SECOND FIVE-YEAR REVIEW REPORT

FOR LAWRENCE TODTZ FARM SITE

CAMANCHE, IOWA

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LIST OF ACRONYMS

AR..... Administrative Record
ARARs ..... Applicable or Relevant and Appropriate Requirements
CAP..... Coalition Against Pollution
CD..... Consent Decree
CERCLA ..... Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS..... Comprehensive, Environmental Response, Compensation, and, Liability Information System
CFR.....Code of Federal Regulations
DOJ..... Department of Justice
EA..... Endangerment Assessment
EPA..... United States Environmental Protection Agency
HAL..... Health Advisory Level
IRIS ..... Integrated Risk Information System
µg/L..... Micrograms per liter
MCL.....Maximum Contaminant Level
MW..... Monitoring Well
NCP..... National, Oil, and Hazardous Substances Pollution Contingency Plan
NPL..... National Priorities List
NRL..... Negligible Risk Level
PZ..... Piezometer
PRP..... Potentially Responsible Parties
RBC..... Risk-Based Concentration
RD/RA ..... Remedial Design/Remedial Action
Rfd..... Reference Dose
RI/FS..... Remedial Investigation and Feasibility Study Report
ROD..... Record of Decision
TES..... Treatment Evaluation Study
THF..... Tetrahydrofuran
UHL..... University of Iowa Hygienics Laboratory

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1.0 INTRODUCTION

This report documents the second Five-Year Review conducted by the U.S. Environmental Protection Agency (EPA) at the Lawrence Todtz Farm landfill Site (alias DuPont Todtz Site) near Camanche, Iowa, to determine if the remedial response actions at that site remain protective of human health, welfare, and the environment. Section 121(c) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, and Section 300.430(f)(4)(ii) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) require that periodic (at least once every five years) reviews be conducted for sites where hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use or unrestricted exposure following the completion of all remedial actions (RAs) for the site. This review is required by statute. The purpose of these reviews is to determine the continued adequacy of the implemented RAs in providing protection of human health, welfare, and the environment. This is the second Five-Year Review for this site. The first Five-Year Review was completed on September 29, 1995.

The Five-Year Review is to be conducted by the lead agency, which is the EPA. at the Lawrence Todtz Farm landfill site. The review was conducted from September 1999 through September 2000. Technical support on this review was provided by Jacobs Federal Operations pursuant to the Response Action Contract (RAC). The first Five-Year Review is to be completed within five years of the start of actual onsite construction for the earliest R.A. Subsequent Five-Year Reviews should be signed no later than five years after the signature date of the previous Five-Year Review.

A significant volume of information on the site has been collected over the last five years. The EPA has considered all information in preparation of this review which includes, but is not limited to, the previous Five-Year Review report, annual sampling results, the Remedial Investigation/Feasibility Study (RI/FS), the Pre-Design Slurry Wall Report, and correspondence with the various parties involved with the response actions. A list of the principal documents used in this report are included at the end of the text and, while all of these documents are not referenced specifically, they were considered in the formation of the Five-Year Review.

2.0 SITE BACKGROUND

2.1 Site Location and History

The Lawrence Todtz Farm landfill site is located approximately one and one-half miles west of Camanche, Iowa. Camanche is located on the Mississippi River about two miles south of Clinton, Iowa, as indicated on Figure 2-1. The 2.7-acre DuPont impoundment is situated within a 12-acre parcel of land known as the Todtz Farm Landfill located on the 120-acre Todtz family farm (Figure 2-2).

Between 1959 and 1969, sand and gravel were mined from the 12-acre parcel of land. The mined area was used as a landfill for disposal of municipal refuse from 1969 to 1975. The

DuPont impoundment was constructed in the northwest corner of the Todtz Farm Landfill in 1971. An estimated 4300 tons of "wet-end" cellophane process wastes from DuPont's Clinton, Iowa, plant were disposed of in the impoundment between 1971 and its closure in 1975.

2.2 Regulatory History

The Lawrence Todtz Farm landfill site was identified as a potentially uncontrolled hazardous waste site and was proposed for the National Priorities List (NPL) in June 1986. On April 5, 1988, EPA entered into an Administrative Order on Consent with Potentially Responsible Parties (PRPs), DuPont. to perform an RI/FS for the site. The Consent Order was issued pursuant to Sections 104 and 122 of CERCLA, 42 U.S.C. §9604 and 9622. A summary of the results of this investigation and previous investigations was included in the REFS that was completed by the PRPs in August 1988. With this information and other documents available in the Administrative Record (AR) file, EPA issued the Record of Decision (ROD) for his site in November 1988. The selected remedy included the following major components:

- A 2-foot soil cover over the DuPont impoundment
- Access restrictions which included deed limitations and site fencing
- Site maintenance which includes mowing the grass and repairing the fence
- A groundwater monitoring system which includes implementation of further remedial actions if certain chemical specific action levels are exceeded
- Replacement of the Bark Residence drinking water well in the deeper bedrock aquifer

DuPont conducted the Remedial Design/Remedial Action (RD/RA) required by the ROD pursuant to a Consent Decree (CD) which was signed by EPA and DuPont on September 28, 1989, and lodged by the Department of Justice (DOJ) on December 28, 1989. After the public comment period the CD was entered by the Judge on November 6, 1990.

2.3 Community Relations Activities

The Lawrence Todtz Farm landfill site is located within one mile of the Chemplex Site (which is another Superfund site) and PCS Nitrogen (formerly Hawkeye Chemical and Arcadian), a fertilizer plant that has recently ceased operation. There are also numerous industries in the nearby cities of Clinton and Camanche and the local citizens have expressed concerns regarding potential pollution from these industries and the Superfund sites. As a result of public concern, several environmental groups including the Coalition Against Pollution (CAP) and Ducks Unlimited have become active.

A community relations plan was prepared by EPA during the RI/FS. As part of the ROD process, the public was given an opportunity to comment on EPA's preferred remedy in the Proposed Plan and to request a public meeting. The public did not request a public meeting or comment on the preferred remedy in the Proposed Plan.

The public, including several environmental groups (i.e., Ducks Unlimited and CAP), became very active in the environmental issues during the public comment period for the Lawrence Todtz Farm landfill site CD which commenced on December 28, 1989, and ended on February 20, 1990. Three public meetings were held during this time to discuss the site and other environmental issues in the community. The EPA received fourteen (14) comment letters regarding the proposed CD that were addressed prior to the entry of the CD.

In response to the community interest surrounding the Lawrence Todtz Farm landfill site and Chemplex Sites, the local companies, DuPont and Equistar, have formed community involvement groups to more effectively inform the local residents on the environmental status of the sites.

An EPA Fact Sheet was issued to concerned citizens, environmental groups, and the media prior to commencement of construction of the soil cover and groundwater monitoring system.

In November 1995, EPA issued a fact sheet and placed a notice in the Clinton Herald newspaper to announce that the first Five-Year Review was completed. The first Five-Year Review report was also placed in the site repository.

In June 1998, EPA issued additional fact sheets to the mailing lists for the Lawrence Todtz Farm landfill and Chemplex Sites. The mailing lists for each of these sites were compiled from citizens and media that have expressed concern in the past. The purpose of the fact sheets was to inform the local community that EPA continues to review all monitoring and progress reports for the sites to ensure that the remedies remain protective of human health and the environment. The EPA has not received any calls or correspondence in response to the fact sheets.

2.4 Site Characterization History

2.4.1 Hydrogeologic setting from the RI/FS

The information in this section was derived from the 1988 R1/FS prepared by DuPont.

A sand and gravel terrace associated with glacial outwash activity forms the natural uppermost unconfined aquifer around the site. Groundwater in this aquifer flows generally in a southeasterly direction toward the Mississippi River. The shallow surface water bodies (i.e., North Pond, South Pond, South Marsh, Murphy's Lake and Bandixen's Lake) near the site are hydraulically connected to this aquifer which is used as a source of drinking water by several private residences in the area. The hydraulic conductivity or the relative ability of the aquifer to produce water is relatively high at 1×10^{-2} centimeters per second (cm/s).

Underlying the outwash deposits is a sequence of fine-grained silt and clay deposits with interspersed lenses of silty and clayey very fine sands. The unit has been interpreted to be fluvial in origin. This deposit has been characterized as a confining unit or aquitard impeding the

vertical migration of site-related contamination to the underlying bedrock. These deposits thin to the east and west of the landfill and thicken toward the center. They appear to occupy a bedrock valley or depression. The surface of the deposit appears to be uniform, dipping slightly to the east to southeast. The dip could represent a former channel of the Mississippi River now occupied by the outwash deposits. Permeability tests conducted on this unit during the RI show a relatively low hydraulic conductivity of 10^{-7}cm/s.

Underlying the fine-grained silt and clay deposits is a dolomite and sandstone bedrock which also serves as a source of drinking water to local residents. The upper 10 feet of the dolomite is highly weathered and becomes more competent (less fractured) with depth. During the 1988 RI/FS, five deep soil borings were drilled at the site. These borings penetrated the low hydraulic conductivity layer and cored up to a maximum of 10 feet into the underlying dolomite bedrock. The rock cores revealed a high degree of weathering and fracturing in the upper portion of the bedrock aquifer which has been tilled with the overlying sediments. Figures 2-3, 2-4, and 2-5 are cross sections illustrating the site geology. Figure 2-6 identifies the transverse lines across the site for the cross-sections.

2.4.2 Site Contamination from the RI/FS

Sampling and analysis of soil and shallow groundwater conducted prior to and during the RI/FS concluded that concentrations of carbon disulfide, toluene, tetrahydrofuran (THF), arsenic, lead, and benzene were present in the impoundment above background concentrations. The location of monitoring wells is as indicated on Figure 2-7. The maximum concentrations identified in the groundwater immediately downgradient of the DuPont impoundment (in monitoring wells previously known as MW-3, MW-4, and MW-5 (as indicated on Figure 2-6), currently referred to as DU-08-S, DU-09-S, and DU-10-S, respectively) in the vicinity of the berm area and prior to initiation of the RA (i.e., reported in the 1988 RI/FS) are as follows: concentrations are reported in micrograms per liter (µg/L) or parts per billion (ppb).

- carbon disulfide 4,250
- toluene 8,400
- tetrahydrofuran 95,500
- arsenic 1,600
- lead 400
- benzene 209

2.5 Site Risks

During the RI phase, the PRPs prepared and submitted to EPA a "Draft Endangerment Assessment" (EA) for the purpose of evaluating the existing and potential impacts of the site on human health and the environment. One of the major objectives of the assessment was to assist

in identification of the principal routes of human and environmental exposure to site contaminants in order to focus the FS on remedial alternatives that would most effectively prevent or preclude adverse impacts.

The following conclusions were reached based on the exposure scenarios evaluated in the EA.

1. Risks to human health or the environment associated with direct contact and ingestion of surface soils or surface water downgradient of the impoundment appear to be below those used by EPA in determining whether human health or the environment are protected.
2. There would be an unacceptable risk to human health or the environment through ingestion of groundwater within the impoundment and at the impoundment berm.
3. Risks to human health or the environment through ingestion or direct contact with groundwater from the shallow aquifer at or near the southern or southeastern boundaries of the landfill site perimeter, (i.e., along Ninth Street) which is several hundred feet downgradient from the DuPont impoundment, appear to be below those used by EPA in determining whether human health or the environment are protected. Concentrations of 60 ug/L and 80 ug/L of arsenic have been detected at PZ-03 (near current perimeter well DU-02-S) on the eastern boundary of the landfill. The location of PZ-03 is indicated on Figure 2-6 and the location of monitoring well DU-02-S is indicated on Figure 2-7. These concentrations exceed the Maximum Contaminant Level (MCL) of 5O ug/L. However, there are no risks to human health or the environment in this portion of the site because the aquifer would not be considered a viable drinking water supply at this location.

The findings of the RI and the EA indicate that the DuPont impoundment is the probable source of the impoundment-related constituents THF, carbon disulfide and arsenic although arsenic is not known to have been used at the DuPont Clinton Plant and is not used in the cellophane manufacturing process.

3.0 REMEDIAL OBJECTIVES

Based on the findings of the RI and EA, the following are the remedial action objectives established in the 1998 FS for the DuPont impoundment:

- Subsurface Soil and Waste:

  "Protect human health and the environment by preventing direct contact with and future release of the contaminated subsurface soil and waste within the impoundment."

- Groundwater:

  "Protect human health and the environment by preventing direct contact with or ingestion of contaminated groundwater, minimizing further release of groundwater

contaminated with DuPont-related constituents at levels that present an unacceptable hazard to human health and the environment beyond the perimeter of the Todtz Farm Landfill."

Based on these objectives, the focus of the FS was on the development of cost-effective remedial actions for controlling the potential release of waste constituents from the impoundment.

Remedial alternatives were screened based on effectiveness, implementability, operation and maintenance efforts and costs, and capital costs. Excavation of the impoundment wastes and incineration, stabilization and in-situ treatment technologies were eliminated since they were not cost-effective based on the relatively low risk to public health and the environment and the large capital costs.

The EPA evaluated four basic alternatives and two variations for remediation of the DuPont impoundment. These alternatives were 1) no action, 2) soil cover, 3) geomembrane multi-layer cap, and 4) geomembrane-clay multi-layer cap with bentonite slurry wall. The alternative that was selected includes the following major components:

- A 2-foot soil cover over the DuPont impoundment;
- Access restrictions which include deed limitations and site fencing;
- Site maintenance which includes mowing, maintaining the vegetative cover and repairing the fence;
- A groundwater monitoring system which includes implementation of further remedial actions if certain chemical specific action levels are exceeded; and
- Replacement of the Bark residence drinking water well in the deeper bedrock aquifer.

4.0 SUMMARY OF RESPONSE ACTIONS

4.1 Access Restrictions

One of the components of the selected remedy was access restrictions which included a restrictive covenant on the deed for the property to prevent future development of the area without further RA or consideration of impacts to public health and the environment. The ROD also stated that the site would be placed on the Iowa State Registry of Hazardous Waste Sites.

The CD provided that the 12-acre Lawrence Todtz Landfill site property may be freely alienated, provided, that the deed or instrument of conveyance shall contain restrictions which run with the land. Those restrictions would: 1) preclude use of the impoundment property for any residential or agricultural purposes; 2) preclude use of the municipal landfill property for any residential or foodchain agricultural purposes; 3) prohibit the construction, installation, maintenance or use of any wells on the site for the purpose of extracting water for drinking or irrigation purposes; and 4) reserve such access as may be necessary to implement other components of the remedy. The

Site has not been sold, conveyed, transferred or otherwise alienated. However, detailed institutional controls apparently have not been filed with the county Recorder's Office.

The site was subsequently placed on the Iowa State Registry of Hazardous Waste Sites in February 1989. The use of a property on the Registry may not be substantially changed without written approval from the Iowa Department of Natural Resources (IDNR). Also such a property may not be sold, conveyed or transferred without IDNR written approval.

The site fence is described in the ROD as being installed a minimum of 10 feet outside of the perimeter of the impoundment to limit access by human or animal traffic to the source area. The fence is to include a locking gate to allow entry for regular maintenance, such as mowing or cover repair. The fence has been installed and is being maintained by DuPont pursuant to the requirements of the CD.

4.2 Non-Contingent Remedial Construction Activities

At the request of the Bark residents, DuPont replaced their drinking water supply well prior to finalization of the CD. The well was installed in September 1989 pursuant to a design that was approved by EPA.

DuPont commenced construction of the 2-foot soil cover and groundwater monitoring system in April 1991 and completed construction on July 29, 1991. The final inspection was conducted on July 31, 1991. Representatives of EPA and DuPont were present during the inspection.

4.3 Post-Construction Activities

In addition to the construction activities summarized in Section 4.2, the RA includes an extensive groundwater monitoring program to ensure protection of human health and the environment with chemical-specific action levels that trigger further RAs if any action levels are met or exceeded. Maintenance of the soil cover, fence, and monitoring well network is also required. DuPont is in the process of conducting these activities pursuant to the CD with EPA oversight.

4.3.1 Groundwater Monitoring Program Requirements

Monitoring of both the shallow glacial outwash aquifer and the bedrock aquifer is required pursuant to the CD. The CD designated "trigger wells" that will be sampled to determine if future RAs are necessary at the Lawrence Todtz Farm landfill site. There are also other monitoring wells at the site that have been previously sampled but are no longer required to be sampled in accordance with the CD.

The locations of the trigger wells are indicated on Figure 2-7. Groundwater samples are submitted for laboratory analysis for the list of analytes summarized on Table 4-1. The specific monitoring requirements are as follows:

The bedrock monitoring wells (including the James Bark residential well) were required to be sampled semiannually for two years following the completion of non-contingent RAs in July 1991. If no DuPont impoundment-related constituents are detected above background concentrations during this period, the wells were to be sampled every five years thereafter. Because no contaminants were detected in bedrock wells during the two years from July 1991 to April 1993, the bedrock wells were not sampled until April 1998. During the April 1998 sampling event, no DuPont impoundment-related constituents were detected above background. Therefore, the bedrock wells are not required to be sampled again until five years after the April 1998 sampling event which will be April 2003.

The shallow monitoring wells are required to be sampled at least semiannually for the first five years and annually thereafter for thirty years. The need to continue monitoring beyond this point will be evaluated at the corresponding statutory Five-Year Review. Sampling of these wells began in July 1991 and is continuing. According to the CD, the semiannual sampling continued at the site until September 1997. Currently, annual sampling is occurring at the site.

4.3.2 Contingent Further Remedial Action Requirements

Further remedial actions will be triggered in the event that the CD Table 1 or Table 2 Action Level concentrations for one or more trigger compounds at specific shallow monitoring wells (specified in Table 4-2, Table 4-3 respectively, and indicated on Figure 2-7) is met or exceeded (which will be verified by statistical analysis). If any of the Table 1 Action Level concentrations are met or exceeded, remediation of the impoundment will be performed. If any of the Table 2 Action Level concentrations are met or exceeded, remediation of the groundwater will be performed. Once groundwater remediation is triggered, groundwater cleanup levels will consist of all applicable state or federal cleanup standards for all DuPont-related constituents listed in Table 4-4. If the impoundment remediation has not been triggered at the time the Table 2 Action Level concentrations are met or exceeded, both the remediation of the impoundment and remediation of the groundwater will be performed at the same time.

Intermediate trigger levels were also established in the CD in order to provide a mechanism for conducting the planning and design functions prior to an Action Level exceedance. For example, if 50 percent of any Table 1 Action Level is met or exceeded, quarterly monitoring (as opposed to the required semiannual or annual monitoring) for that particular compound at the exceeded well will be conducted. If 80 percent of any Table 1 Action Level is met or exceeded, DuPont is required to submit a Treatment Evaluation Study (TES) to evaluate remedial options including a slurry wall around the impoundment as well as other treatment remedies. After completion of the TES, EPA was to decide whether the predesign of the selected remedy should be completed prior to a 100 percent Table 1 Action Level exceedance (refer to Section 5.3.4 for further discussion of the TES).

5.0 FIVE-YEAR REVIEW FINDINGS

5.1 ARARs Review

5.1.1 Background

The Five-Year Review includes a review of newly promulgated or modified requirements of federal and state environmental laws. These new laws are evaluated to determine whether they are applicable or relevant and appropriate requirements (ARARs) and whether they call into question the protectiveness of the response action selected in the ROD. The intent of the review is to evaluate whether the selected remedy remains protective of human health and the environment. Although ARARs are usually considered frozen as of the date of the ROD, if an evaluation in the light of the new laws concludes that the remedy is no longer protective of human health and the environment, it would be necessary to change the remedy to meet the new ARAR standards. The NCP provides:

> *Requirements that are promulgated or modified after ROD signature must be attained (or waived) only when determined to be applicable or relevant and appropriate and necessary to ensure that the remedy is protective of human health and the environment (NCP 40 CFR 300.430(f)(1)(ii)(03)(1).*

For the Lawrence Todtz Farm landfill site, the remedy as contained in the ROD included the following components: (1) replacement of a residential drinking water well, (2) an impoundment soil cover, (3) groundwater monitoring, and (4) two contingent operable units, one involving further impoundment containment and the other involving groundwater cleanup remediation. The two contingent operable units could be triggered by certain chemical concentration action levels of any of the four designated trigger compounds found in monitoring well samples: arsenic, hexavalent chromium, THF, and carbon disulfide (see Table 4-2 and Table 4-3). The ROD also specified the cleanup levels to be attained for the four compounds in the event that groundwater remediation is ever implemented (see Table 4-4). Since the groundwater cleanup remediation has not been triggered and is not being implemented, it may be premature to review groundwater cleanup levels for the groundwater extraction and treatment system. However, such numerical levels were defined in the ROD for this site.

A CD was negotiated for the performance of the RA at the site. The CD established cleanup levels for other chemical constituents in addition to the four that had been specifically mentioned in the ROD. The CD did not freeze the cleanup levels but recognized that MCLs and other cleanup standards might change in the future and allowed for the changed standards to be used as future cleanup levels.

The CD established MCLs as the cleanup levels to be attained in the event groundwater remediation is triggered. The CD also provided that "Settling Defendants shall extract groundwater until such time when all applicable state or federal cleanup standards are met for

DuPont impoundment-related constituents as listed in Table 3 (Table 4-4 of this report). In the absence of any other applicable cleanup standards, the work shall achieve compliance with all primary MCLs established under the Safe Drinking Water Act. The MCLs include the primary MCLs currently established at 40 C.F.R. Part 151, Subpart B and Part 143. The parties recognize that the MCLs established at the time of entry of this Decree may be changed in the future and that such future primary MCLs will constitute the clean-up level." (EPA CD, 1989). The Five-Year Review does not need to revisit and conduct an ARAR analysis for the additional requirements in the CD. It is the remedy as stated in the ROD which the Five-Year Review is required by statute and regulation to address.

5.1.2 New Laws Since the ROD

After the ROD was signed on November 4, 1988, the Iowa Environmental Protection Commission adopted "Rules for Determining Cleanup Actions and Responsible Parties" (Iowa Rules) (Iowa Admin. Code, Chapter 133) and the U.S. EPA adopted a number of new or modified MCLs. These new laws are evaluated in relation to the remedy selected in the ROD in this ARARs section of the Five-Year Review.

On August 16, 1989, the Iowa Environmental Protection Commission adopted the Chapter 133 of the Iowa Administrative Code. Provided below are the pertinent parts to these codes:

> Groundwater - The goal of groundwater cleanup is use of best available technology and best management practices as long as it is reasonable and practical to remove all contaminants, and in any event until water contamination remains below the action level for any contaminant, and the department determines that the contamination is not likely to increase and no longer presents a significant risk. Where site conditions and available technology are such that attainment of these goals would be impractical, the department may establish an alternative cleanup level or levels, including such other conditions as will adequately protect the public health, safety, environment, and quality of life [Iowa Admin. Code § 133.4(3)b.1].

