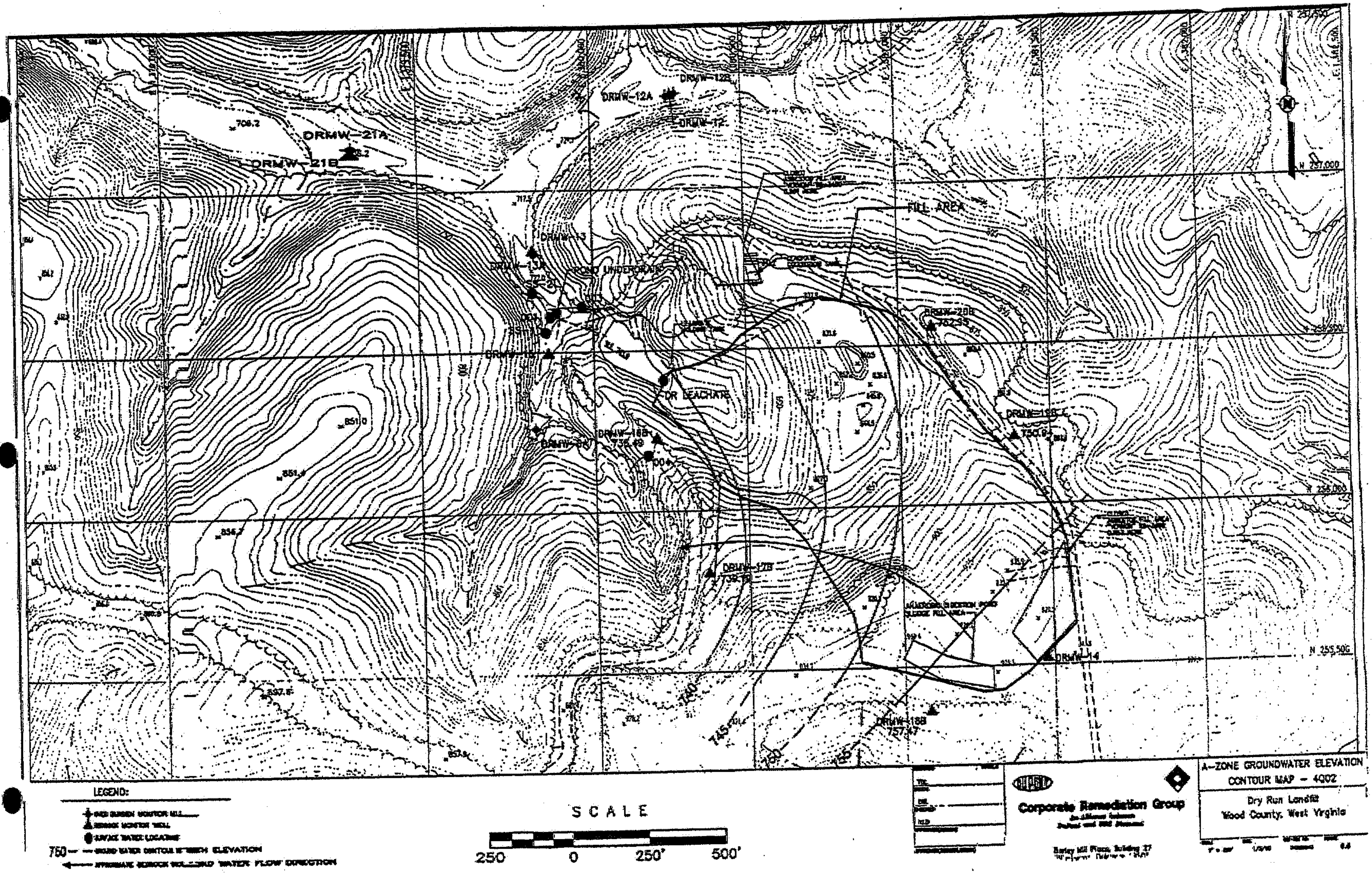
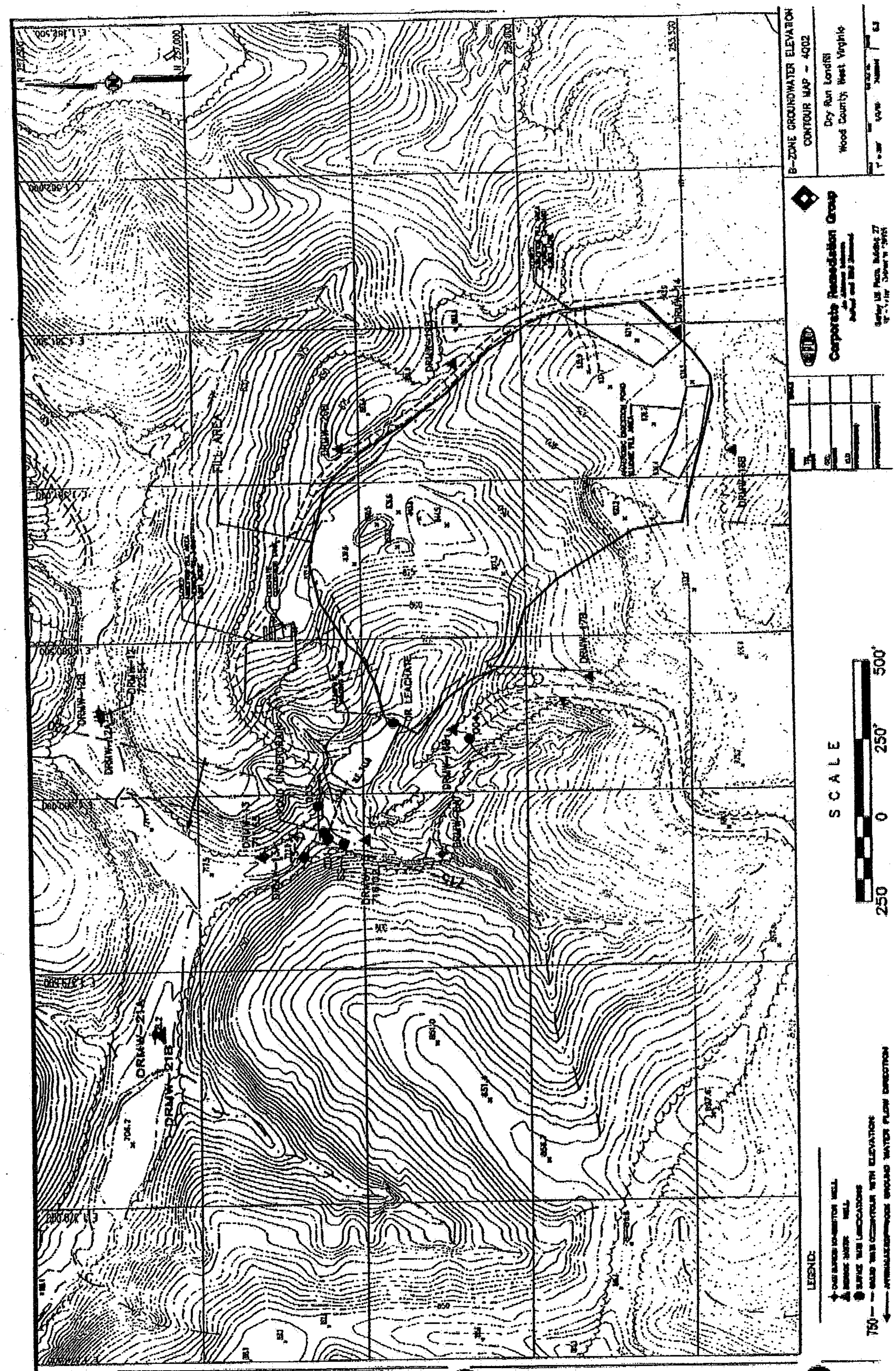


ASH021810

EID640042



ASH021811

EID640043