The term "Action Level" is defined by the Iowa Rules as "the Health Advisory Level (HAL), if one exists; if there is no HAL, then the Negligible Risk Level (NRL), if one exists; if there is no HAL or NRL, then the MCL. A "HAL" is a lifetime health advisory level for a contaminant, established by the United States Environmental Protection Agency..." A "NRL" is the "negligible risk level for carcinogens established by the EPA..." If there is no HAL, NRL, or MCL, an action level may be established by the department based on current technical literature and recommended guidelines of EPA and recognized experts, on a case-by-case basis [Iowa Admin. Code § 133.2].

The Iowa "Acton Levels" and Iowa Rules should probably be considered ARARs particularly for the groundwater cleanup levels part of the remedy selected in the Lawrence Todtz Farm landfill

site. The Iowa "Action Levels," which are cleanup standards, would probably not be considered ARARs for purposes of reevaluating the protectiveness of the site trigger levels.

Also, after signature of the ROD, the EPA promulgated new or modified MCLs for a variety of contaminants. The MCL for total chromium changed; the MCL for arsenic remained the same. Generally, MCLs are considered ARARs in setting cleanup standards for groundwater that is usable for human consumption. The MCLs would probably not be considered ARARs for purposes of reevaluating the protectiveness of the trigger levels.

Table 4-1 lists the DuPont impoundment-related constituents agreed upon by the parties in the CD. Since its preparation for the CD in 1989, some of the values quoted in that table have changed. For example, the MCL for chromium is now 100 µg/L instead of 50, the MCL for toluene is now 1,000 µg/L instead of 2,000 µg/L. Antimony now has an MCL of 6 µg/L instead of a Reference Dose (Rfd) of 14 µg/L, beryllium now has an MCL of 4 µg/L instead of a Rfd of 175 µg/L, nickel now has an MCL of 100 µg/L instead of a Rfd of 700, and lead now has an Action Level at the tap of 15 µg/L instead of an MCL of 50 µg/L.

The CD requires that MCLs promulgated or modified after ROD signature shall be attained as cleanup standards in the event that groundwater remediation is triggered. The CD Performance Standards also sets out an elaborate hierarchy of potential sources of cleanup levels in order to assure that some appropriate contemporary standard will be available in the future. The numeric concentration values will be determined by whatever of the identified standards are in effect at the time. This moots the need to update the CD cleanup standards by means of an ARAR analysis.

5.1.3. Analysis of the Four Compounds Specified in the ROD

Out of the four compounds, only arsenic had an established MCL at the time of the ROD. The Lawrence Todtz Farm landfill site ROD considered the MCL an ARAR for determining completion of groundwater cleanup but not for setting action levels that would trigger the commencement of groundwater remediation, particularly in the causeway area of the site (The causeway area is located on the eastern boundary of the site, north of DU-02-S and south of DU-03-S as shown on Figure 2-7, adjacent to the Murphy property lake). In the event groundwater remediation is triggered, the arsenic MCL of 50 µg/L would be the cleanup level (EPA ROD, 1988). The ROD determined that the arsenic MCL was not applicable or relevant and appropriate in setting the arsenic action levels for the causeway between the municipal landfill of the Lawrence Todtz Farm landfill site and Murphy's Lake because the groundwater monitored there was not considered a viable water supply. The arsenic MCL is presently under review but it has not changed since the ROD. The MCL for arsenic remains at 50 µg/L. The Iowa Rule set up a hierarchy of sources for establishing cleanup levels in the definition of "Action Level." The Iowa Rules would use a HAL or a NRL as a cleanup level before it would use an MCL. The HAL and the NRL for arsenic may be concentrations that are lower than the MCL of 50 µg/L and consequently more protective. Neither the statute nor the NCP require the EPA, in its Five-Year

Review, to adopt a subsequently enacted ARAR that is the "more protective" or "most protective." The EPA considers MCLs, by definition, to be protective of human health and the environment. Since there has not been a change in MCL status, there is no reason to change the cleanup or trigger levels for arsenic.

For hexavalent chromium, at the time of the ROD there was no MCL specifically for hexavalent chromium but there was an MCL of 50 µg/L for total chromium which includes hexavalent chromium. The ROD used the total chromium MCL of 50 µg/L both as the trigger level for hexavalent chromium and as the chromium cleanup level (EPA ROD, 1988). The CD stated that the cleanup level for hexavalent chromium shall be the MCL (EPA CD, 1989). The CD Table 4-4, "DuPont impoundment related constituents to meet specified cleanup criteria upon completion of groundwater operable unit remediation" lists simply "chromium" rather than hexavalent chromium as the constituent to be cleaned up to the MCL which at the time was 50 µg/L. So, in the CD, the trigger levels are stated in terms of hexavalent chromium and the cleanup level is stated in terms of total chromium. An analytical level for total chromium includes both hexavalent and trivalent chromium. So the use of a total chromium level as a cleanup standard would assure that not only hexavalent chromium but also all types of chromium together are below the total chromium cleanup level.

Since the ROD, the MCL for total chromium has been increased from 50 µg/L to 100 µg/L. The protectiveness of a cleanup level which was 50 µg/L at the time of the ROD is not called into question by an increase to the present MCL of 100 µg/L. Consequently, there is no requirement to lower the ROD cleanup level or action level during the Five-Year Review in order to assure protectiveness of the remedy. The CD reaffirmed that the cleanup level would be the MCL and also allowed for future fluctuation of the value of the MCL such as the increase from 50 µg/L to 100 µg/L.

For carbon disulfide and THF, there have not been MCLs established. The definition of "Action Level" in the Iowa Rules includes not only MCLs but also "HALs" and "NRLs" as cleanup standards. However, the EPA has not established either an MCL or a HAL or NRL for either carbon disulfide or THF. The Iowa Rules would then revert to a case-by-case determination which is how the ROD and CD levels should be set for these two compounds.

Health-based standards in groundwater of 3,500 µg/L for carbon disulfide and 700 µg/L for THF respectively, were established for these compounds during the EA. The health-based standards developed during the EA and RI/FS were based on ingestion of the reference doses (Rfds) for these compounds. The Rfd is defined as an estimate of a daily exposure to the human population that is unlikely to result in appreciable risk of deleterious effects during a lifetime. The trigger levels set by the ROD for THF varied from 50 µg/L to 700 µg/L, depending on the location of the monitoring well and the contingent operable unit involved. The trigger levels set for carbon disulfide varied similarly from 250 µg/L to 3,500 µg/L.

Since the EA, a provisional risk-based concentration (RBC) has been calculated for THF in groundwater. Based upon new studies indicating the potential carcinogenic potency of THF at the 10^{-6}risk level, the provisional RBC for THF has been calculated at 2 ug/L. At the 10^{-4} risk level, the provisional RBC is 200 ug/L (EPA, 1997).

The health-based levels established during the EA were based on the Rfds for these two compounds. The Rfd for carbon disulfide has not changed. The Rfd for THF is currently under review. Since the last Five-Year Review, there is new information that indicates potential carcinogenicity of THF. During the EA, the safe level for THF was calculated to be 700 ug/L. The Table 1 Action Level of 50 ug/L was determined to be acceptable because it was less than 10 percent of the safe level of 700 ug/L. The provisional RBC, which was calculated with carcinogenic slope factors for the 10^{-4} to 10^{-6} risk range, is 2 to 200 ug/L. This new information has not been peer reviewed and, therefore, is not in EPA's Integrated Risk Information System (IRIS) database. Since this new information has not been peer reviewed, the provisional RBC is subject to change and will not be relied upon by EPA to change the Action Levels for THF. However, EPA will continue to monitor the toxicological research on this compound. If new values are finalized in the IRIS database, it may become necessary to change the Action Level prior to the next Five-Year Review.

5.2 Summary of Site Visits

In accordance with the CD, DuPont is required to maintain the security fence and soil cover at the Lawrence Todtz Farm landfill site. Oversight and inspections of PRP-lead site activities have been conducted by EPA since DuPont took the lead on these activities during the 1988 RI/FS. Oversight was conducted during the RA and the final inspection in 1991. The post RA monitoring began in July 1991 and involves semiannual sampling of shallow aquifer monitoring wells for five years, after which time the interval increases to annual monitoring. Deep or bedrock wells were sampled semiannually for two years, after which time the wells are required to be sampled every five years. Since the completion of the RA, EPA has conducted oversight, collected split samples from every sampling event, and has inspected the integrity of the soil cover. Photographs from previous site visits are included in Appendix B.

Sampling events at Lawrence Todtz Farm landfill site	
Date	Activities
July 1991	1st Semi-Annual Sampling Event
January 1992	2nd Semi-Annual Sampling Event
July 1992	3rd Semi-Annual Sampling Event
April 1993	4th Semi-Annual Sampling Event
October 1993	5th Semi-Annual Sampling Event
April 1994	6th Semi-Annual Sampling Event
October 1994	7th Semi-Annual Sampling Event
April 1995	8th Semi-Annual Sampling Event
October 1995	9th Semi-Annual Sampling Event
April 1996	10th Semi-Annual Sampling Event
September 1996	1st Annual Sampling Event
September 1997	2nd Annual Sampling Event
September 1998	3rd Annual Sampling Event
September 1999	4th Annual Sampling Event

5.2.1 April. June, and September 1996:

During the three 1996 sampling events, the soil cover was inspected for erosion damage and adequate vegetative cover; the fence surrounding the impoundment was inspected for damage and structural integrity. It was noted in April that burrowing animals caused minor damage to the soil cover, which was subsequently repaired. The impoundment cover remained in good condition and continued providing good vegetative cover. The integrity of the fence remained sound. No additional maintenance requirements were implemented.

5.2.2 September 1997:

The EPA performed a site visit in conjunction with the annual split sample collection in September 1997. During the September 1997 sampling event, the soil cover was inspected for erosion damage and adequate vegetative cover, and the fence surrounding the impoundment was inspected for damage and structural integrity. A number of holes, apparently caused by burrowing animals, were observed about 50 feet west of the eastern fence and along the western

perimeter, as was a 6- to 8-inch gap under the fence near monitoring well DU-08-S. It was noted at the end of 1996 that burrowing animals caused minor damage to the soil cover, and several fence posts along the eastern fence sustained damage due to erosion. Repairs to these defects were confirmed during the cover inspection. The impoundment cover remained in good condition and provided good vegetative cover. The cover was not inspected in December due to snow cover. The integrity of the fence remained sound.

5.2.3 September 1998:

The EPA performed a site visit in conjunction with the annual split sample collection in September 1998. Glacial outwash and bedrock monitoring wells were sampled as scheduled. The fence was in good shape except for the main gate and minor washouts. The vertical sliding bar of the main gate was out of alignment with the receiving pipe in the ground. Therefore, the only means of securing the gate was by wrapping the chain between the two swinging sections of the gate. The protective casing of monitoring well DU-09-S would not close due to ground heaving. DuPont also stated that the eroded area of the impoundment should be filled and re-seeded. The gate should be realigned to allow for proper closure of the vertical sliding bar. The casing around monitoring well DU-08-S should be repaired to allow for closure of the cover plate and locking of the protective casing. The EPA planned to continue the site inspection and collection of groundwater split samples in the future.

5.2.4 September 1999:

The EPA performed a site visit in conjunction with the annual split sample collection in September 1999. The monitoring wells were sampled as scheduled. During the September 1999 sampling event, the soil cover was inspected for erosion damage and adequate vegetative cover, and the fence surrounding the impoundment was inspected for damage and structural integrity. The entrance to the impoundment and the eastern fence area were muddy and devoid of vegetation. The grass on the cap was long and dry. Burrow holes and other surface imperfections were checked and no burrow holes or other surface imperfections were found. In September 1998, it was noted that the hinged cover plate of DU-08-S would not close. Repairs were made to the pad and cover; the cover plate is now secure and functional. Nails were observed to be protruding from the left door on the shed as a result of a missing decorative cross board. A shingle is also missing from the west overhang of the shed. The areas of exposed soil as mentioned above have been reseeded. Routine mowing and weed control will continue in 2000. Also, minor repairs to the storage building will be implemented in the fall of 2000.

In regard to response, monitoring, and maintenance, DuPont has incurred the following annual costs since the commencement of the RA:

Year	Cost
1991	$657,000
1992	$334,000
1993	$219,000
1994	$279,000
1995	$301,000
1996	$379,000
1997	$120,000
1998	$105,000
1999	$150,000

5.3 Groundwater Data Review

Groundwater monitoring pursuant to the CD has been conducted by DuPont with EPA oversight since July 1991. Monitoring was also conducted prior to 1991 during the RI/FS in 1988 and in 1989 and 1990. A summary of analytical results, including results above trigger levels is included in Tables 4-5 through 4-7. Some exceedances of 50 percent, 80 percent, and 100 percent of the THF and arsenic Table 1 Action Level have occurred in at least one trigger well and the discussion of these exceedances are as follows:

5.3.1 Results Through September 1995

THF was detected at a concentration of 41 µg/L in monitoring well DU-05-S, located hydraulically downgradient from the DuPont impoundment, during a routine semiannual groundwater sampling event conducted in April 1993. This value constituted an 80 percent exceedance of the Table 1 Action Level for THF which is 50 µg/L. Pursuant to the CD, verificaton of the 80 percent exceedance is the next required step. The verification process consists of obtaining quadruplicate samples from any wells that exceed 80 percent of a Table 1 Action Level. The samples are to be collected as soon as practicable after realizing the previous event yielded data which exceeded any established trigger levels.

DuPont conducted the 80 percent verification sampling in June 1993 and obtained the following quadruplicate results: 91 µ/L, 93 µg/L, 110 µg/L, and 110 µg/L. The June 1993 sampling data conclusively verified an 80 percent exceedance of the Table 1 Action Level for THF and, in addition, all of the verification samples exceeded the 100 percent Table 1 Action Level of 50 µg/L.

DuPont collected quadruplicate samples in August 1993 to verify the initial 100 percent exceedance of THF observed during the June 1993 event. The DuPont quadruplicate THF results for the August 1993 sampling event were as follows: 48 µg/L, 50 µg/L, 51 µg/L, and 51 µg/L. The August 1993 sample results indicated that the initial 100 percent exceedance was verified and that an 80 percent THF exceedance was verified for a second time.

The EPA split samples were obtained by a contractor during the August 1993 sampling event. The EPA samples were analyzed by the Region VII Laboratory and yielded the following THF results: 10 µg/L and 15 µg/L. The average value for the two EPA split samples was 12.5 µg/L. The EPA split samples did not confirm the 100 percent THF exceedance nor the initial 80 percent exceedance. The EPA's sampling results were substantially less than the results obtained by DuPont. Following an analysis of the data, it was determined that the two sets of values were statistically different or not from the sample population. The large data differences indicated that either the DuPont or the EPA results may not be valid. The incompatibility of the DuPont and the EPA data for the August 1993 event as well as the incompatibility of the DuPont data when compared to the June 1993 DuPont results indicated that the data were erratic. The June 1993 DuPont data represented a twofold increase over the prior April 1993 and subsequent August 1993 results.

The erratic nature of the data, coupled with the fact that only one well (DU-05-S) was yielding elevated results, led to the decision to collect additional EPA split samples during the routine semiannual sampling event in October 1993. Additionally, the observed exceedances occurred during the time period of the Midwestern flooding events of 1993. A large portion of the Lawrence Todtz Farm landfill site was flooded and certain wells, including monitoring well DU-05-S, were only accessible by boat. Since the site is located on terrace and flood plain deposits and is in close proximity to the Mississippi River, the wells in low lying areas had been constructed on artificial soil berms in order to avoid overtopping during a flood event. An additional factor in the decision to obtain more information by evaluating the October 1993 sampling event included the position of static water level in well DU-05-S. This was the only on-site monitoring well which had a water level that directly corresponded to the elevation of the surrounding ponded water. This fact indicates a more direct hydraulic relationship of this well to the shallow subsurface, which is in direct hydraulic communication with any ponded or surface water. This situation is most likely due to the position of the DU-05-S well screen being located at a very shallow depth.

DuPont conducted a semiannual groundwater sampling event in October 1993 which included quadruplicate sampling at well DU-05-S. The EPA personnel collected groundwater split samples which included a sample from monitoring well DU-05-S. The THF values for the quadruplicate DuPont samples and the EPA split sample for well DU-05-S were all at non-detect levels. The DuPont and the.EPA data for the October 1993 event, including the comparison of data from the other split samples from different wells, were in agreement. The October 1993 data indicated that there was no groundwater exceedance for any Action Level value mandated by the CD.

Pursuant to the CD, DuPont was required to sample DU-05-S on a quarterly basis for THF because there was an exceedance of at least 50 percent. The monitoring frequency for THF in that well would revert back to a semiannual basis only after four consecutive quarterly samples from that well indicate that no Table 1 compound is detected at 50 percent of the Table 1 Action Level concentrations.

During the January 1994 sampling event, THF was again non-detect in DU-05-S. However, in April 1994, THF was detected at concentrations of 34 µg/L, 37 µg/L, 38 µg/L, and 42 µg/L according to DuPont's results and at concentrations of 57 µg/L and 63 µg/L according to EPA's results. The EPA results indicated an 80 percent exceedance of the Table 1 Action Levels whereas DuPont's results did not. However, when the verification sampling took place in June 1994, THF was detected in DU-05-S at concentrations of 6.8 µg/L, 8.1 µg/L, 9.3 µg/L, and 12 µg/L according to DuPont's results and at concentrations of 14 µg/L and 15 µg/ L according to EPA's results. In October 1994, THF was not detected in DU-05-S according to DuPont's results. The EPA detected THF at a concentration of 31 µg/L. It is believed that this sampling result was probably related to cross-contamination and should be considered unreliable.

In January 1995, both DuPont's and EPA's results for THF in DU-05-S were non-detect. On April 25, 1995, another semiannual sampling event was conducted. The results of both EPA and DuPont were again non-detect for THF. Since four consecutive quarterly samples from DU-05-S indicated that no trigger compounds exceeded the 50 percent Table 1 Action Level concentrations, the monitoring frequency for this well reverted to semiannual sampling.

5.3.2 Last Five-Years Results in Trigger Wells

Of the four trigger compounds, only arsenic and THF were detected in the trigger wells above the 100 percent Table 1 Action Levels between April 1996 and September 1999. There were only two exceedances for THF and one for arsenic from the trigger wells. No exceedances for THF were detected in trigger well DU-05-S. THF was detected at a concentration of 340 µg/L on April 23, 1996, and 110 µg/L on September 24, 1997, at trigger well DU-04-S (Table 4-6). These concentrations exceeded the Table 1 Action Level of 100 µg/L for DU-04-S. The April 23, 1996, result of 340 µg/L for THF prompted quadruplicate sampling of this well on June 25, 1996. The highest concentration detected during the June sampling event was 3.5 µg/L for THF. This well was sampled again in September 24, 1996, and THF was detected at a concentration of 7.6 µg/L. Neither of these concentrations verified the April 23, 1996, 100 percent Table 1 Action Level exceedance for THF. Subsequent quadruplicate verification sampling occurred in December 1997 for the THF detected at 110 µg/L during the September 24, 1997, sampling event. Neither the DuPont nor the EPA sampling results were above the sample quantitation limit, thus failing to confirm the apparent 100 percent exceedance of the Table 1 Action Level.

Arsenic was detected at a concentration of 155 µg/L at trigger well DU-02-S (Table 4-5) which is above the 100 percent Table 1 Action Level of 125 µg/L on April 23, 1996. The 100 percent exceedance of the Table 1 Action Level prompted quadruplicate sampling at this well on

June 25, 1996. The highest arsenic result detected during the June sampling event was 19.5 µg/L. This well was again sampled on September 25, 1996, with an arsenic result of 49.8 µg/L. Neither of these concentrations verified the April 23, 1996, 100 percent Table 1 Action Level exceedance for arsenic of 155 µg/L and these results were below 50 percent of the Table 1 Action Level.

5.3.3 Last Five-Years Results in DuPont Impoundment Berm Wells

The September 1995 Five-Year Review noted elevated levels of three of the four imoundment-related constituents (arsenic, THF, and carbon disulfide) were observed in the impoundment berm wells, particularly DU-08-S and DU-10-S. Tables 4-5 through 4-7 summarize the detections including the last five years of annual sampling. Elevated concentrations of all three compounds continue to be detected in the impoundment berm wells.

Arsenic concentrations in DU-08-S appear to exhibit an increasing trend over time. In monitoring wells DU-09-S, arsenic concentrations increased to a high of 87.6 µg/L in April 1996 and have shown a decreasing trend since then. In DU-10-S, arsenic has historically been detected in concentrations ranging from 1,500 to 2,490 µg/L but appears to show a decreasing trend since September 1997.

THF concentrations in DU-08-S appear to show a slightly increasing trend over time. In DU-09-S, concentrations of THF have fluctuated erratically in the last five years from a low of 240 µg/L in September 1998 to a high of 1,800 µg/L in September 1999. In DU-10-S, the concentrations of THF had been fairly flat until September 1998 when there was a sharp increase and then a significant decrease in September 1999.

Carbon disulfide concentrations have shown an increase in DU-08-S from 65 µg/L in April 1996 to 5,000 µg/L in September 1999. In DU-09-S, carbon disulfide has not been detected. In DU-10-S, carbon disulfide showed a sharp increase from 1995 until September 1998 and then a significant decrease in September 1999.

The site-related contaminants detected in monitoring wells DU-08-S, DU-09-S, and DU-10-S (i.e., DuPont impoundment berm wells) indicate that contamination has migrated into the impoundment berm. It is worth noting that the trends and concentrations observed in the impoundment berm wells are not reflected in the downgradient trigger wells suggesting attenuation is occurring between the impoundment beret wells and the downgradient trigger wells.

5.3.4 Further Actions

Due to the verified 80 percent exceedance of THF in monitoring well DU-05-S in June 1993, DuPont was required by the CD to provide a draft TES (refer to Section 4.3.2 for previous discussion on the TES). The TES was submitted to the EPA on September 22, 1993. The EPA

provided comments to DuPont dated October 22, 1993. DuPont submitted a revised TES on December 6, 1993. Since the elevated THF levels were not confirmed during the October 1993 and January 1994 sampling events, EPA halted the schedule that included finalization of the TES and predesign activities. However, when elevated levels of THF were again detected in April 1994, the EPA decided that these activities should resume. In an October 21, 1994, letter to DuPont, the EPA requested that DuPont submit a Draft Project Operations Plan for Predesign Study. In a December 2, 1994, letter to EPA, DuPont agreed to submit the Draft Project Operations Plan which was submitted on April 12, 1995. The EPA submitted comments on the plan to DuPont dated May 17, 1995. According to the schedule in the CD, DuPont was required to conduct the predesign but would not be required to conduct the design or implement the remedy until there is a verified 100 percent exceedance of a Table 1 Action Level. As part of the predesign, DuPont conducted a geotechnical investigation of a potential slurry wall alignment in the fall of 1995. The results of the investigation were finalized in a 1996 report titled "Predesign Investigation Report Slurry Wall Design and Construction" prepared by DuPont Environmental Remediation Services (DERS).

5.3.5 University of Iowa Hygienics Monitoring Data

In addition to monitoring conducted by the EPA and DuPont, the University of Iowa Hygienics Laboratory (UHL) has conducted monitoring of the residential wells adjacent to both the Lawrence Todtz Farm landfill and Chemplex sites since 1990. Monitoring of the residential wells was originally on a quarterly basis until 1994 when the samples were collected on a semiannual basis in the spring and fall. Since 1997, the monitoring has been conducted on an annual basis. Table 5-1 lists the compounds that are routinely analyzed. The location of the residential wells is as indicated on the sampling location map (Figure 5-1).

There have been no exceedances of compounds analyzed by the UHL above human health criteria that can be attributed to the Lawrence Todtz Farm landfill site. Results for the latest sampling event conducted in May 1999 are provided in Appendix C and discussed in the following paragraph. Based on these sampling results, there are currently no residents known to be drinking groundwater with site-related contaminants.

Nitrates were detected in most of the residential wells. However, this compound is not a contaminant of concern at the Lawrence Todtz Farm landfill site. The nitrates are believed to be attributable to either agricultural practices or the PCS Nitrogen facility. Radon has been detected in a number of the residential wells and this contaminant is also believed to not be attributable to the site. Other contaminants detected in some of the residential wells in 1999 include lead, copper, zinc, and trichloroethylene (TCE). These contaminants are not believed to be major contaminants of concern at the site. Lead was detected at residential well location 56 on Figure 5-1 at a concentration of 0.14 parts per million, or milligrams per liter, or 140 µg/L, which is above the MCL of 50 µg/L. This location is hydraulically upgradient and; therefore, not attributable to the site. In the residential wells that contained copper, zinc, and TCE, all of the detections were below their corresponding MCLs.

The September 1995 Five-Year Review report discusses the detection of bis (2-ethylhexyl) phthalate in two of the residential wells. Based on followup sampling conducted after the detections, EPA believes that the DuPont impoundment is not the source of this contaminant. To EPA's knowledge, this contaminant has not been detected in any of the residential wells since the previous Five-Year Review.

5.3.6 Conclusions of Data Review

The discussion in Sections 5.3.1 and 5.3.2 indicates that THF concentrations in monitoring wells DU-04-S and DU-05-S and arsenic in monitoring well DU-02-S have shown periodic excursions above established trigger levels but concentrations decrease within a short time period. An evaluation of other impoundment-related constituents that have been detected at different monitoring wells during the course of the monitoring program also indicate periodic but temporary exceedences of trigger values. No clear patterns or trends are apparent in the trigger or impoundment monitoring wells.

The impoundment berm monitoring wells (DU-08-S, DU-09-S, and DU-10-S) are installed in the berm wall of the impoundment and indicate that constituents have migrated into the berm. The periodic occurrence of the impoundment constituents in the perimeter monitoring wells suggests some degree of leakage from the impoundment. However, there is no correlation between the observed trends in the berm wells and the sporadic detection of impoundment-related constituents in the perimeter wells and no indication that a constant release is occurring. Monitoring wells were not installed in the actual municipal landfill area due to the obvious hazards associated with directly drilling through a landfill. However, the presence of impoundment-related constituents in the berm wells as well as the periodic detection in the downgradient trigger wells suggests that the compounds may be present in the municipal landfill portion of the site.

5.4 Hydrogeologic Evaluation

5.4.1 New Information since the Last Five-Year Review

Based on previous sampling results and new data obtained from the 1996 DERS PreDesign Slurry Wall Report, several items of concern have come to light since the previous Five-Year Review report, which was finalized in September 1995. These items include the continuity of the low-hydraulic conductivity layer underlying the site, the potential impact this would have on the monitoring well network, and implications to the design of the slurry wall.

5.4.2 Low-Hydraulic Conductivity Layer

The continuity of the low-hydraulic conductivity layer underlying the site was evaluated during the RI and subsequent investigations. This layer has been described as a "thick sequence of fine-grained silt and clay deposits with interspersed lenses of silty and clayey very fine sands," which

may prevent or minimize the vertical migration of site-related contamination. The RI/FS performed in 1988 suggested that the low-hydraulic conductivity layer was relatively continuous across the site.

However, according to the 1996 DERS Report, in the southwestern portion of the DuPont impoundment, the clay confining unit is thin or absent. Figures 5-2 and 5-3 are from the 1996 DERS Report. Figure 5-2 indicates boring locations and Figure 5-3 indicates cross-section locations. Figure 5-4 is a conceptual model of the site which illustrates a profile of cross-section B-B' and the thinning of the clay confining unit. Logs of borings B-5, B-6, B-12, and B-13 are included in Appendix A. These borings which were advanced for the predesign slurry wall investigation indicate that the confining unit is very thin or absent near the extreme southwestern portion of the DuPont impoundment. Boring B-14, which was drilled within the southwestern portion of the DuPont impoundment just north of the presumed southern boundary, did not encounter the confining unit. Based on best historical information, B-14 may have been drilled through or near the haul road that provided access to the impoundment. It is presumed that the clay may have been excavated as part of the haul road construction. This raises a concern that there may be direct hydraulic communication between the upper glacial outwash shallow aquifer and the underlying bedrock aquifer. Since the new Bark's residential water supply well and other local residential wells are screened in the bedrock aquifer there is a concern that these receptors may be adversely affected by site-related contamination in the future.

5.4.3 Site Monitoring Well Network

The landfill perimeter monitoring well network present at the site was designed to monitor the potential migration of site-related contaminants. The previous geologic and hydrogeologic data along with contaminant distributions have been reviewed to determine if the monitoring well network is spatially distributed and screened vertically to detect site-related contamination. The adequacy of the monitoring well network is vital to meeting the requirements set forth in the CD. Specifically, trigger levels have been established for four contaminants of concern (i.e., tetrahydrofuran, chromium, arsenic, and carbon disulfide). Exceedances of the trigger levels for these four contaminants at the trigger wells require certain actions to be performed at the site. The actions to be performed are discussed in Section 4.3 of this report.

The EPA's evaluation of hydrogeologic information from the 1998 RI/FS, the 1996 DERS Report, and the annual and semiannual monitoring indicates the following facts:

- Eight borings have been drilled either along or close to the southern impoundment berm. Borings from the 1988 RI/FS and 1996 DERS Reports are included in Appendix A. The borings indeed show that definable clay is absent beneath the extreme southwestern corner of the impoundment and in at least one location (B 14) it appears that the base of the impoundment or the impoundment haul road is in contact with weathered bedrock. The fluvial clay is documented to be present to the north, east, and south of this area and attains considerable thickness in those directions. The bedrock boring logs note that the

upper few feet are highly weathered and that the weathered material (or overlying soils) have filled many of the fractures. The materials in the fracture have a silt-like consistency which would likely have a lower permeability than the sand and gravel outwash deposits and would probably impede the movement of water into the fractures.

- The fluvial clays occupying the bedrock valley serve as a confining layer separating the shallow outwash aquifer from the bedrock aquifer. Where the clay is absent and the outwash and bedrock units are in direct contact, they behave as a single aquifer under water table conditions. At the Todtz Farm landfill, this situation only occurs at the western most part of the facility along the Interstate Power access road which is along the wall of the buried bedrock valley. As described above and in the site reports, the majority of the landfill and the impoundment (except for the anomaly) are underlain by a thick sequence of fluvial clay and silt. In areas where the low permeability clay (hydraulic conductivity = 10^{-7} cm/sec) underlies the much higher permeability upper aquifer (hydraulic conductivity = 10^{-2} cm/sec), groundwater (and any contamination contained therein) will move preferentially and horizontally in the upper aquifer. In the southwest corner of the impoundment, where the clay is thin or absent, the outwash or outwash deposits overlie weathered bedrock. As described above, the weathered bedrock zone is expected to have lower permeability than the overlying outwash due to the fine-grained nature of the material filling the fractures. As in areas where outwash overlies the clay, groundwater will move preferentially in the higher permeability unit.

- In addition to the physical factors governing groundwater movement, all of the historic groundwater level data from nested well pairs completed in the bedrock and shallow aquifers show strong upward gradients from the bedrock to the shallow aquifer which provides the strongest evidence of the improbability of migration of impoundment fluids or contaminated groundwater from the shallow aquifer into the bedrock aquifer. Table 5-2 presents calculated vertical gradients for nested well pairs DU-02-S/D, DU-03-S/D, DU-06-S/D, and DU-07-S/D for static groundwater elevations collected in September and December 1997, September 1998, and September 1999. This information indicates that the static head of the bedrock wells is at least three feet higher than the static elevations in the shallow aquifer wells. This condition has been consistent since the bedrock wells were installed in 1991, indicating that the static elevations in the bedrock aquifer are under artesian conditions. The result of this condition is that vertical hydraulic gradients have been consistently strongly upward in all nested well pairs indicating flow potential from the bedrock to the shallow aquifer.

- Regarding the location and spatial distribution of the downgradient bedrock wells, EPA believes they are adequate given the size of the site and additional wells are not necessary. All of the downgradient bedrock wells plus the Bark well were installed in 1991. None of these wells shows the faintest indication of being impacted by either the landfill or the impoundment. Given that the impoundment has existed for at least 29 years and the fact that the Bark well, being an active pumping well, would intercept

contaminated groundwater, it is reasonable to assume that if bedrock contamination had occurred it would have been detected in at least one of these wells. The fact that there is no evidence of contamination indicates impoundment fluids are not contaminating the bedrock aquifer.

5.4.4 Protectiveness of Contingent Response Actions

Should verified exceedences of final Table 1 Action Levels be observed in the shallow trigger monitoring wells, the next level of response action would be a slurry wall and cap as specified in the CD. The DERS predesign investigations noted the thinning and apparent absence of clay in the southwest corner of the impoundment which raises concerns about the long-term effectiveness of this proposed remedy.

The slurry wall/cap remedy remains a viable option because proven pressure grouting technologies are available to seal the weathered bedrock anomaly present in the southwestern corner of the impoundment. This may require additional investigative work which would be required if Table 1 Action Levels are exceeded.

5.5 Access Restriction Review

Certain access restrictions such as placement of the site on the Iowa Registry of hazardous waste sites and site fencing have been implemented. However, review of information from the county Recorder's Office indicates that detailed institutional controls that would run with the land in the event that the property was ever sold or conveyed are not on file. In response to this, an Environmental Protection Easement and Declaration Restrictive Covenants document has been drafted in accordance with the recent EPA guidance on institutional controls to assure that the use restrictions which would run with the land are put in place. The attorneys for the parties are preparing the easement and declaration for filing with the Recorder's Office.

6.0 ASSESSMENT

The following conclusions support the determination that the remedy at the Lawrence Todtz Farm landfill site is expected to remain protective of human health and the environment.

Question A: Is the remedy functioning as intended by the decision documents?

The trigger wells established in the ROD and CD are located hydraulically downgradient of the DuPont impoundment and the municipal landfill. Monitoring wells installed downgradient of the municipal landfill also include deep wells that are installed in the upper bedrock zone in order to detect any vertical migration of constituents and evaluate the effectiveness of the intervening clay unit.

The ROD and CD envisioned a typical migrating groundwater plume scenario in which levels of constituents would steadily increase in concentration over time. The different trigger levels, and values assigned to them, were intended to provide an early warning system for a migrating plume. The early warning system would then allow sufficient time for the design and implementation of a remedy prior to experiencing substantial off-site releases. Even though the releases appear to be periodic rather than steady, the observed behavior of the releases suggests a fair degree of attenuation because higher concentrations have been shown to decline rapidly outside the impoundment. Data from the UHL also support the fact that local residents are not drinking groundwater contaminated with site-related contaminants.

As noted previously, one or more of the impoundment-related constituents (principally THF and, to a lesser extent, arsenic) have been detected sporadically in one or more of the landfill perimeter wells at concentrations that have exceeded intermediate and, in one instance, final trigger values. Each time, DuPont has implemented required response actions as mandated by the CD within the schedule mandated by the decree. In each case verification sampling has failed to demonstrate a continued exceedence of these trigger values and in accordance with the CD additional RAs have not been necessary.

While there is some uncertainty regarding the periodic appearance of impoundment-related constituents in the downgradient monitoring wells outside the berm, it can be concluded that the monitoring well network and the mandated response actions are functioning as originally intended and that the site remains in compliance with the ROD.

Question B: Are the assumptions used at the time of remedy selection still valid?

As discussed in Section 5, a provisional RBC has been proposed for THF, one of the main contaminants of concern. The new RBC is not peer reviewed; therefore, it is not in the IRIS database. Therefore, the RBC could change prior to being placed in the IRIS database. The EPA is reviewing and evaluating all data generated by DuPont and the UHL to ensure that the provisional RBC for THF is not exceeded. In fact, no THF has been detected in any residential well or monitoring well located downgradient of the impoundment berm since 1997. Because of this and the fact that the RBC could change before being listed in the IRIS database, EPA does not believe that the current trigger level for THF should be modified. If an RBC is listed in the IRIS database, even if this happens before the next Five-Year Review, the EPA will need to evaluate whether the trigger value for THF should be modified.

Regarding arsenic, the MCL has not changed since finalization of the ROD or CD. However, the MCL is currently under review and there is a possibility that the MCL could change in the future. If this happens, the EPA will need to evaluate whether the trigger value for arsenic should be modified. Currently, there are no residents known to have arsenic in their private wells.

Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

Information has come to light as documented by the 1996 DERS report that indicates that the clay layer underlying the site is not as thick or laterally continuous beneath the southwest comer of the impoundment as had originally been believed. The EPA has evaluated the potential impact that this could have on the bedrock aquifer and on future design of the slurry wall. A detailed discussion of EPA's evaluation is included in Section 5.4.

Regarding the potential impact to the bedrock aquifer, EPA believes that due to the thickness of clay in other directions from the anomaly, the strong upward hydraulic gradients from the bedrock to the shallow aquifer, close spacing of the downgradient bedrock monitoring wells, and lack of detections of contaminants of concern in the bedrock aquifer, that the remedy stated in the ROD remains protective of the bedrock aquifer. However, EPA believes that it is prudent to monitor the bedrock more frequently than every five years.

A slurry wall is required to be installed at the site if there is a verified 100 percent exceedance of a Table 1 Action Level. In the event that a slurry wall is required for the site, pressure grouting technologies would likely be needed to seal the weather fractured bedrock where the confining unit is absent in the southwest corner of the DuPont impoundment to allow for proper installation of the slurry wall.

7.0 STATEMENT OF PROTECTIVENESS

Based on the information contained herein, it is concluded that the remedy selected in the original ROD remains protective of human health and the environment. It is recommended that groundwater monitoring of the shallow aquifer and cover inspection continue at the frequency specified in the CD and accompanying support documents. The contingent response actions required by the ROD and CD should sustained trigger level exceedances occur will enhance the protectiveness of the remedy.

8.0 RECOMMENDATIONS

Currently, as directed in the CD, the bedrock trigger wells are being sampled once every five years. The discovery of the clay anomaly in the southwestern part of the impoundment has raised concerns about hydraulic connection between the upper and bedrock aquifers in this portion of the site. Although there is no evidence to suggest contamination has migrated into the bedrock aquifer and the probability of this occurring is considered to be remote, the EPA finds it necessary for DuPont to sample all monitoring wells annually, including the bedrock monitoring wells. In addition, EPA and IDNR will continue to provide oversight of the operation and maintenance activities required by the PRPs and their consultants. These activities should ensure

that any potential future migration of impoundment-related constituents will be identified and addressed prior to adversely impacting human health and the environment.

As stated in Section 5.5, an Environmental Protection Easement and Restrictive Covenants document that will assure the use restrictions will run with the land will be filed with the County Recorder's Office. The attorneys for the parties are in the process of preparing it to be filed with the Recorder's Office.

9.0 NEXT REVIEW

Since hazardous substances, pollutants, or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure, the EPA will conduct another statutory Five-Year Review in 2005. The review will be completed in September 2005.

10.0 REFERENCES

U.S. EPA, 1988. Record of Decision - DuPont Impoundment of the Todtz Farm Site, November 1988.

U.S. EPA, 1989. Consent Decree for the Remedial Action - Todtz Farm Site, Camanche, Iowa, September 1989.

U.S. EPA, 1995. Five-Year Review Report, DuPont/Todtz Site, September 1995.

U.S. EPA, 1997. Memorandum, Risk-Based Concentrations for Tetrahydrofuran in Groundwater, December 17, 1997.

CH2M Hill, 1988. Remedial Investigation Report, Lawrence Todtz Farm Landfill NPL Site, August 1988.

CH2M Hill, 1997. Annual Long-term Groundwater Monitoring Report - DuPont Impoundment Operable Unit 1996, Lawrence Todtz Farm Landfill NPL Site, January 1997.

CH2M Hill, 1998. Annual Long-term Groundwater Monitoring Report - DuPont Impoundment Operable Unit 1997, Lawrence Todtz Farm Landfill NPL Site, February 1998.

CH2M Hill, 1999. Annual Long-term Groundwater Monitoring Report - DuPont Impoundment Operable Unit 1998, Lawrence Todtz Farm Landfill NPL Site, January 1999.

DuPont Environmental Remediation Services, 1996. Pre-Design Investigation Report Slurry Wall Design and Construction, Lawrence Todtz Farm Landfill, NPL Site, July 1996.

TABLES

Table 4-1 List of Analytes Groundwater Monitoring Program Requirements		
Volatile Organic Compounds	2-Chloroethylvinylether	Iron
	Bromoform	Lead
Tetrahydrofuran	4-Methyl-2-Pentanone	Magnesium
Chloromethane	2-Hexanone	Manganese
Bromoethane	Tetrachloroethene	Mercury
Vinyl Chloride	1, 1, 2, 2-Tetrachloroethene	Molybdenum
Chloroethane	Toluene	Nickel
Methylene Chloride	Chlorobenzene	Potassium
Acetone	Ethylbenzene	Selenium
Carbon Disulfide	Styrene	Silver
1, 1-Dichloroethene	Total Xylenes	Sodium
1, 1-Dichloroethane	**Semi-Volatile Organic Compounds**	Thallium
Trans-1, 2-Dichloroethene		Titanium
Chloroform	Total Phenol	Vanadium
1,2-Dichloroethane	(See Note 4)	Zinc
2-Butanone	**Inorganic Compounds**	**Miscellaneous WaterQuality Parameters**
1, 1, 1-Trichloroethane		
Carbon Tetrachloride	Aluminum	Sulfate
Vinyl Acetate	Antimony	Sulfide
Bromodichloromethane	Arsenic	Chloride
1, 2-Dichloropropane	Barium	Total Organic Carbon
Trans-1, 3-Dichloropropene	Beryllium	Total Organic Halogen
Trichloroethene	Cadmium	**Field Parameters**
Dibromochloromethane	Calcium	
1, 1, 2-Trichloroethane	Chromium	Temperature
Benzene	Cobalt	Conductivity
Cis-1, 3-Dichloropropene	Copper	pH

Notes:
1. Shallow wells to be sampled on semi-annual basis for first five years, annually thereafter for 30 years, and reevaluated on a five year basis.
2. Bedrock wells to be sampled semi-annually for first two years and once every five years thereafter unless an exceedance above background is detected.
3. Exceedance of 50% of a trigger level will result in quarterly monitoring.
4. Exceedance of 80% of a level two (2) trigger level will result in monitoring of shallow wells for U. S. EPA Target Compound List semi-volatile organic compounds.

TABLE 4-2

Table 1
ACTION LEVEL 1: CONCENTRATION LIMITS
TODTZ FARM LANDFILL NPL SITE

Action Level 1 Compounds	Action Level 1 Concentration Limits (µg/l) DU-04-S	Perimeter Wells (*)
Carbon Disulfide	500	250
Tetrahydrofuran	100	50
Chromium (VI)	100	50
	DU-02-S/DU-03-S	DU-06-S/DU-07-S
Arsenic	125	50

* DU-02-S, DU-03-S, DU-05-S. DU-06-S, DU-07-S

TABLE 4-3

Table 2
ACTION LEVEL 2: CONCENTRATION LIMITS
TODTZ FARM LANDFILL NPL SITE

Action Level 2 Compounds	Action Level 2 Concentration Limits (µg/1) DU-04-S	Perimeter Wells (*)
Carbon disulfide	3,500	1,750
Tetrahydrofuran	700	350
Chromium (VI)	------	50

	DU-02-S/DU-03-S	DU-06-S/DU-07-S
Arsenic	250	75

* DU-02-S, DU-03-S, DU-05-S, DU-06-S, DU-07-S

Table 4-4
Consent Decree Cleanup Criteria for Groundwater Operable Unit Remediation

Volatile Organic Compounds	Health Based Standard (µg/l)	Standard Type	Source	Note
Benzene	5	MCL	SDWA	(1)
Ethylbenzene	700	MCL	SDWA	(2)
Tetrachloroethylene	5	MCL	SDWA	(2)
Toluene	2000	MCL	SDWA	(2)
Carbon disulfide	3500	Rfd	IRIS	(3)
2-Butanone (MEK)	1750	Rfd	IRIS	(3)
Vinyl acetate	--	--	--	--
2-Hexanone	--	--	--	--
4-Methyl-2-pentanone (M1BK)	17500	Rfd	IRIS	(3)
Xylenes	10000	MCL	SDWA	(2)
Tetrahydrofuran	700	Rfd	IRIS	(3)
Acid Extractable Parameters				
Phenol	1400	Rfd	IRIS	(3)
2-Methylphenol	17500	Rfd	IRIS	(3)
4-Methylphenol	17500	Rfd	IRIS	(3)
Benzoic Acid	140000	Rfd	IRIS	(3)
Metals				
Antimony	14	Rfd	IRIS	(3)
Arsenic	50	MCL	SDWA	(1)
Barium	1000	MCL	SDWA	(1)
Beryllium	175	Rfd	IRIS	(3)
Chromium	50	MCL	SDWA	(1)
Cobalt	--	--	--	--
Lead	50	MCL	SDWA	(1)
Nickel	700	Rfd	IRIS	(3)
Vanadium	245	Rfd	HEAST	(4)

Notes:
(1) - Final Maximum Contaminant Level for drinking water as established by the Safe Drinking Water Act (SDWA)
(2) - Proposed Maximum Contaminant Level for drinking water as established by the Safe Drinking Water Act
(3) - Risk based concentrations based on verified reference doses (Rfds) derived from toxicity values listed on U.S. EPA's Integrated Risk Information System (IRIS)
(4) - Risk based concentrations based on verified reference doses (Rfds) derived from toxicity values listed on U.S. EPA's Office of Research and Development Health Effects Assessment Summary Tables (HEAST)

Table 4-5
Todtz Farm Landfill Site
Camanche, Iowa
Arsenic in Groundwater (µg/L)

Well	03/07/88 03/08/88 03/09/88	03/28/88 03/29/88	06/19/89 06/20/89	06/28/89	10/02/90	07/30/91 07/31/91	01/29/92 01/30/92	03/18/92	07/28/92 07/29/92	04/27/93	06/08/93	08/18/93	10/12/93	01/26/94	04/25/94	06/29/94	10/04/94	01/24/95	04/25/95	10/11/95	04/23/96	06/25/96	09/25/96	09/24/97	12/09/97	09/15/98	09/29/99
DU-01-S	ND	NA	NA	NA	NA	33	5.5	NA	1.31	ND	NA	NA	3.9	NA	ND	NA	4.6	NA	ND	ND	ND	NA	3.1	ND	NA	ND	ND
DU-02-S	84 a	60	50	30	41.3	41	29	NA	28.8	29	NA	NA	27.2	27.2	24.5	34.5	52.6	NA	33.4	50.9	155 c	19.5	49.8	53	NA	ND	54
DU-03-S	NA	NA	40	NA	34.8	42	20	ND	30.5	16	NA	NA	37.9	17.6	22.1	36	42.6	NA	25.9	42.8	42.8	NA	47.2	55	NA	54	46
DU-04-S	ND	1	2	NA	5.8	6	4.7	NA	3.16	3.8	NA	NA	7.4	3.8	3.1	2.5	5.1	NA	2.7	3.7	4	NA	7	ND	ND	ND	ND
DU-05-S	NA	2	ND	NA	1.6	2.7	ND	NA	ND	ND	ND	ND	2.5	2	ND	ND	ND	ND	ND	1.8	3.1	NA	4.1	ND	NA	ND	ND
DU-06-S	ND	9	6	NA	14.8	9.8	9	NA	7.02	3.6	NA	NA	11.3	5.8	5	8	9.3	NA	9.5	12.1	15.8	NA	15.6	16	NA	18	13
DU-07-S	ND	1	ND	NA	2.1	2.7	14	NA	8.19	3.9	NA	NA	9.8	4.5	3.6	2.2	ND	4	19.4	5.3	4	NA	9.9	ND	NA	ND	ND
DU-08-S	90	60	NA	NA	NA	130	430	NA	131	119	NA	NA	300	NA	326	NA	185	NA	231	387	185	NA	386	430	NA	270	430
DU-09-S	ND	22	NA	NA	NA	17	NA	NA	33.9	41.1	NA	NA	12.6	NA	34.5	NA	20.5	NA	55.1	22.9	87.6	NA	54.1	22	NA	24	21
DU-10-S	1600	1500	NA	NA	NA	2490	2350	NA	2400	1980	NA	NA	1640	NA	1980	NA	1680	NA	1730	1620	1770	NA	1550	2000	NA	1600	570

ND = Below the sample quantitation limit
NA = Not applicable
* = Signifies Trigger Well

Trigger Levels (Action Level 1/Action Level 2)	DU-02-S	DU-03-S	DU-04-S	Perimeter Wells **
Carbon Disulfide			500/3,500	250/1,750
THF			100/700	50/350
Chromium (VI)			100/--	50/50
Arsenic	125/250	125/250		50/75

a = Level 1 50% exceedance
b = Level 1 80% exceedance
c = Level 1 100% exceedance

**DU-02-S, DU-03-S, DU-05-S, DU-06-S, DU-07-S

Table 4-6
Todtz Farm Landfill Site
Camanche, Iowa
Tetrahydrofuran in Groundwater (µg/L)

Well	03/07/88 03/08/88 03/09/88	03/28/88 03/29/88	06/19/89 06/20/89	06/28/89	10/02/90	07/30/91 07/31/91	01/29/92 01/30/92	03/18/92	07/28/92 07/29/92	04/26/93 04/27/93	06/08/93	08/18/93	10/12/93	01/26/94	04/25/94	06/29/94	10/04/94	01/24/95	04/25/95	10/11/95	04/23/96	06/25/96	09/25/96	09/24/97	12/09/97	09/15/98	09/29/99
DU-01-S	ND	ND	NA	NA	NA	ND	ND	NA	ND	ND	NA	NA	ND	NA	ND	NA	ND	NA	ND	ND	ND	NA	ND	ND	NA	ND	ND
DU-02-S	ND	ND	ND	ND	ND	14.5	ND	NA	ND	ND	NA	NA	ND	ND	ND	ND	4.6	NA	ND	ND	ND	NA	ND	ND	NA	ND	ND
DU-03-S	NA	NA	ND	NA	15	ND	43 b	10	ND	10	NA	NA	ND	ND	ND	ND	2.4	NA	11	ND	ND	NA	ND	ND	NA	ND	ND
DU-04-S	ND	ND	ND	NA	ND	ND	ND	NA	11	ND	NA	NA	ND	ND	20	36	22	NA	10	21	340 c	3.5	7.6	110 c	ND	ND	ND
DU-05-S	NA	ND	ND	NA	ND	ND	ND	NA	ND	41 b	110 c	51 c	ND	ND	42 b	12	ND	ND	ND	ND	ND	NA	ND	ND	NA	ND	ND
DU-06-S	ND	ND	ND	NA	ND	ND	ND	NA	ND	ND	NA	NA	ND	ND	ND	ND	ND	NA	ND	ND	38 a	ND	ND	ND	NA	ND	ND
DU-07-S	ND	ND	ND	NA	ND	15.2	ND	NA	ND	ND	NA	NA	ND	ND	22	4.1	ND	NA	7.3	ND	18	NA	ND	ND	NA	ND	ND
DU-08-S	ND	74000	NA	NA	NA	15800	7140	NA	17000	12000	NA	NA	45000	NA	46000	NA	54000	NA	41000	39000	19000	NA	50000	29000	NA	29000	49000
DU-09-S	56300	85900	NA	NA	NA	9700	1040	NA	950	260	NA	NA	280	NA	350	NA	540	NA	120	300	260	NA	620	1000	NA	240	1800
DU-10-S	ND	ND	NA	NA	NA	428	300	NA	340	190	NA	NA	240	NA	290	NA	560	NA	190	180	170	NA	200	100	NA	3000	ND

ND = Below the sample quantitation limit
NA = Not applicable
* = Signifies Trigger Well

Trigger Levels (Action Level 1/Action Level 2)	DU-02-S	DU-03-S	DU-04-S	Perimeter Wells **
Carbon Disulfide			500/3,500	250/1,750
THF			100/700	50/350
Chromium (VI)			100/--	50/50
Arsenic	125/250	125/250		50/75

a = Level 1 50% exceedance
b = Level 1 80% exceedance
c = Level 1 100% exceedance

**DU-02-S, DU-03-S, DU-05-S, DU-06-S, DU-07-S

Table 4-7
Todtz Farm Landfill Site
Camanche, Iowa
Carbon Disulfide in Groundwater (µg/L)

Well	03/07/88 03/08/88 03/09/88	03/28/88 03/29/88	06/19/89 06/20/89	06/28/89	10/02/90	07/30/91 07/31/91	01/29/92 01/30/92	03/18/92	07/28/92 07/29/92	04/27/93	06/08/93	08/18/93	10/12/93	01/26/94	04/25/94	06/29/94	10/04/94	01/24/95	04/25/95	10/11/95	04/23/96	06/25/96	09/25/96	09/24/97	12/09/97	09/15/98	09/29/99
DU-01-S	ND	ND	NA	NA	NA	ND	ND	NA	ND	ND	NA	NA	ND	NA	NA	NA	ND	NA	ND	ND	3	ND	ND	ND	NA	ND	ND
DU-02-S	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	NA	NA	ND	ND	ND	ND	5.8	NA	ND	ND	ND	NA	ND	ND	NA	ND	ND
DU-03-S	NA	NA	ND	NA	3	ND	NA	8	ND	ND	NA	NA	ND	ND	ND	ND	ND	NA	ND	ND	2.1	NA	ND	ND	NA	ND	ND
DU-04-S	ND	ND	ND	NA	ND	ND	ND	NA	ND	ND	NA	NA	ND	ND	ND	ND	ND	NA	ND	ND	ND	NA	ND	ND	ND	ND	ND
DU-05-S	NA	ND	ND	NA	ND	ND	ND	NA	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND	NA	ND	ND
DU-06-S	ND	ND	ND	NA	ND	ND	ND	NA	ND	ND	NA	NA	ND	ND	ND	ND	ND	NA	ND	ND	0.84	NA	ND	ND	NA	ND	ND
DU-07-S	ND	ND	ND	NA	ND	ND	ND	NA	ND	ND	NA	NA	ND	ND	ND	ND	ND	NA	ND	ND	ND	NA	ND	ND	NA	ND	ND
DU-08-S	1120	749	NA	NA	NA	ND	27	NA	76	52	NA	NA	370	NA	ND	NA	180	NA	360	160	65	NA	470	630	NA	1300	5000
DU-09-S	ND	ND	NA	NA	NA	ND	ND	NA	ND	ND	NA	NA	ND	NA	ND	NA	ND	NA	ND	ND	ND	NA	ND	ND	NA	ND	ND
DU-10-S	4250	2350	NA	NA	NA	55	ND	NA	ND	16	NA	NA	13	NA	ND	NA	39	NA	9	68	150	NA	1500	17000	NA	20000	5800

ND = Below the sample quantitation limit
NA = Not applicable
* = Signifies Trigger Well

Trigger Levels (Action Level 1/Action Level 2)	DU-02-S	DU-03-S	DU-04-S	Perimeter Wells **
Carbon Disulfide			500/3,500	250/1,750
THF			100/700	50/350
Chromium (VI)			100/--	50/50
Arsenic	125/250	125/250		50/75

a = Level 1 50% exceedance
b = Level 1 80% exceedance
c = Level 1 100% exceedance

**DU-02-S, DU-03-S, DU-05-S, DU-06-S, DU-07-S

TABLE 5-1
UNIVERSITY OF IOWA HYGIENIC LABORATORY
ANALYTICAL PARAMETERS

GC/MS VOLATILES

ANALYTE	DETECTION LIMIT - µg/L
Acetone	5
Carbon disulfide	5
Methyl ethyl ketone	5
Tetrahydrofuran	5

VOLATILE ORGANIC ANALYSIS

ANALYTE	DETECTION LIMIT - µg/L
Benzene	0.5
Toluene	0.5
Ethylbenzene	0.5
Total Xylenes	0.5
Methylene chloride	0.5
1,1-Dichloroethylene	0.5
Trichloroethylene	0.5
Tetrachloroethylene	0.5

GC/MS EXTRACTABLES

ANALYTE	DETECTION LIMIT - µg/L
Phenol	5
4-Methylphenol	5
bis (2-Ethylhexyl) phthalate	10

TABLE 5-1 (cont.)

RADIOCHEMISTRY

ANALYTE	UNITS IN pCi/L
Radon-222	

INORGANIC CHEMISTRY

ANALYTE	UNITS
Laboratory pH	pH Units
Specific Conductance	umhos/cm
Total Alkalinity	mg/L as CaC03
Total Hardness	mg/L as CaC03
Total Disolved Solids	mg/L
Sodium	mg/L
Chloride	mg/L

INORGANIC CHEMISTRY

ANALYTE	DETECTION LIMIT - mg/L
Total Organic Carbon	1 mg/L
Arsenic	.01 mg/L
Beryllium	.02 mg/L
Chromium	.O1 mg/L
Lead	.01 mg/L

Description of units used within this report

µg/L - Micrograms per Liter
pCi/L - PicoCuries per Liter
mg/L as CaC03 - Milligrams per Liter as Calcium Carbonate
mg/L - Milligrams per Liter
pH Units - pH Units
umhos/cm - Micromhos per Centimeter
Detection Limit - Lowest concentration reliably measured

Table 5-2
Vertical Hydraulic Gradients Between Bedrock and Overburden Aquifers
Lawrence Todtz Farm Landfill NPL Site

September 1997

Shallow Well	Top of Riser Elev. (ft)	Top of Screen Elev. (ft)	Bottom of Screen Elev. (ft)	Mid-Screen Elev. (ft)	GW Elev. (ft)	Deep Well	Top of Riser Elev. (ft)	Top of Screen Elev. (ft)	Bottom of Screen Elev. (ft)	Mid-Screen Elev. (ft)	GW Elev. (ft)	Difference between Statics (ft)	Vertical Hydraulic Gradient[1]
DU-01-S	594.58	587.16	594.58	590.88	dry	DU-01-D	594.37	465.37	459.87	462.62	587.25	--	--
DU-02-S	590.79	578.09	590.79	584.44	581.55	DU-02-D	590.34	478.84	473.34	476.09	585.64	4.09	0.0377
DU-03-S	587.61	580.61	587.61	584.11	580.66	DU-03-D	587.90	455.70	450.30	453.00	586.20	5.54	0.0423
DU-06-S	604.23	575.23	604.23	589.73	576.64	DU-06-D	604.98	487.48	481.98	484.73	583.00	6.36	0.0606
DU-07-S	598.36	583.46	573.46	578.46	577.76	DU-07-D	602.45	536.95	531.45	534.20	583.56	5.80	0.1310

December 1997

Shallow Well	Top of Riser Elev. (ft)	Top of Screen Elev. (ft)	Bottom of Screen Elev. (ft)	Mid-Screen Elev. (ft)	GW Elev. (ft)	Deep Well	Top of Riser Elev. (ft)	Top of Screen Elev. (ft)	Bottom of Screen Elev. (ft)	Mid-Screen Elev. (ft)	GW Elev. (ft)	Difference between Statics (ft)	Vertical Hydraulic Gradient[1]
DU-01-S	594.58	587.16	594.58	590.88	dry	DU-01-D	594.37	465.37	459.87	462.62	586.86	--	--
DU-02-S	590.79	578.09	590.79	584.44	581.58	DU-02-D	590.34	478.84	473.34	476.09	585.44	3.86	0.0356
DU-03-S	587.61	580.61	587.61	584.11	580.73	DU-03-D	587.90	455.70	450.30	453.00	583.79	3.06	0.0233
DU-06-S	604.23	575.23	604.23	589.73	576.67	DU-06-D	604.98	487.48	481.98	484.73	582.81	6.14	0.0585
DU-07-S	598.36	583.46	573.46	578.46	578.76	DU-07-D	602.45	536.95	531.45	534.20	583.25	4.49	0.1014

September 1988

Shallow Well	Top of Riser Elev. (ft)	Top of Screen Elev. (ft)	Bottom of Screen Elev. (ft)	Mid-Screen Elev. (ft)	GW Elev. (ft)	Deep Well	Top of Riser Elev. (ft)	Top of Screen Elev. (ft)	Bottom of Screen Elev. (ft)	Mid-Screen Elev. (ft)	GW Elev. (ft)	Difference between Statics (ft)	Vertical Hydraulic Gradient[1]
DU-01-S	594.58	587.16	594.58	590.88	dry	DU-01-D	594.37	465.37	459.87	462.62	589.69	--	--
DU-02-S	590.79	578.09	590.79	584.44	582.33	DU-02-D	590.34	478.84	473.34	476.09	586.79	4.46	0.0412
DU-03-S	587.61	580.61	587.61	584.11	578.53	DU-03-D	587.90	455.70	450.30	453.00	586.32	7.79	0.0594
DU-06-S	604.23	575.23	604.23	589.73	577.91	DU-06-D	604.98	487.48	481.98	484.73	585.20	7.29	0.0694
DU-07-S	598.36	583.46	573.46	578.46	579.24	DU-07-D	602.45	536.95	531.45	534.20	585.86	6.62	0.1496

September 1999

Shallow Well	Top of Riser Elev. (ft)	Top of Screen Elev. (ft)	Bottom of Screen Elev. (ft)	Mid-Screen Elev. (ft)	GW Elev. (ft)	Deep Well	Top of Riser Elev. (ft)	Top of Screen Elev. (ft)	Bottom of Screen Elev. (ft)	Mid-Screen Elev. (ft)	GW Elev. (ft)	Difference between Statics (ft)	Vertical Hydraulic Gradient[1]
DU-01-S	594.58	587.16	594.58	590.88	dry	DU-01-D	594.37	465.37	459.87	462.62	588.17	--	--
DU-02-S	590.79	578.09	590.79	584.44	581.62	DU-02-D	590.34	478.84	473.34	476.09	586.46	4.84	0.0447
DU-03-S	587.61	580.61	587.61	584.11	580.87	DU-03-D	587.90	455.70	450.30	453.00	584.85	3.98	0.0304
DU-06-S	604.23	575.23	604.23	589.73	576.68	DU-06-D	604.98	487.48	481.98	484.73	583.46	6.78	0.0646
DU-07-S	598.36	583.46	573.46	578.46	578.81	DU-07-D	602.45	536.95	531.45	534.20	583.43	4.62	0.1044

Note: By Convention, positive values of vertical hydraulic gradient mean the flow potential is upward from bedrock to overburden aquifer.

FIGURES

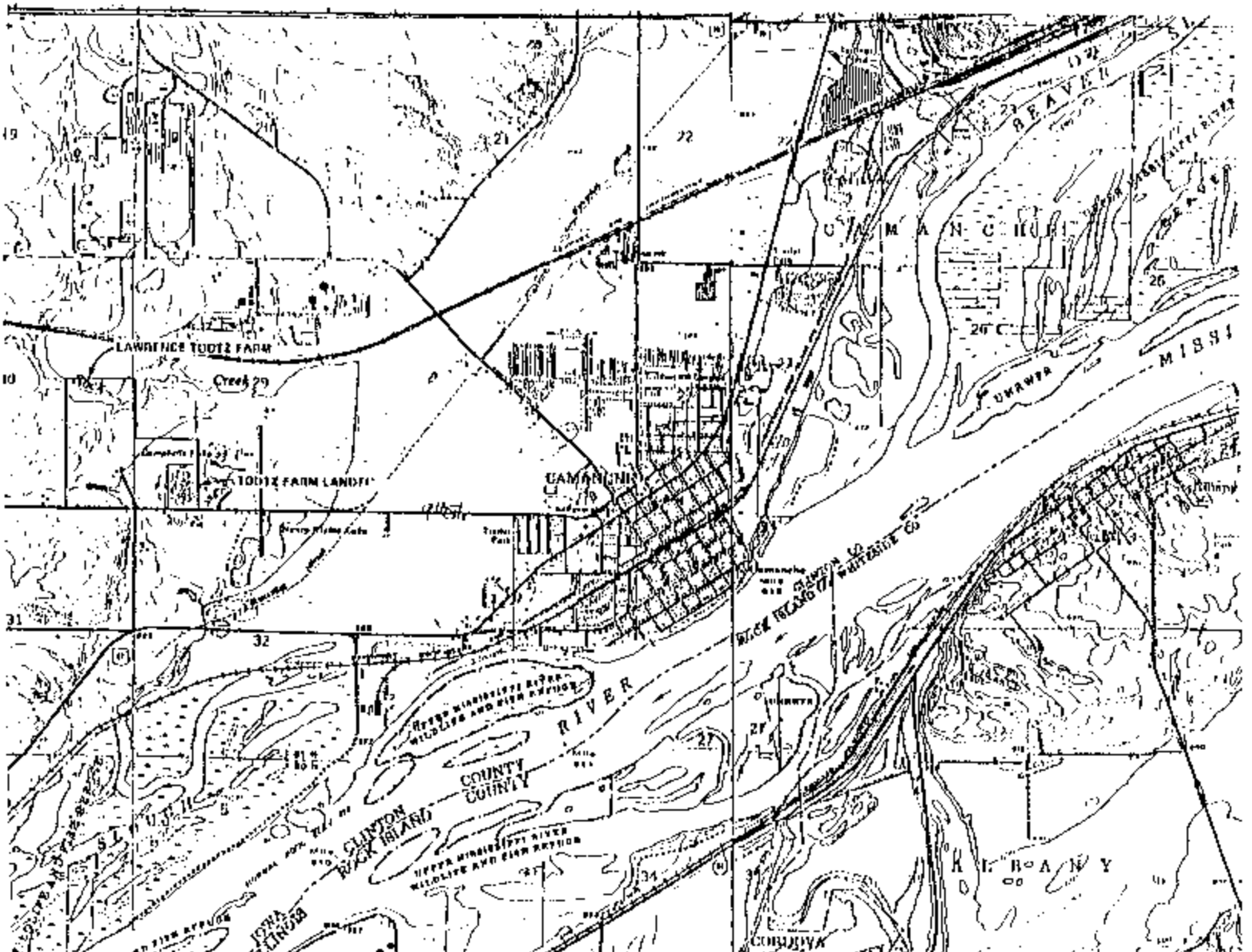
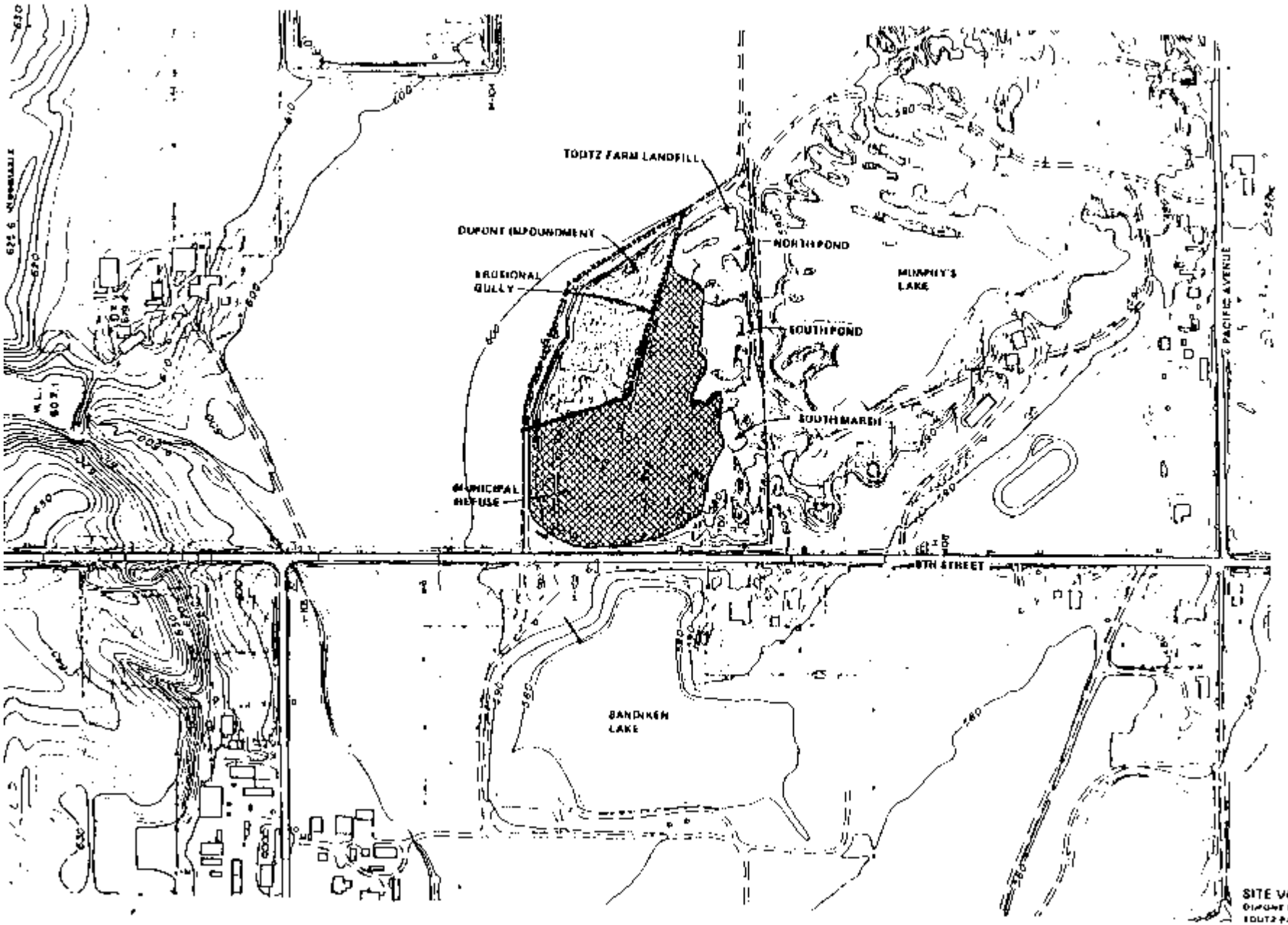

LAWRENCE TOOTZ FARM
TOOTZ FARM LANDFI
CAMANCHE
BEAVER
CREEK
MISSI
SSIPPI
RIVER
CLINTON COUNTY
CLINTON COUNTY
BLACK HAWK
IOWA
ILLINOIS
COBURVA
0
1000
2000
BLACK IN FEET

Figure 2-1


TOPTZ FARM LANDFILL
DUPONT IMPOUNDMENT
NORTH POND
EROSIONAL GULLY
MURPHY'S LAKE
SOUTH POND
PACIFIC AVENUE
SOUTH MARSH
MUNICIPAL REFUSE
8TH STREET
SANDPIKEN LAKE
SCALE IN FEET
1" = 250'
SITE VICINITY MAP
DUPONT IMPOUNDMENT SITE
TOPTZ FARM LANDFILL SITE

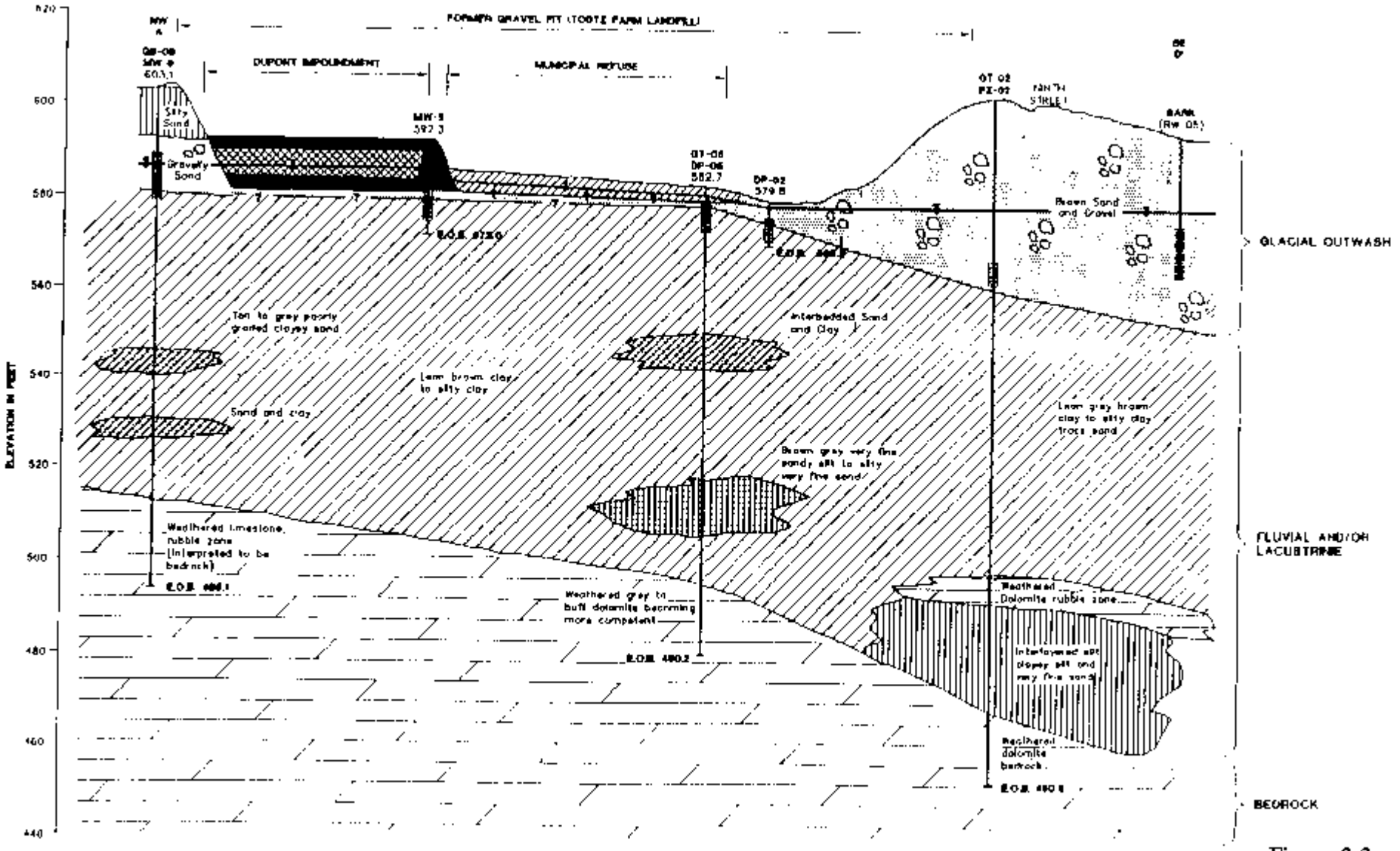


Figure 2-3
Geologic Cross Section A-D'
DUPONT IMPOUNDMENT RI/FS
TODTZ FARM LANDFILL

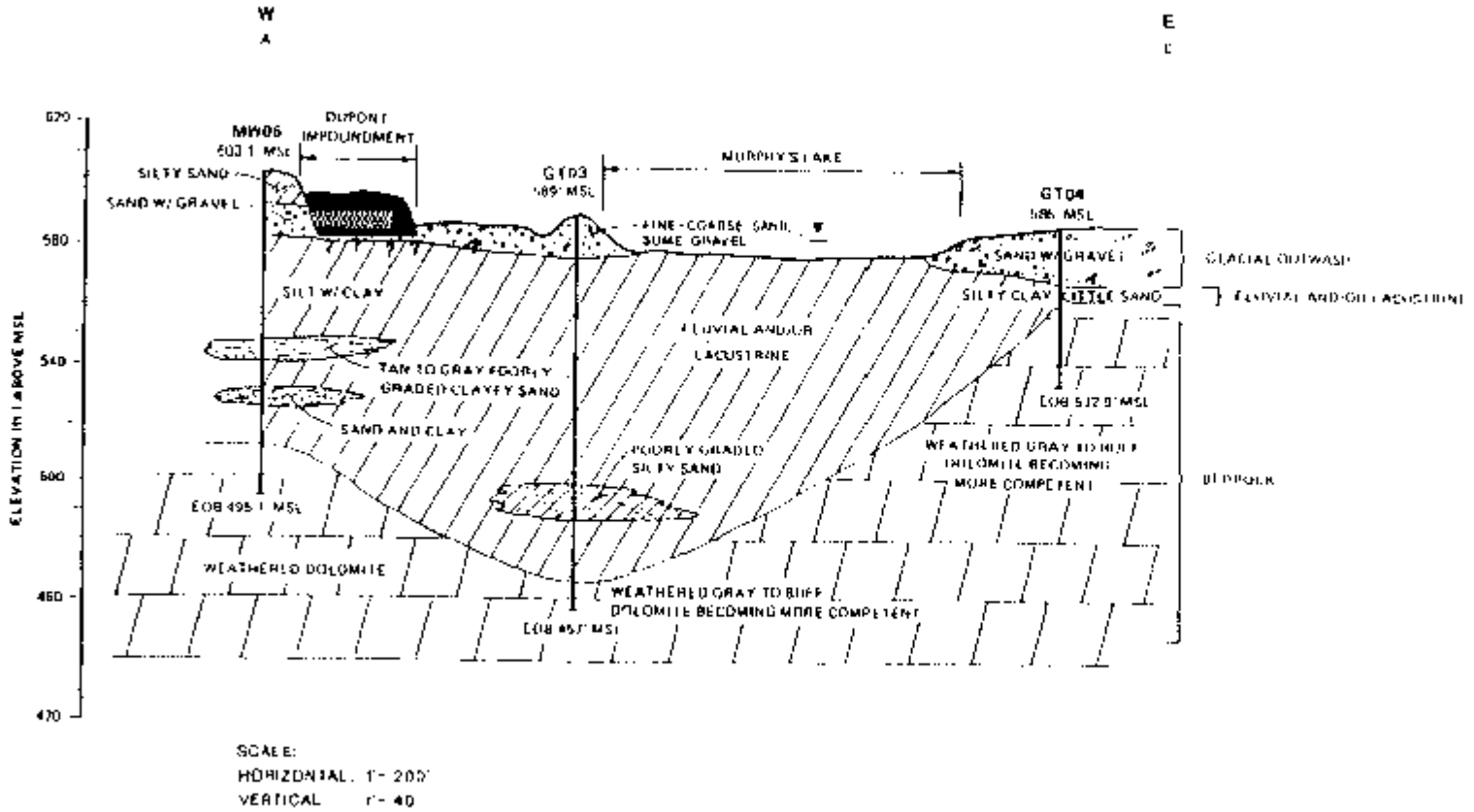


Figure 2-4
Geologic Cross Section A C'
DUPONT IMPOUNDMENT RI/FS
TODTZ FARM LANDFILL SITE

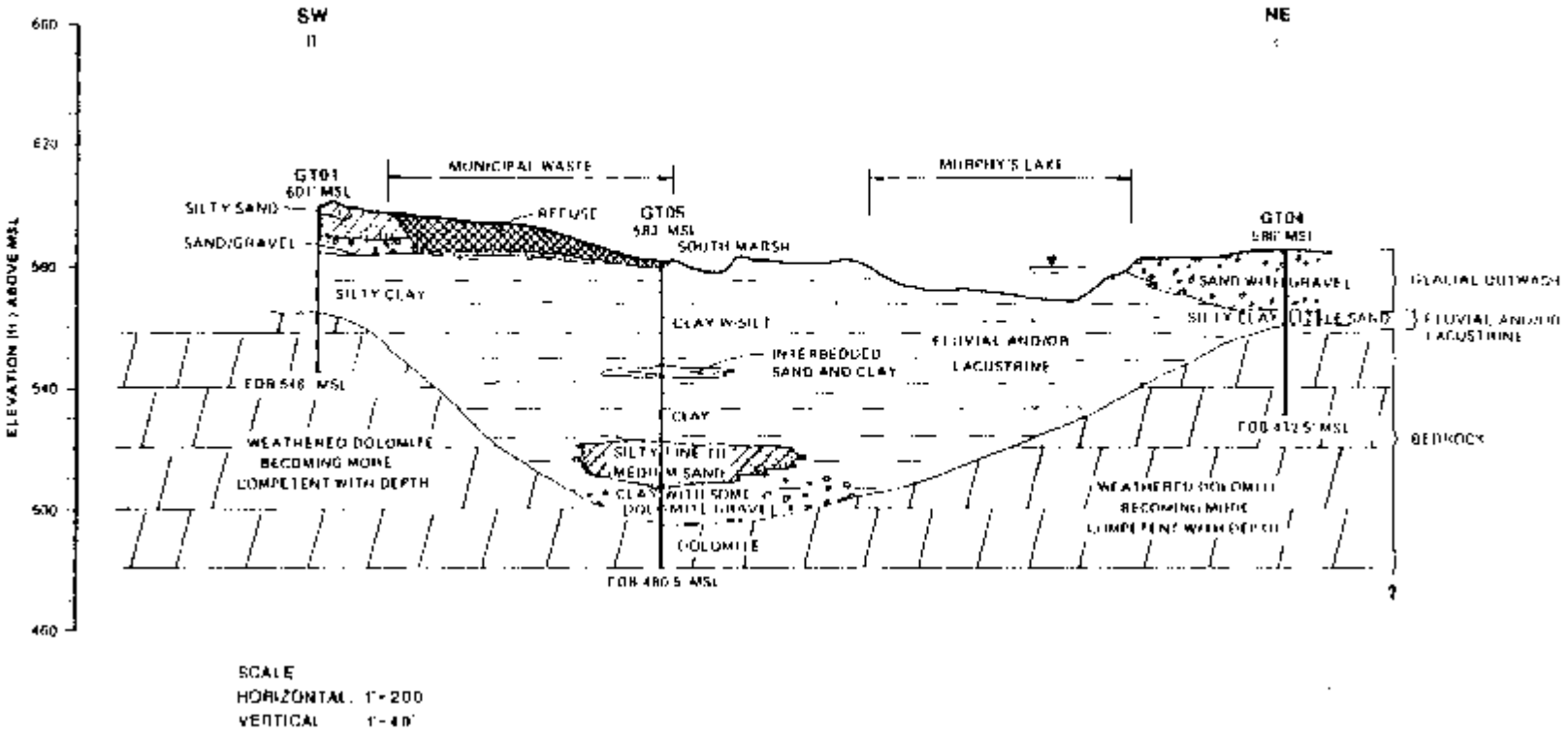
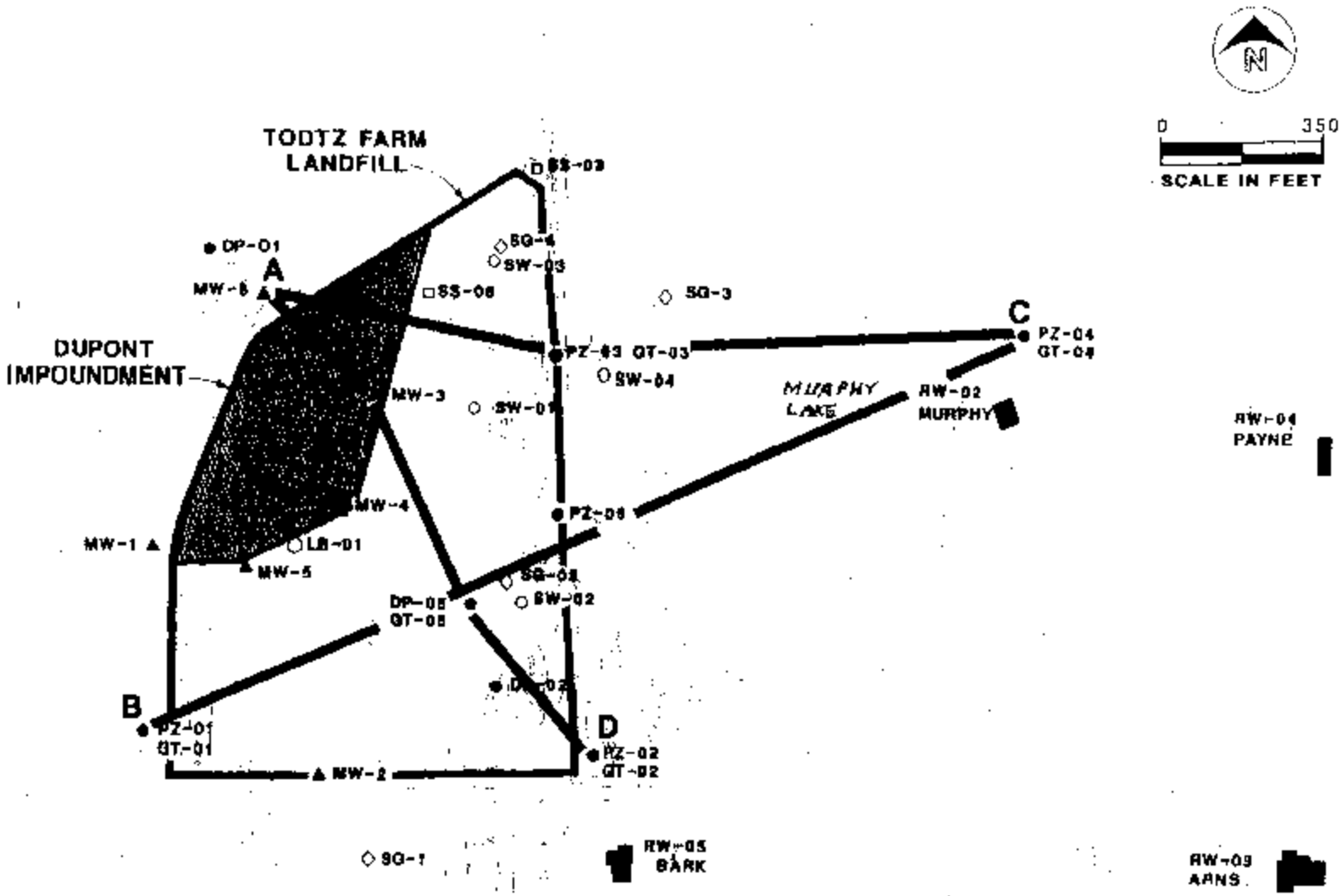


Figure 2-5
GEOLOGIC CROSS SECTION B C'
DUPONT IMPUNDMENT RI/FS
TODTZ FARM LANDFILL SITE



LEGEND

- DP-02 / PZ-02 / GT-02 — STAINLESS STEEL MONITORING WELL / PVC PIEZOMETER / GEOTECHNICAL BORING (INSTALLED BY CH2M HILL)
- MW-2 — WELL INSTALLED BY EPA
- LB-01 — EXPLORATORY BORING
- TP-01 — TEST PIT LOCATION
- SS-01 — SURFACE SOIL SAMPLING LOCATION
- SG-1 — STAFF GAGE LOCATION
- SW-01 — SURFACE WATER SAMPLING LOCATION
- RW-01 TODTZ — RESIDENTIAL WELL SAMPLING LOCATION

Figure 2-6
CROSS SECTION LOCATIONS
DUPONT IMPOUNDMENT RI/FS
TODTZ FARM LANDFILL SITE

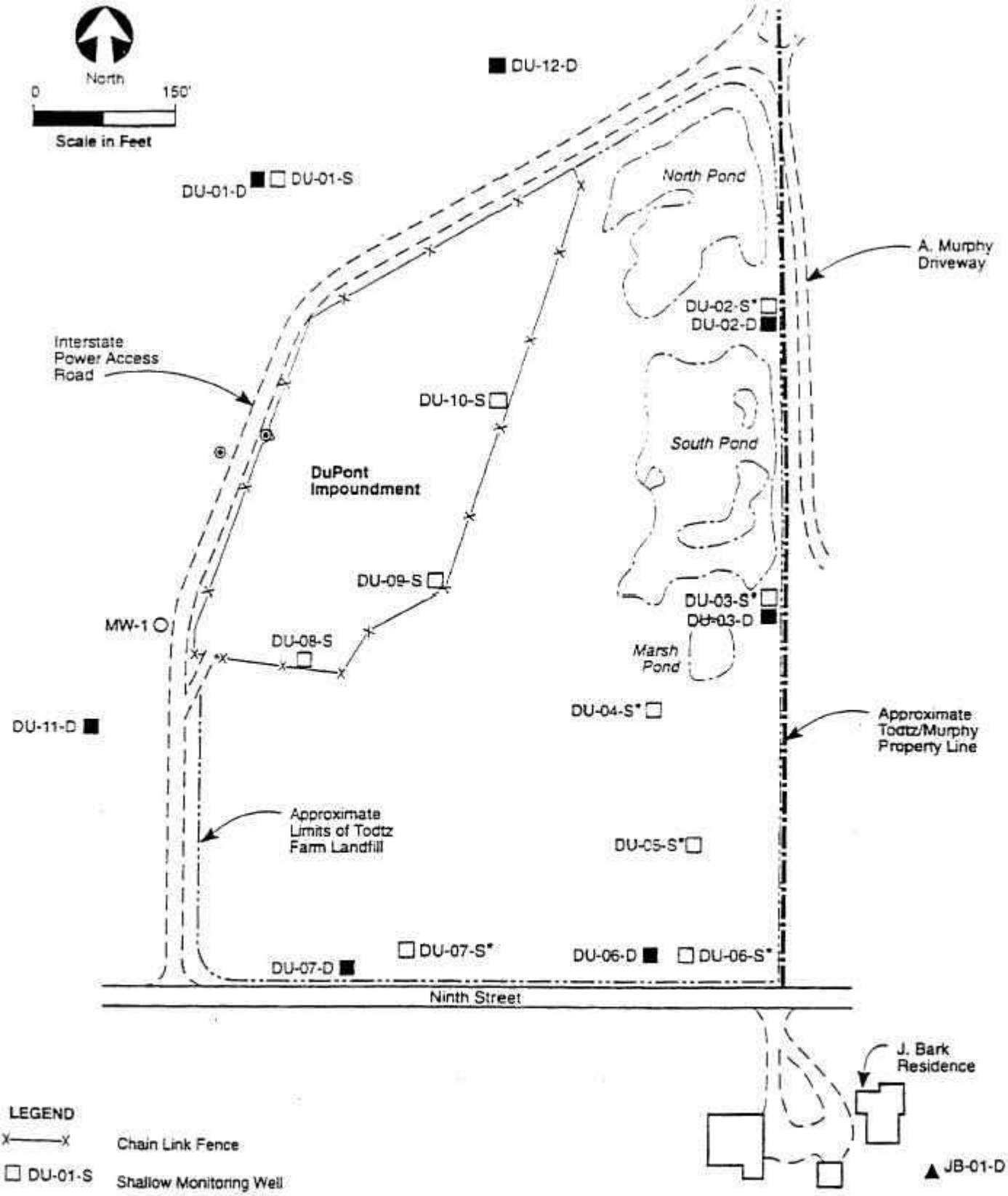


Figure 2-7

Site Map
DuPont Impoundment RA
Lawrence Todtz Farm Landfill Site

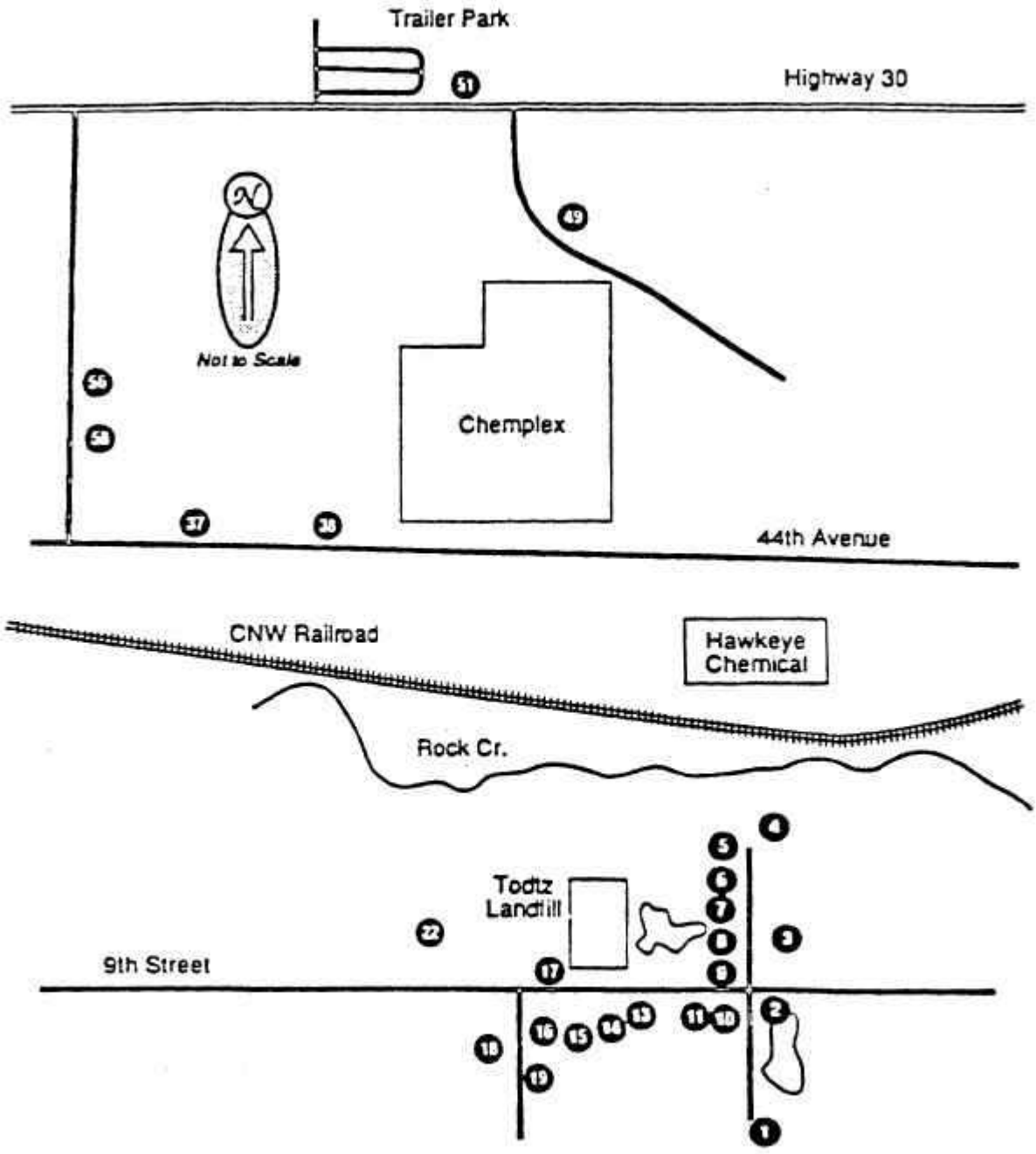
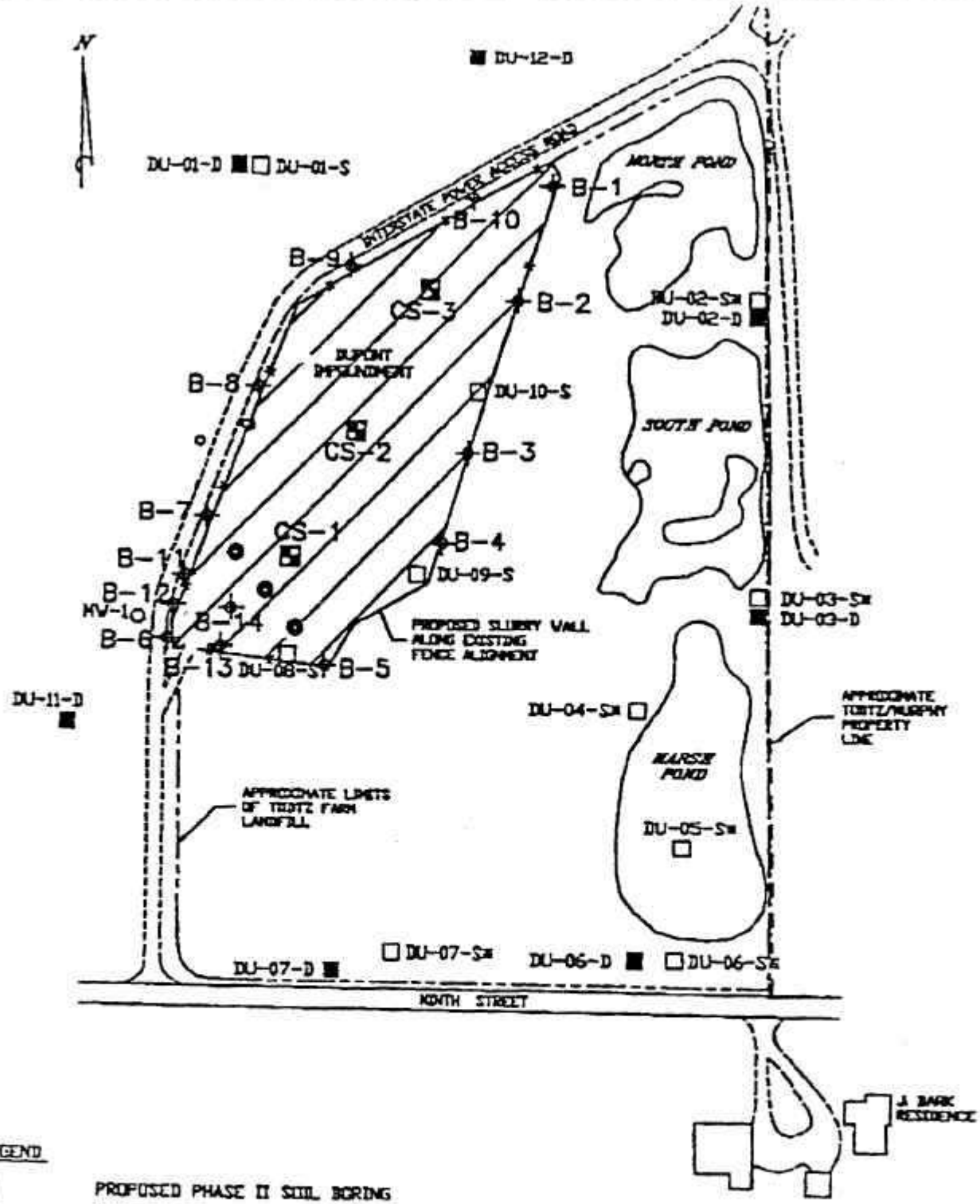


Figure 5-1 **Sampling Locations**

UHL/graphics



LEGEND

- PROPOSED PHASE II SOIL BORING
- PHASE I SOIL BORING
- CAP SYSTEM SHELBY TUBE SAMPLE
- EXISTING CHAIN LINK FENCE
- DU-01-S EXISTING SHALLOW MONITORING WELL
- DU-02-S EXISTING REMEDIAL ACTION TRIGGER WELL
- DU-01-D EXISTING DEEP MONITORING WELL
- MW-1 EXISTING EPA MONITORING WELL
- EXISTING POWER TRANSMISSION LINE PEDESTAL

BASE PLAN TAKEN FROM DRAWING NO. 3556A002, PREPARED BY DUPONT ENVIRONMENTAL REMEDIATION SERVICES, DATED APRIL 1, 1996.

SLURRY TRENCH PREDESIGN INVESTIGATION
TODTZ FARM LANDFILL
CAMANCHE IOWA

MUESER RUTLEDGE CONSULTING ENGINEERS
708 THIRD AVENUE, NEW YORK, NY 10017

MADE BY: WK	DATE: 2-23-95	FILE NO. 8080
CHKD BY:	DATE:	

SITE PLAN **Figure 5-2**

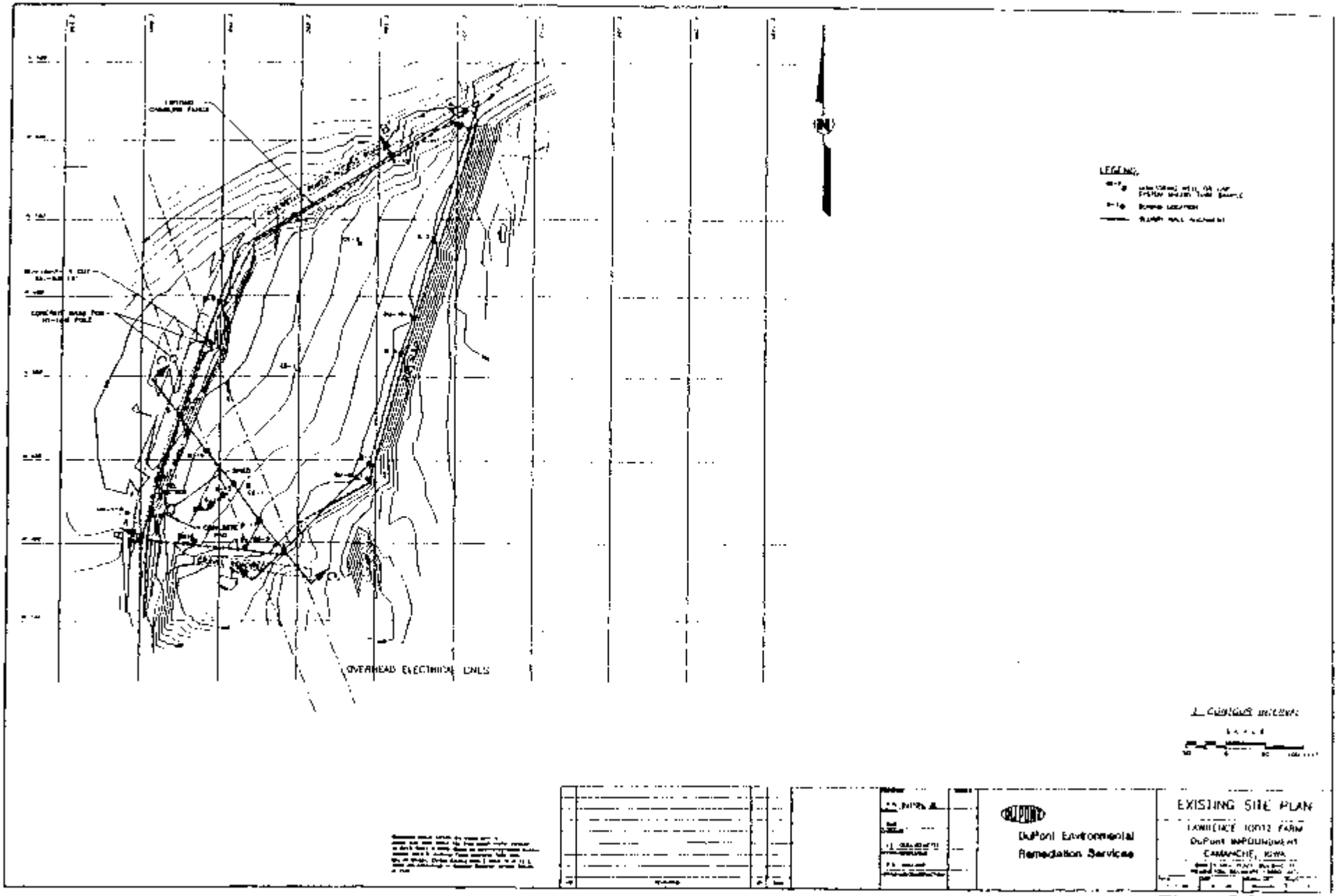

OVERHEAD ELECTRICAL LINES
LEGEND:
DuPont Environmental
Remediation Services
EXISTING SITE PLAN

Figure 5-3

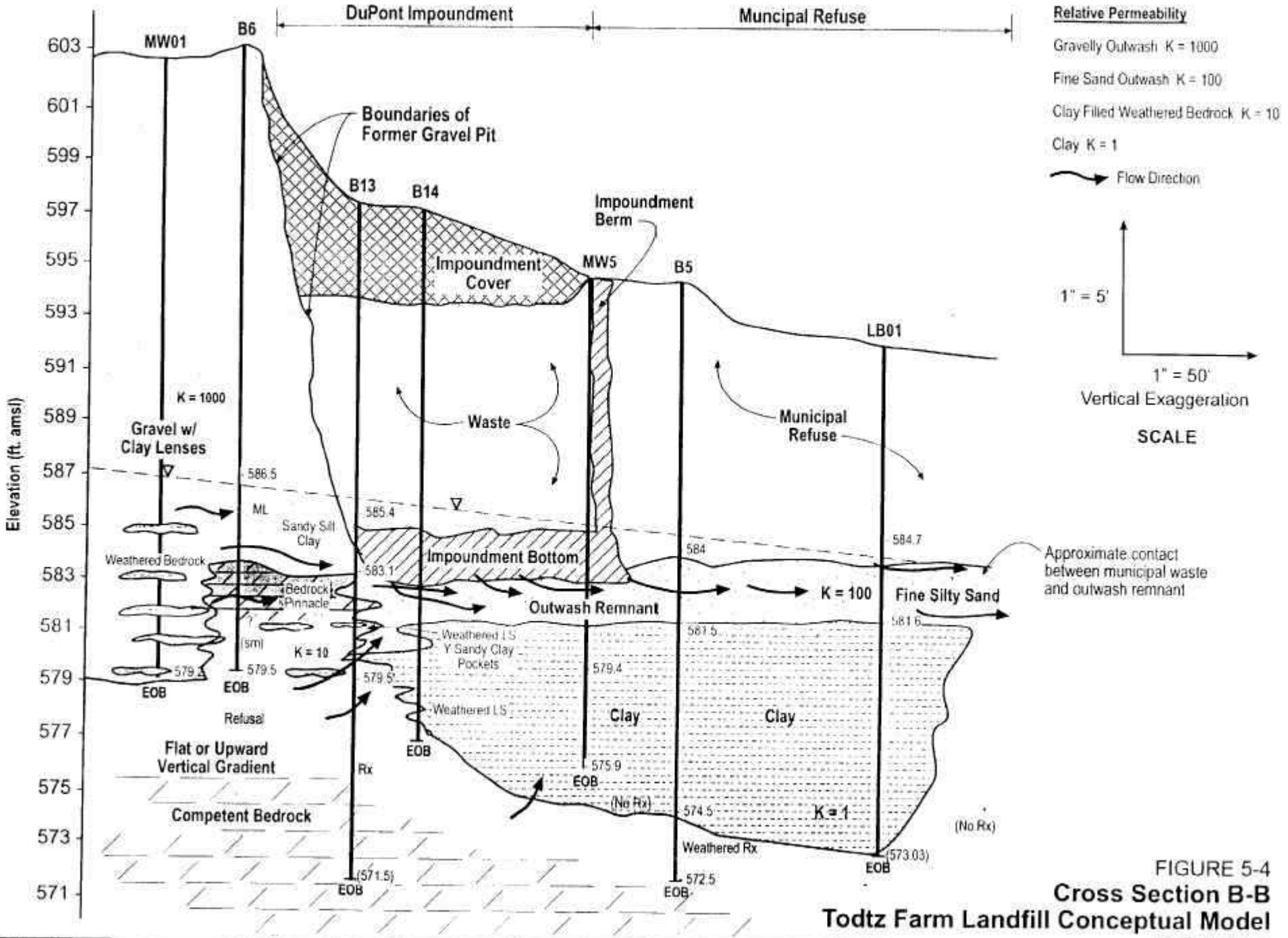


FIGURE 5-4
Cross Section B-B
Todtz Farm Landfill Conceptual Model

CH2MHILL

APPENDIX A

DuPont Environmental Remediation Services

LOG OF BORING NO. B-1

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 11-29-95 Date Completed 11-29-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 895.9 E 1106.0

Surface Elev. 595.5

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": BLACK ORGANIC SOIL WITH VEGETATION		SS-1	2-3 5-8	1.25	20	0	
		MEDIUM STIFF, BROWN, SANDY SILT, MOIST		SS-2*	11-19 17-18	1.75	17	0	ML
590	5			SS-3	2-5 4-5	1.0	24	0	
		MEDIUM DENSE, TANNISH-BROWN, FINE SILTY SAND, DRY TO MOIST		SS-4*	15-18 13-14	—	13	0	
		VERY LOOSE TO LOOSE, TANNISH-BROWN, COARSE SAND, WITH SOME GRAVEL, MOIST TO WET		SS-5	3-6 6-2	—	12	0	
	10			SS-6*	9-11 10-9	—	16	0	
		LOOSE, BLACK, COARSE SAND, TRACE GRAVEL, VERY WET		SS-7	3-3 3-3	—	17	0	SP
580	15			SS-8*	9-9 13-12	—	18	0	
				SS-9	4-5 9-10	—	18	0	
		[GRAVEL LAYER FROM 19.5' TO 20']		SS-10*	52-42 32-32	—	17	0	GM
	20	MEDIUM DENSE TO DENSE, BLACK-GREY, SILTY SAND, TRACE GRAVEL, WET		SS-11	7-14 22-21	—	15	0	
				SS-12*	57-60 100/4"	—	18	0	SP-SM
570	25			SS-13	16-12 14-15	2.0	20	0	
		MEDIUM STIFF TO STIFF, GREY-BLACK, SILTY CLAY, DRY		SS-14	9-12 15-19	2.75	16	0	
				ST-1	—	—	24	0	
	30			SS-15	9-12 15-20	3.25	15	0	CL
				SS-16	10-14 18-20	3.25	15	0	
560	35	BOTTOM OF BORING AT 36.0'		SS-17	11-13 17-20	2.5	22	0	

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-2

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 11-30-95 Date Completed 11-30-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL. Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS, 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 752.7 E 1061.1

Surface Elev. 594.9

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6". BLACK ORGANIC SOIL WITH VEGETATION		SS-1*	7-17 16-21	2.0	18	0	
		MEDIUM STIFF, TAN-BROWN, SANDY SILT, MOIST		SS-2	4-8 20-20	2.0	20	0	
590	5			SS-3*	20-35 27-17	2.0	21	0	
				SS-4	3-3 4-5	0.5	19	0	ML
		MEDIUM DENSE TO DENSE, BLACK-GREY, SILTY SAND, WET		SS-5*	23-24 30-47	——	19	0	
	10			SS-6	8-14 13-9	——	22	0	
		[COARSE SAND LAYER FROM 12.5' TO 13.0']		SS-7*	5-8 10-14	1.75	20	0	
580		STIFF TO VERY STIFF, BROWN, SILTY CLAY, DRY		SS-8	8-14 15-16	3.5	24	0	
	15			ST-2	——	——	6	0	
				ST-2R	——	——	24	0	
	20			SS-9	14-19 20-23	4.5	24	0	
				SS-10	6-10 15-16	4.5	23	0	
570	25			SS-11	5-11 16-18	4.5	23	0	CL
		[PEAT LENSES AT 28.0']		SS-12	10-14 16-18	>4.5	24	0	
				SS-13	7-11 15-18	4.5	23	0	
	30	MEDIUM STIFF TO STIFF, REDDISH BROWN, CLAYEY SILT, MOIST		SS-14	5-11 14-15	2.5	24	0	
		[SAND LENSES AT 33.0']		SS-15	4-7 11-13	3.75	24	0	
560	35	BOTTOM OF BORING AT 34.0'							

NOTES:

* 3 1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-3

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-1-95 Date Completed 12-1-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 608.5 E 1020.5

Surface Elev. 594.8

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6 INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": BLACK ORGANIC SOIL WITH VEGETATION		SS-1*	7-15 15-15	1.75	20	0	ML
		MEDIUM STIFF, TAN-BROWN, SANDY SILT, MOIST		SS-2	3-7 18-20	2.0	18	0	GM
590	5	[LIMESTONE GRAVEL LAYER FROM 3.5' TO 4.25']		SS-3*	34-29 24-21	3.5	15	0	
		MEDIUM DENSE TO DENSE, BLACK-GREY, SILTY SAND, WET		SS-4	5-7 9-9	—	10	0	
	10			SS-5*	56-43 43-91	—	19	0	ML
				SS-6	8-10 11-12	—	23	0	
		[COARSE SAND LAYER FROM 13.5' TO 14.0']		SS-7*	14-18 24-32	—	14	0	
580	15	STIFF TO VERY STIFF, BROWN, SILTY CLAY, DRY		SS-8	4-6 10-12	2.75	24	0	
				SS-9	12-17 24-24	2.75	22	0	
	20			SS-10	9-12 12-13	3.0	19	0	CL
				ST-3	—	—	24	0	
				SS-11	10-14 18-22	>4.5	21	0	
570	25	BOTTOM OF BORING AT 24.0'							
	30								
560	35								

NOTES:

* 3 1/2" SPLIT SPOON USED TO OBTAIN SAMPLE

DuPont Environmental Remediation Services

LOG OF BORING NO. B-4

Client: TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location: CAMANCHE, IOWA

Date Started: 12-1-95 Date Completed: 12-1-95

Field Eng./Geo.: R.H. SUTTON Checked By: ____ GWL: Depth ____ Date/Time ____

Driller: BOWSER MORNER ____ Date/Time ____

Drilling Method: 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 476.1 E 981.7

Surface Elev. 594.6

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": BLACK ORGANIC SOIL WITH VEGETATION		SS-1*	5-10 10-14	—	19	0	
		MEDIUM STIFF, TAN-BROWN, SANDY SILT, MOIST		SS-2	8-15 15-9	—	19	0	
590	5	[GEOTEXTILE FABRIC ENCOUNTERED]		SS-3*	17-28 32-30	—	16	0	ML
				SS-4	3-7 8-10	—	20	0	
		MEDIUM DENSE TO DENSE, BLACK-GREY, SILTY SAND, WET		SS-5*	14-22 25-22	—	18	0	
	10			SS-6	5-10 7-14	—	21	0	SM
		LOOSE, BLACK, COARSE SAND, WET		SS-7*	21-21 26-24	—	17	0	SP
580	15	STIFF TO VERY STIFF, BROWN, SILTY CLAY, DRY TO MOIST		SS-8	3-6 6-8	3.0	23	0	
				ST-4	—	—	20	0	
				SS-9	5-6 9-10	1.5	20	0	CL
	20			SS-10	5-6 8-10	2.0	24	0	
		SOFT, REDDISH BROWN, SILTY CLAY, PEAT LAYERS, MOIST		SS-11	10-15 16-16	2.25 1.0	24	0	MH
570		MEDIUM STIFF, OLIVE GREEN-GREY, CLAYEY, SILT, DRY TO MOIST		SS-12	8-13 19-20	1.0	20	0	
	25			SS-13	6-8 10-11	1.0	24	0	ML
				SS-14	8-10 12-14	1.0	24	0	
	30			ST-5	—	—	24	0	
				SS-15	8-16 22-28	2.5	15	0	CH
560	35	BOTTOM OF BORING AT 34.0'							

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-5

Client: TODTZ FARM: DuPONT IMPOUNDMENT | Project No. 3558

Location: CAMANCHE, IOWA

Date Started: 12-2-95 Date Completed: 12-2-95

Field Eng./Geo.: R.H. SUTTON Checked By: _____ GWL: Depth _____ Date/Time _____

Driller: BOWSER MORNER _____ Date/Time _____

Drilling Method: 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates: N 370.0 E 872.1

Surface Elev.: 594.6

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 8": BLACK ORGANIC SOIL WITH VEGETATION		SS-1*	5-7 6-9	—	18	0	
		MEDIUM STIFF, TAN-BROWN, SANDY SILT, MOIST		SS-2	3-4 4-4	—	18	0	ML
590	5			SS-3*	9-9 9-10	—	15	0	
				SS-4	2-3 3-3	—	15	0	CL
		MEDIUM DENSE TO DENSE, BLACK-GREY, SILTY SAND, WET		SS-5*	5-9 10-11	—	16	0	SM CL
	10	LOOSE, BLACK, COARSE SAND WITH SOME SILTY CLAY AND TRACE GRAVEL, VERY WET		SS-6	3-4 5-8	—	6	0	SP
				SS-7*	13-16 23-29	>4.5	16	0	
580		STIFF TO VERY STIFF, BROWN-RED-GREY MOTTLED, SILTY CLAY, MOIST TO DRY		SS-8	7-13 22-25	>4.5	16	0	
	15			SS-9	8-9 14-22	2.75	12	0	CL
		STIFF, OLIVE GREEN-GREY, SILTY CLAY WITH TAN SAND LENSES, DRY TO MOIST		SS-10	11-15 23-52	2.5	22	0	
	20	DENSE TO VERY DENSE, TAN SAND AND WEATHERED LIMESTONE, WET		SS-11	31-62 55-100/4"	2.5	18	0	SM
		BOTTOM OF BORING AT 22.0'							
570	25								
	30								
560	35								

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-6

Client TOOTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-2-95 Date Completed 12-2-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 588.5 E 692.9

Surface Elev. 603.7

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": STONE ACCESS ROAD SUBBASE		SS-1*	42-20 13-18	—	20	0	SP-SM
600	5	MEDIUM DENSE, DARK BROWN TO TAN, FINE SILTY SAND, DRY TO MOIST		SS-2	2-3 3-3	—	21	0	
				SS-3*	20-9 7-8	—	18	0	SP
				SS-4	3-3 4-4	—	19	0	
	10			SS-5*	6-7 6-7	—	20	0	
				SS-6	2-3 3-4	—	22	0	
590				SS-7*	9-12 16-18	—	19	0	
		LOOSE TO MEDIUM DENSE, BROWN COARSE SAND WITH SOME GRAVEL, MOIST		SS-8	6-8 8-8	—	14	0	
	15			SS-9*	10-13 42-70	—	14	0	ML
		DENSE TO VERY DENSE, TAN SAND AND WEATHERED LIMESTONE, WET		SS-10	31-45 45-47	—	20	0	SM GP-GM
	20			SS-11	18-22 42-52	—	16	0	SM
580				SS-11	53-65 47-100/5"	—	24	0	
	25	BOTTOM OF BORING AT 24.0'							
	30								
570	35								

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DUPONT

DuPont Environmental Remediation Services

LOG OF BORING NO. B-7

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-2-95 Date Completed 12-2-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 533.9 E 739.3

Surface Elev. 605.6

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S SYMBOL
600	5	MEDIUM DENSE, DARK BROWN TO TAN, FINE SILTY SAND, DRY TO MOIST		SS-1*	7-10 10-10	—	19	0	SP
				SS-2	2-2 2-2	—	21	0	
				SS-3*	8-6 8-8	—	24	0	
				SS-4	3-3 4-4	—	18	0	
	10			SS-5*	8-10 11-11	—	18	0	
				SS-6	3-3 3-3	—	20	0	
				SS-7*	23-10 10-8	—	20	0	
590	15	LOOSE TO MEDIUM DENSE, BROWN COARSE SAND WITH SOME GRAVEL, MOIST TO WET		SS-8	3-3 1-1	—	10	0	
				SS-9*	11-14 18-23	—	16	0	
				SS-10	7-9 11-12	—	18	0	
	20	STIFF TO VERY STIFF, OLIVE GREEN-GREY, CLAYEY SILT, DRY TO MOIST		SS-11	11-16 18-23	3.0	20	0	CL
				SS-12	14-17 19-24	3.0	22	0	
580	25			SS-13	12-17 27-27	>4.5	21	0	
				ST-6	—	4.0	6	0	
	30			SS-14	12-19 27-27	4.0	24	0	
				ST-6R	—	—	24	0	CH
				SS-15	7-17 30-28	>4.5	24	0	ML
570	35	MEDIUM STIFF, BROWN, SILT, TRACE SAND, DRY BOTTOM OF BORING AT 36.0'		SS-16	10-15 33-55	1.0	13	0	

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-8

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-3-95 Date Completed 12-3-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 673.8 E 788.5

Surface Elev. 605.6

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		MEDIUM DENSE, DARK BROWN TO TAN, FINE SILTY SAND, DRY TO MOIST		SS-1*	4-7 9-9	—	21	0	SM
				SS-2	2-2 2-2	—	24	0	
600	5			SS-3*	7-7 8-9	—	18	0	SP
				SS-4	3-3 4-4	—	22	0	
	10			SS-5*	7-7 8-8	—	22	0	
				SS-6	3-3 5-5	—	18	0	SP-SM
				SS-7*	9-8 8-10	—	22	0	SM
590	15	LOOSE TO MEDIUM DENSE, BROWN COARSE SAND WITH SOME GRAVEL, MOIST TO WET		SS-8	3-3 3-3	—	12	0	SP
				SS-9*	7-8 14-12	—	13	0	
	20			SS-10	5-6 7-7	—	16	0	
		STIFF, REDDISH-BROWN, SILTY CLAY, MOIST		SS-11*	12-10 16-32	2.5	16	0	CL
		MEDIUM STIFF TO STIFF, OLIVE GREEN-GREY, CLAYEY SILT, DRY TO MOIST		SS-12	6-16 23-24	2.0	16	0	
580	25			ST-7	—	—	24	0	
				SS-13	6-7 11-15	4.0	13	0	
		BOTTOM OF BORING AT 28.0'							
570	30 35								

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-9

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No 3556

Location CAMANCHE, IOWA

Date Started 12-3-95 Date Completed 12-3-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 785.3 E 880.5

Surface Elev. 603.5

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		MEDIUM DENSE, DARK BROWN TO TAN, FINE SILTY SAND, DRY TO MOIST		SS-1*	6-6 6-6	—	17	0	SM
600	5			SS-2	1-1 1-2	—	19	0	SP
				SS-3*	6-6 7-8	—	16	0	
				SS-4	2-2 2-2	—	17	0	
	10			SS-5*	6-7 8-9	—	20	0	
				SS-6	2-3 4-6	—	17	0	
590		LOOSE TO MEDIUM DENSE, BROWN COARSE SAND WITH SOME GRAVEL, MOIST TO WET		SS-7*	17-13 10-9	—	18	0	
	15			SS-8	5-6 6-7	—	12	0	
				SS-9*	14-18 18-17	—	17	0	SP-SM
	20	SOFT TO MEDIUM STIFF, BLACK-GREY, SILTY CLAY, TRACE SAND, MOIST		SS-10	4-5 6-8	1.5	16	1.0	CL
				SS-11	11-5 8-7	2.0	18	1.0	
580				SS-12	10-12 14-14	1.0	12	0.5	
	25	MEDIUM STIFF TO STIFF, BROWN, CLAYEY SILT, MOIST		SS-13	8-13 13-13	2.75	18	0	
				SS-14	8-12 19-17	—	—	0	
	30			SS-15	11-12 15-15	2.25	24	0	
				ST-8	—	—	24	0	
570	35	BOTTOM OF BORING AT 32.0'							

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-10

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-3-95 Date Completed 12-3-95

sid Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

iller BOWSER MORNER _____ Date/Time _____

illing Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 863.0 E 1006.2

Surface Elev. 601.1

(M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
10	0	TOP 10": BLACK ORGANIC SOIL WITH VEGETATION		SS-1*	6-9 13-12	—	16	0	SM
		MEDIUM DENSE, DARK BROWN TO TAN, FINE SILTY SAND, DRY TO MOIST		SS-2	2-2 2-2	—	21	0	SP
	5			SS-3*	6-7 7-7	—	19	0	
				SS-4	3-3 4-6	—	20	0	
				SS-5*	10-22 22-17	—	19	0	
0	10	LOOSE TO MEDIUM DENSE, BROWN COARSE SAND WITH SOME GRAVEL, MOIST TO WET		SS-6	5-6 5-4	—	12	0	
				SS-7*	10-20 25-17	—	15	0	
	15			SS-8	5-5 7-6	—	15	0	
		[SILTY SAND LAYER FROM 16.5' TO 18.5']		SS-9*	11-13 19-20	—	20	0	
				SS-10	2-2 2-3	—	18	0	SP-SM
30	20	MEDIUM STIFF TO STIFF, BROWN-GREY, SILTY CLAY, MOIST TO DRY		SS-11*	6-12 17-28	2.5	20	0	CL
				SS-12	8-13 16-21	3.0	15	0	
	25			ST-9	—	—	24	0	
				SS-13	7-9 9-13	—	24	0	
	30								
70				SS-14	7-10 12-13	2.25	24	0	
	35								

NOTES:

3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-10

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-3-95 Date Completed 12-3-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 863.0 E 1006.2

Surface Elev. 601.1

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		MEDIUM STIFF TO STIFF, BROWN-GREY, SILTY CLAY, MOIST TO DRY							CL
	40	VERY STIFF, REDDISH BROWN, SILTY CLAY WITH SOME SANDY PEAT LENSES, MOIST		SS-15	5-8 10-13	4.25	24	0	
560				ST-10	——	——	24	0	CH
		MEDIUM DENSE TO DENSE, BROWN, SILTY SAND WITH SOME REDDISH BROWN CLAY LENSES, MOIST		SS-16	5-9 10-15	1.0	18	0	CL / CL-SC
	45	BOTTOM OF BORING AT 44.0'							
550	50								
	55								
540	60								
	65								
	70								

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-11

Client TOOTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-4-95 Date Completed 12-4-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 457.3 E 711.3

Surface Elev. 604.8

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
600	5	MEDIUM DENSE, DARK BROWN TO TAN, FINE SILTY SAND, DRY TO MOIST							SP-SM
	10								
590	15	LOOSE TO MEDIUM DENSE, BROWN COARSE SAND WITH SOME GRAVEL, MOIST TO WET		SS-1	6-9 11-10	—		0	SP
				SS-2	9-7 8-9	—		0	
	20	STIFF TO VERY STIFF, BROWN-GREY, SILTY CLAY, DRY TO MOIST		SS-3	4-10 13-15	—		0	CL
580	25			SS-4	12-16 22-28	—		0	
		BOTTOM OF BORING AT 25.0'							
	30								
570	35								

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-12

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-4-95 Date Completed 12-4-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 420.9 E 703.8

Surface Elev. 604.2

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
600	5	MEDIUM DENSE, DARK BROWN TO TAN, FINE SILTY SAND, DRY TO MOIST	2 2 2 2 2 2						SP-SM
590	10	LOOSE TO MEDIUM DENSE, BROWN COARSE SAND WITH SOME GRAVEL, MOIST TO WET		SS-1	6-8 8-9	—	12	0	SP
	15	DENSE, BROWN, SILTY SAND, WET	2	SS-2	9-16 19-10	—	18	0	SM
		MEDIUM STIFF, BROWN, SILTY CLAY, WET		SS-3	13-30 33-23	—	24	0	CL
	20	WEATHERED LIMESTONE							ROCK
		BOTTOM OF BORING AT 20.0'							
580	25								
	30								
570	35								

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-13

Client TODTZ FARM: DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-4-95 Date Completed 12-5-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 382.2 E 758.7

Surface Elev. 597.4

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": BLACK ORGANIC SOIL WITH VEGETATION							ML
		MEDIUM STIFF, BROWN SANDY SILT, MOIST							
	5	SILTY SAND AND GRAVEL MIXED WITH WASTE (PLASTIC, WOOD, PAPER)		SS-1	6-9 7-6	—	15	0	WASTE
590				SS-2	3-13 30-2	—	3	0	
	10			SS-3	4-5 5-2	—	6	0	
				SS-4	1/12" 1-1	—	0	0	
		SOFT, BROWN, SANDY SILT AND CLAY, WET		SS-5	8-7 7-12	—	9	0	CL
	15	WEATHERED LIMESTONE WITH SANDY CLAY POCKETS, WET		SS-6	16-18 14-14	—	14	0	SM
580				SS-7	60-58 77-100/4"	—	18	0	
	20	ROCK CORE		RC-1		—	20	0	ROCK
		ROCK CORE		RC-2		—	24	0	
570	25	BOTTOM OF BORING AT 26.0'							
	30								
	35								

NOTES:

* 3-1/2" SPLIT SPOON USED TO OBTAIN SAMPLE.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-14

Client TODTZ FARM: DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-5-95 Date Completed 12-5-95

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" SPLIT SPOON

Coordinates N 425.5 E 779.5

Surface Elev. 597.5

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": BLACK ORGANIC SOIL WITH VEGETATION							ML
		MEDIUM STIFF, BROWN SANDY SILT, MOIST							
	5	SILTY SAND AND GRAVEL MIXED WITH WASTE (SLUDGE, WOOD, VERY WET)							WASTE
590				SS-1	28-6 7-8	—	8	0	
	10			SS-2	10-4 7-6	—	4	0	
	15			SS-3	10-9 14-12	—	0	0	
580				SS-4	14-33 45-65	—	6	0	
		WEATHERED LIMESTONE		SS-5	30-71 100/4"	—	14	0	ROCK
	20	BOTTOM OF BORING AT 20.0'							
570	25								
	30								
	35								

NOTES:

DuPont Environmental Remediation Services

LOG OF BORING NO. B-15

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location CAMANCHE, IOWA

Date Started 12-23-96 Date Completed 12-23-96

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" SPLIT SPOONS

Coordinates N 450.8 E 807.6

Surface Elev. 597.1

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": BLACK ORGANIC SOIL WITH VEGETATION		SS-1	7-10 10-15	1.5	18	0	
		MEDIUM STIFF, BROWN, SANDY SILT, MOIST TO WET		SS-2	11-10 11-13	1.5	12	0	
	5			SS-3	12-23 11-10	1.75	24	0	ML
590				SS-4	2-3 3-5	.5	15	0	
		SILTY SAND AND GRAVEL MIXED WITH WASTE (SLUDGE, WOOD, VERY WET)		SS-5	2-2 2-2	-	15	0	
	10			SS-6	65/4"	-	4	5.0	WASTE
				SS-7	5-5 8-9	3.0	24	0	
		STIFF TO VERY STIFF, BLACK-GREY, SILTY CLAY, DRY		SS-8	7-8 12-12	4.0	24	0	
580	15			ST-11	-	-	24	0	
	20			SS-9	27-19 12-17	-	12	0	CL
				SS-10	21-19 17-17	-	18	0	
		BOTTOM OF BORING AT 24.0'							
570	25								
	30								
	35								

NOTES:

DuPont Environmental Remediation Services

LOG OF BORING NO. B-16

Client TOOTZ FARM; DuPONT IMPOUNDMENT | Project No. 3556

Location COMANCHE, IOWA

Date Started 12-23-96 Date Completed 12-23-96

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 491.0 E 773.3

Surface Elev. 598.4

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": BLACK ORGANIC SOIL WITH VEGETATION							
		SOFT, BROWN, SANDY SILT, DRY TO WET		SS-1	3-4 4-5	0	17	0	ML
	5			SS-2	4-5 6-4	0	14	0	
590				SS-3	1-1 1-1	0	18	0	
	10	SILTY SAND AND GRAVEL MIXED WITH WASTE (SLUDGE, WOOD, VERY WET)							WASTE
				SS-4	3-6 8-13	0	13	0	
	15	STIFF TO VERY STIFF, GREY TO BROWN, SILTY CLAY, MOIST TO DRY		SS-5	9-9 16-21	4.25	20	0	
580				ST-12	–	–	–	0	
	20								CL
				SS-6	5-9 9-13	4.5	24	0	
				SS-7	15-18 17-25	3.5	24	0	
	25								
570									
	30								
	35								

NOTES:

DuPont Environmental Remediation Services

LOG OF BORING NO. B-17

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No. 3555

Location CAMANCHE, IOWA

Date Started 12-24-96 Date Completed 12-24-96

Field Eng./Geo. R H SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 406.9 E 84D

Surface Elev. 596.0

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6". BLACK ORGANIC SOIL WITH VEGETATION MEDIUM STIFF, BROWN, SANDY SILT, MOIST							ML
590	5	DENSE, BLACK, SILTY SAND WITH SOME GRAVEL, MOIST		SS-1	5-6 5-6	0	15	0	SP-SM
				SS-2	3-4 3-4	0	19	27	
				SS-3	2-2 2-3	0	24	1.3	
	10	SOFT TO MEDIUM STIFF, BLACK, SILTY CLAY, MOIST TO WET		SS-4	2-2 2-2	0	14	1.5	CL
		STIFF TO VERY STIFF, GREY, SILTY CLAY, MOIST TO DRY		SS-5	4-7 9-14	>4.5	24	0	
580	15	[PEAT LENSES AT 16']		SS-6	3-7 12-16	>4.5	14	0	
				SS-7	7-9 16-22	>4.5 >4.5	24	0	
		VERY STIFF, GREY, SANDY CLAY, WITH SOME GRAVEL, DRY		SS-8	28-52 100/2"	0	16	0	
	20	WEATHERED LIMESTONE							ROCK
		BOTTOM OF BORING AT 20.0'							
570	25								
	30								
	35								

NOTES.

DuPont Environmental Remediation Services

LOG OF BORING NO. B-18

Client TODTZ FARM; DuPONT IMPOUNDMENT | Project No 3556

Location CAMANCHE, IOWA

Date Started 12-24-96 Date Completed 12-24-96

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 437.7 E 794.4

Surface Elev. 597.2

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC. (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": BLACK ORGANIC SOIL WITH VEGETATION							
		MEDIUM STIFF, TAN, SANDY SILT, DRY		SS-1	7-6 5-8	1.5	19	0	ML
	5	SOFT OLIVE GREEN-GREY, SANDY SILT, DRY TO WET		SS-2	4-3 4-5	.75	24	0	SP
590		SILTY SAND AND GRAVEL MIXED WITH WASTE (SLUDGE, WOOD, VERY WET, STRONG ODOR)		SS-3	1-1 2-5	-	19	13.2	WASTE
	10								
		STIFF, BLACK-GREY MOTTLED SILTY CLAY, DRY		SS-4	1-2 4-5	-	18	0	CL
	15			SS-5	6-6 8-11	-	18	0	
580				SS-6	7-9 12-15	-	18	0	
		[SHELBY TUBE REJECTED]							
	20	DENSE, GREY-BROWN-WHITE, SANDY, SILTY, CLAY AND GRAVEL, DRY TO MOIST		SS-7	13-18 21-38	-	18	0	SM-CL
		WEATHERED BEDROCK		SS-8	68-38 44-45	-	12	0	ROCK
		BOTTOM OF BORING AT 23.0'							
570	25								
	30								
	35								

NOTES:

DuPont Environmental Remediation Services

LOG OF BORING NO. B-18

Client TODTZ FARM: DuPONT IMPOUNDMENT | Project No 3556

Location CAMANCHE, IOWA

Date Started 12-24-96 Date Completed 12-24-96

Field Eng./Geo. R.H. SUTTON Checked By _____ GWL: Depth _____ Date/Time _____

Driller BOWSER MORNER _____ Date/Time _____

Drilling Method 4-1/4" I.D. HOLLOW STEM AUGERS; 2" AND 3-1/2" SPLIT SPOONS

Coordinates N 437.7 E 794.4

Surface Elev. 597.2

ELEVATION (M.S.L.)	DEPTH (FEET)	DESCRIPTION	PROFILE	SAMPLE NO. AND TYPE	BLOWS PER 6-INCH INCREMENTS	POCKET PENET. RESIST. VALUE (TONS/SF)	SAMPLE REC (IN.)	PID (ppm)	U.S.C.S. SYMBOL
		TOP 6": BLACK ORGANIC SOIL WITH VEGETATION							
		MEDIUM STIFF, TAN, SANDY SILT, DRY		SS-1	7-6 5-8	1.5	19	0	ML
	5	SOFT OLIVE GREEN-GREY, SANDY SILT, DRY TO WET		SS-2	4-3 4-5	.75	24	0	SP
590		SILTY SAND AND GRAVEL MIXED WITH WASTE (SLUDGE, WOOD, VERY WET, STRONG ODOR)		SS-3	1-1 2-5	-	19	13.2	WASTE
	10								
		STIFF, BLACK-GREY MOTTLED SILTY CLAY, DRY		SS-4	1-2 4-5	-	18	0	CL
	15			SS-5	6-6 8-11	-	18	0	
580				SS-6	7-9 12-15	-	18	0	
		[SHELBY TUBE REJECTED]							
	20	DENSE, GREY-BROWN-WHITE, SANDY, SILTY, CLAY AND GRAVEL, DRY TO MOIST		SS-7	13-18 21-38	-	18	0	SM-CL
		WEATHERED BEDROCK		SS-8	68-38 44-45	-	12	0	ROCK
		BOTTOM OF BORING AT 23.0'							
	25								
570									
	30								
	35								

NOTES:

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-01	SHEET 1	OF 2	

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 601.4 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750, Mud Rotary, 4-7/8" Diameter Roller Bit, Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE 585.2 ft., 2/17 START 2/16/88 FINISH 2/17/88 9:10 LOGGER D. Plomp

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0							OVA bkgd = 1.0 ppm
	4.5						
5	6	01	0.9	1-1-2 (3)	SILTY, FINE to MEDIUM SAND, brown, wet, loose (SP-SM)	(SP-SM)	Sample OVA = bkgd
	9.5						
10	11	02	1.2	2-5-6 (11)	SAME AS ABOVE 10.6		
					FINE-COARSE SAND, little silt, tr. gravel, brown-red-grey, wet (SP-SM)	(SP-SM)	Sample OVA = bkgd
	14.5						587.5 Screened Interval PZ-01
15	16	03	0.2	2-3-2 (5)	SAME AS ABOVE		Discontinue OVA
	19.5				18.5		Drillers note change in drilling 582.5
20	21	04	1.2	4-6-8 (14)	SILTY CLAY, little SAND, GRAVEL, reddish grey, moist, stiff (CL-ML)	(CL-ML)	
	23.0	Shelby Tube					
	24.5						
25	26	05	1.5	6-9-12 (21)	CLAYEY SILT, little FINE SAND, reddish grey, moist, stiff (ML)	(ML)	
	29.5						
30		06	1.5	3-7-7			

CH2MHILL

PROJECT NUMBER	BORING NUMBER
L24319.A2	GT-01 SHEET 2 OF 2

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 601.4 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750, Mud Rotary, 4-7/8" Diameter Roller Bit, Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells

WATER LEVEL AND DATE 585.2 ft. 2/17 START 2/16/88 FINISH 2/17/88 9:10 LOGGER D. Plomb

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30	31	06	18"	3-7-7 (14)	SILT, little to some CLAY, tr. FINE SAND, dk. grey, tr. organic	(ML)	
	34.5						
35	36	07	18"	8-14-21 (35)	V. CLAYEY SILT, little FINE SAND, grey, moist (ML-CL)	(ML-CL)	
					36.4		Encounter very weathered dolomite bedrock
40	43.5						
	45	08	18"	32-20-75/5 (> 95)	Weathered limestone pieces w/rock flour. 45.0		
45					Bedrock – Begin rock core at 45' (see attached Rock Core Log)		Competent bedrock
50							
55							
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-01	SHEET 1	OF 1	

ROCK CORE LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 601.4 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750: NX Corng

WATER LEVEL AND DATE 16.2 ft., 2/17 START 2/16/88 FINISH 2/17/88 LOGGER D. Plomb

TOTAL RUN LENGTH: 10'
% RECOVERY: 6.8'/10' = 68%
RQD: 2.6'/10.0' = 26%

DEPTH BELOW SURFACE (FT)	DESCRIPTION/COMMENTS		LITHOLOGY
45	Hairline fractures to 1/2" throughout core; large fracture		Weathered tan dolomite Highly vugged and pitted with a calcareous cement in hairline fractures. Large fractures show heavy iron staining. Fossiliferous or dolomite crystals forming in vug areas. No developed crystals in matrix.
	Fracture (dolomite mudstone)		Loose, highly stained, highly weathered.
50	Portion of core very highly fractured, with poor recovery. High fluid loss during drilling of this portion. Fracture intensity great enough to form large gravel-sized pieces in core with most surfaces highly stained (iron).		
55	Portion of core as shown in 0-4' interval.	55.0	
	EOB @ 55'		
60			
65			
70			
75			

CH2M HILL

PROJECT NUMBER	BORING NUMBER				
L24319.A2	GT-02	SHEET	1	OF	5

SOIL BORING LOG

PROJECT DuPont Impoundment LOCATION Todtz Farm Landfill

ELEVATION 601.8 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750 4-7/8" Roller Bit: Mud Rotary; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/17/88 FINISH 2/20/88 LOGGER J. Gannon, R. Huddleston

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0							Bkgd OVA = 1.0 ppm
	3.5						
	5	01	0.5	7-2-2 (4)	COARSE SAND and FINE GRAVEL (10-12%), brown, loose, gravel is subangular to angular (SP)	(SP)	OVA = Bkgd
5							OVA on sample = Bkgd t = 16:50
	8.5						
	10	02	0.25	7-6-4 (10)	FINE to MEDIUM SAND and GRAVEL (30-40%), tr. SILT, brown, loose, gravel subangular to angular (SP)	(SP)	Cuttings circulating out of gravel t = 1730
10							OVA = Bkgd on sample End shift 18:00 2/17/88
	13.5						Begin shift 07:30 2/18/88
	15	03	0.25	6-9-4 (13)	AS ABOVE, probably cave-in		OVA on sample = Bkgd t = 0750
15							
	18.5						
	20	04	0.5	13-7-5 (12)	MED. SAND and FINE GRAVEL (30%), brown, gravel is subangular (SP)	(SP)	t = 0845
20							Lots of drill chatter - probably large cobbly zone
	23.5						
		05	0.5	5-5-5 (10)	AS ABOVE, no gravel, sand is medium to coarse (SP)	(SP)	t = 0915 OVA on sample = Bkgd
25							Drilling @ 23.5-28.5 lots of drill chatter - cobbly Drive shoe lost in hole. Abandon and move north 5 feet.
	28.5						First time no recovery – no catches in spoon – resample
	30	06	0.5	5-5-5 (10)	FINE subangular GRAVEL	(SP)	t = 1412 – Appeared washed – is probably cave-in or washed sample that didn't circulate out (no sand); formation probably as above.
30							

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-02	SHEET 2	OF 5	

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 601.8 ft. amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750 4-7/8" Roller Bit; Mud Rotary; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/17/88 FINISH 2/20/88 LOGGER J. Gannon, R. Huntington

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30							Add water and mud OVA = bkgd while drilling
	33.5						
		07	0.5	4-5-9 (14)	COARSE SAND, some MED. SAND, tr. GRAVEL (10%), brown, gravel is subangular, poorly graded (SP)	(SP)	OVA on sample = bkgd t = 1510 566.8 Screened Interval PZ-02
35							
	38.5						
		08	1.0	28-30-16 (46)	FINE-COARSE SAND, tr. FINE GRAVEL, brown grading to gray, loose, gravel is subangular, fragmented, a piece of angular, 1/4" thick at 40.5 division between brown & gray sand, poorly graded (SP)	(SP)	t = 1555 Driller notes clay-like layer at ~ 40.5', cutting off circulation (cuttings circulating are small clay chips) 561.8
40							
	43.5						
		09	2.0	3-4-4 (8)	SILTY CLAY, tr. V. FINE SAND, gray, soft, trace organics (grass-wood fragments), sticky, plastic (CL-ML)	(CL-ML)	t = 1620 Appears to be lacustrine or backwater floodplain rather than till
45							
	48.5						Slow, smooth drilling, intermittent breaks in water circulation
		10	2.0	3-4-5 (9)	AS ABOVE, with seams 1-2" thick of higher sand content, organic material not as noticable		t = 1655 Formation does not become sandier with depth but is uniform with slightly sandier or higher clay content seams or zones
50							
	53.5						
		11	2.0	7-7-9 (16)	LEAN CLAY, trace Silt, trace Sand, gray soft, organics not as noticable (CL)	(CL)	t = 1715
55							End shift 17:30 2/18/88 Begin shift 0:30 2/19/88
	58.5						
		12	2.0	9-11-13 (24)	LEAN CLAY, grey, tr. Silt, Sand, reddish brown seams (2-3mm thick) of FINE SAND, slightly stiff. No organic material noted, tiny angular blotches (~2mm dia.) of gray silt.	(CL)	t = 0750
60							

PROJECT NUMBER	BORING NUMBER		
L24319.A2	GT-02	SHEET 3	OF 5

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 601.8 ft. amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750 4-7/8" Roller Bit; Mud Rotary; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/17/88 FINISH 2/20/88 LOGGER J. Gannon, R. Henderson

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60							Slow, smooth drilling with intermittent interruptions in water circulation
	63.5						
		13	2.0	7-9-12 (21)	LEAN CLAY, some Sand, tr. Silt, grey with reddish-brown streaks, mottles, stiff, platy structure, sandy seams not noted, higher clay content than above (CL)	(CL)	t = 0815
65							Drilling as above
	68.5						
		14	2.0	9-12-16 (28)	AS ABOVE, with medium-coarse sand seam from 68.5-69', grades back to silt as above at 69.5 (69-69.5 is gradation from high sand to law sand & high silt content)	(CL)	t = 0845
70							
	73.5						
		15	2.0	15-17-17 (34)	As above, with 1" sand seam at ~ 74.5'	(CL)	t = 0915
75							
	78.5						
		16	2.0	11-13-14 (27)	LEAN CLAY, tr. Sand, grey, varve-like layers of reddish, grey & black clay layers = 3-5mm thick (CL)	(CL)	t = 0940
80					grades to		
	83.5						
		17	2.0	14-17-18 (35)	LEAN CLAY, some Sand, tr. Silt, brown, as above but varve layering not apparent (CL)	(CL)	t = 1007
85							
	88.5						
		18	2.0	12-16-20 (36)	LEAN CLAY, some Sand, reddish brown, stiff (ML-SM), from 88.5-84.5' tr. V. FINE GRAVEL (~10%; seams of MED. to COARSE SAND (~1" thick) also occur)	(CL)	Appears more till-like here t = 1055
90							

OHM/HIT

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-02	SHEET	4	OF 5

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 601.8 ft. amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750 4-7/8" Roller Bit; Mud Rotary; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/17/88 FINISH 2/20/88 LOGGER J. Gannon, R. Huddleston

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90							
	93.5						
		19	1.5	15-18-26 (44)	SILTY CLAY, trace Sand, reddish-brown, stiff to very stiff (CL)	(CL)	Does not appear till-like t = 1130
95							
	98.5						
		20	2.0	17-19-24 (43)	AS ABOVE, with fine sand seams – 3mm thick – every 6 inches. Trace dark black angular chips which appear to be wood fragments/organic material (chips are the size of coarse sand or very fine gravel, < 5%).		t = 1315
100							Slow, smooth, very level drilling with frequent interruptions in in water circulation
	103.5				AS ABOVE to 104' (ML), fine-medium sand – 1-2" thick at 104', beneath which is 104.5	(ML)	t = 1425
		21	2.0	15-18-22 (90)	SILTY FINE SAND, grey, stiff, with clay and organic material (roots, leaf/grass fragments, wood)(SM)	(SM)	
105					107.0		Driller notes changes in drilling with drill chatter. Drill bit advances somewhat easier.
	108.5						
		22	0.5	37-42-37 (79)	WEATHERED DOLOMITE – yellowish-angular, coarse gravel-sized fragments in a fine sand-like matrix (matrix is limestone weathered to sand-sized particles). Orange medium-coarse sand seam (– 2' thick) in tip of spoon. 110.0		t = 1530
110							
	113.5						
		23	0.5	18-19-22 (41)	SAND, orange-brown coarse (SP) – Sand is both quartz & limestone/dolomite fragments) – angular fragments	(SP)	t = 1665
115					116.5		Driller's note: slow, stiff drilling; circulation frequently interrupted.
	118.5						
		24	2.0	18-21-22 (43)	SILT, tr. clay, grey, moist, possibly a trace of V. FINE SAND		t = 1700 End shift 17:30 2/19/88
120							

PROJECT NUMBER	BORING NUMBER
L24319.A2	GT-02 SHEET 5 OF 5

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 601.8 ft. amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750 4-7/8" Roller Bit; Mud Rotary; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/17/88 FINISH 2/20/88 LOGGER J. Gannon, R. Houdeshell

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120							Begin shift 07:30 2/20/88
	123.5						
		25	2.0	14-14-16 (30)	CLAYEY SILT, tr. V. FINE SAND, slightly stiff (ML-CL)	(ML-CL)	t = 0945
125							Drilling easy, no chattering
	128.5						
		26	2.0	14-17-18 (35)	INTERLAYERED SANDY SILT; V. FINE SAND, lt. brown and grey, varves 3-5mm in thickness (SM-ML)	(SM-ML)	Drilling easy; no chattering t = 1015
130							
	133.5						
		27	1.5	25-39-25 (64)	133.5-134' WELL GRADED FINE to COARSE SILTY SAND, brown, loose (SW)		t = 1100
135					134-134.5' Highly weathered DOLOMITE, SAPROLITE		
					134.5-135.0' POORLY GRADED MED. SAND, blackish brown (SP)		
	138.5						
		28	1.5	45-60-104 (164)	DOLOMITE-SAPROLITE with some quartz pebbles and coarse sand		A lot of resistance t = 1115
140							
							Rock appears more competent Switch to NX coring (see Rock Core Log)
145					145.5		t = 1400
					Rock coring starting at 145.5'		
150							

PROJECT NUMBER	BORING NUMBER
L24319.A2	GT-02 SHEET 1 OF 1

ROCK CORE LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 601.8 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750; NX Coring

WATER LEVEL AND DATE START 2/17/88 FINISH 2/17/88 LOGGER J. Gannon

TOTAL RUN LENGTH: 5.8'
% RECOVERY: 4.9'/5.8' = 85%
RQD: 2.5'/5.8' = 43%

DEPTH BELOW SURFACE (FT)	DESCRIPTION/COMMENTS	LITHOLOGY
145.5		
146		Gray vuggy DOLOMITE with some iron staining. Highly weathered, highly fractured.
147		
148		
149		
150		
151		
	EOB @ 151.3'	

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-03	SHEET 1	OF 5	

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 589.3 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 850; Mud Rotary; 4-7/8" Diameter Roller Bit; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/21/88 FINISH 2/23/88 LOGGER J. Lamont

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0							Bkgd OVA - 1.0 ppm
	3.5						
		01	0.9	2-1-2 (3)	FINE-COARSE SAND, some Gravel, tr. Silt, Gravel is low to medium dense, subangular to rounded (SP)	(SP)	OVA = bkgd
5							
	8.5						
		02	0.25	1-1-4 (5)	FINE-COARSE SAND with GRAVEL, tr. Silt, gravel subangular to rounded (SP) 9.9	(SP)	OVA = 2.6 PPM deflection in sample. Black discoloration in spoon tip. 580.19
10					SAME AS ABOVE, but w/black discolorations		Screened Interval PZ-03
	13.5						
		03	0.5	3-5-7 (12)	SAME AS ABOVE 14.5	(SP)	OVA = bkgrd (open spoon) 575.19
15	15.0				SILTY CLAY, brown, moist, soft to med. stiff, very homogeneous (CL)	(CL)	
	17.0	Shelby Tube					
	18.5						
		04	1.4	5-5-10 (15)	SILTY CLAY, brown-grey, moist, med. stiff, homogeous, some indication of lamination (CL)	(CL)	OVA = bkgrd (open spoon) Backwater environment
20							End shift 17:30 2/21/88
							Begin shift 07:30 2/22/88
	23.5						
		05	1.5	8-12-14 (26)	SILT, some Clay, brown-grey, moist, med. stiff, laminated (ML-CL)	(ML-CL)	OVA - bkgrd (open spoon)
25							
	28.5						
		06	1.5	4-4-7 (11)	AS ABOVE, with 1/2" seam of organic material (wood and leaves) near bottom (ML-CL)	(ML-CL)	OVA = .2 PPM deflec. (on op. spoon) penetrometer = 3.5
30							

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-03	SHEET 2	OF 5	

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill
ELEVATION 589.3 ft., amsl DRILLING CONTRACTOR ETI
DRILLING METHOD AND EQUIPMENT CME 850; Mud Rotary; 4-7/8" Diameter Roller Bit; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)
WATER LEVEL AND DATE START 2/21/88 FINISH 2/23/88 LOGGER J. Lamont

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30							
	33.5						
		07	1.5	4-7-11 (18)	AS ABOVE 34.5	(ML-CL)	OVA = 0.2 PPM deflection (open spoon)
35					V. FINE SANDY SILT with CLAY, brown-grey, med. dense (ML)	(ML)	OVA = 4 PPM deflection (open spoon) Organics (wood)(sampled sandy silt)
	38.5						
		08	1.3	5-9-12 (21)	CLAYEY SILT, brown-grey, moist, stiff, well laminated (CL-ML)	(CL-ML)	OVA = bkgrd (open spoon) penetrometer = 4.0
40							
	43.5						
		09	1.3	7-11-16 (27)	CLAYEY SILT, brown-grey, moist, med. stiff, well laminated (CL-ML) 44.5	(CL-ML)	OVA = bkgrd on (open spoon) penetrometer = 3.25
45					V. FINE SANDY SILT with CLAY, brown-grey, low to med. dense (ML)	(ML)	
	48.5						
		10	1.3	6-8-15 (23)	CLAYEY SILT, brown-grey, moist, medium stiff to stiff (CL-ML)	(CL-ML)	OVA = bkgrd (open spoon)
50							
	53.5						
		11	1.5	7-9-15 (24)	INTERLAYERED CLAYEY SILT (50%) and SANDY SILT (50%): CLAYEY SILT, brown-grey, med. stiff, homogeneous, moist; SANDY SILT, brown-grey, wet, med. dense, 3 to 6" layers (CL and ML)		OVA = 0.3 PPM deflection on (open spoon)
55							
	58.5						
		12		7-11-13 (24)	AS ABOVE (CL and ML)		OVA = bkgrd (open spoon) penetrometer = 2.50
60							

CH2M HILL

PROJECT NUMBER	BORING NUMBER				
L24319.A2	GT-03	SHEET	3	OF	5

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 589.3 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 850; Mud Rotary; 4-7/8" Diameter Roller Bit; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/21/88 FINISH 2/23/88 LOGGER J. Lamont

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60							
	63.5						
		13	100% 1.5	7-11-16 (27)	CLAYEY SILT, brown-grey, moist, med. stiff, homogeneous with a 2" seam of SANDY SILT, brown-grey, wet, med. dense (ML and CL)	(ML-CL)	OVA = bkgrd (open spoon) penetrometer = 3.5
65							
	68.5						
		14	100% 1.5	7-10-16 (26)	CLAYEY SILT, brown-grey, moist, med. stiff, homogeneous (ML-CL) 69.5	(ML-CL)	OVA = 0.2 PPM deflection on the (open spoon) Penetrometer = 3.5
70					FINE SANDY SILT, brown-grey, wet, w/clay, med. dense 69.8	(ML)	
					SILTY CLAY, brown-grey, moist, med. stiff, homogeneous (CL-ML)	(CL-ML)	
	73.5						
		15	100% 1.5	9-13-17 (30)	CLAYEY SILT, brown-grey, moist, med. stiff to stiff, homogeneous (ML-CL) 74.0	(ML-CL)	OVA = bkgrd (open spoon) Penetrometer = 4.5
75					FINE SANDY SILT with CLAY, brown-grey, wet, medium dense, trace gravel (ML)	(ML)	
	78.5						
		16	1.2	4-7-13 (20)	FINE SANDY SILT with CLAY, brown-grey, wet, med. dense, some fine GRAVEL, DOLOMITE pebbles (ML)	(ML)	OVA = bkgrd (open spoon) penetrometer = 4.0
80							
	83.5						
		17	1.5	8-13-19 (32)	AS ABOVE (ML) 84.0	(ML)	OVA = bkgrd (open spoon)
					CLAYEY SILT, brown-grey, moist, stiff to v. stiff (ML-CL)	(ML-CL)	Penetrometer = 4.5
85							
	88.5						
		18	1.3	8-25-25 (50)	AS ABOVE (ML-CL)	(ML-CL)	OVA = bkgrd on (open spoon) Penetrometer = 4.5
90					SANDY SILT, tr. CLAY, brown-grey 89.5 with coarse gravel, subangular dolomite weathered fragments (ML)	(ML)	

CH2M HILL

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-03	SHEET 4	OF 5	

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 589.3 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 850; Mud Rotary; 4-7/8" Diameter Roller Bit; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/21/88 FINISH 2/23/88 LOGGER J. Lamont

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90							
	93.5				V. FINE SILTY SAND, some CLAY, blue-grey, wet, low to med. dense, somewhat laminated (SM) 94.0	(SM)	OVA = Bkgrd (open spoon) Sampled both
		19	1.5	8-12-17 (29)	V. FINE SILTY SAND to SANDY SILT, some CLAY, orangish brown, wet, med. dense, homogeneous (SM-ML)	(SM-ML)	Penetrometer = 2.0
95	98.5						
		20	0.7	15-22-30 (52)	AS ABOVE (SM-ML) 99.5	(SM-ML)	OVA = bkgrd (open spoon)
100					FINE to COARSE POORLY GRADED SAND, lt. orangish brown, wet, very clean, dense (SP to SM)	(SP-(SM)	
	103.5						
		21	1.5	9-13-16 (29)	CLAYEY SILT, brown-grey, moist, stiff to v. stiff, homogeneous (ML-CL)	(ML-CL)	OVA = bkgrd (open spoon) Penetrometer = 4.5
105	108.5						
		22	1.5	14-17-25 (42)	CLAYEY SILT, grey, moist, stiff to v. stiff, homogeneous (CL-ML)	(CL-ML)	Only grey, no brown anymore OVA = bkgrd (open spoon) Penetrometer = 4.0
110	113.5						
		23	1.5	13-12-15 (27)	CLAYEY V. FINE SILT, lt. brown to buff, moist, stiff to v. stiff, homogeneous (ML-CL)	(ML-CL)	OVA = bkgrd (open spoon) Penetrometer = 4.0 Color change right at 113.5 ft.
115	118.5						
		24	1.5	11-19-27 (46)	CLAYEY V. FINE SILT, brown-grey with some orange, some FINE to COARSE GRAVEL (dolomite), moist, stiff to v. stiff, laminated (ML)	(ML)	OVA = bkgrd (open spoon) Penetrometer = 4.25
120							

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-03	SHEET 5	OF 5	

SOIL BORING LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 589.3 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 850: Mud Rotary: 4-7/8" Diameter Roller Bit: Standard Split Spoon Sampling: 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/21/88 FINISH 2/23/88 LOGGER J. Lamont

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
120							
	123.5						
			0	50/6	Bedrock (weathered) 125.0'		Refusal – Spoon bounces off bottom of hole
125					Rock Core Log begins at 125.8'		(see Rock Core Log)

CH2M HILL

PROJECT NUMBER	BORING NUMBER
L24319.A2	GT-03 SHEET 1 OF 1

ROCK CORE LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill
ELEVATION 589.3 ft., amsl DRILLING CONTRACTOR ETI
DRILLING METHOD AND EQUIPMENT CME 850; NX Coring
WATER LEVEL AND DATE START 2/2/88 FINISH 2/23/88 LOGGER J. Lamont

TOTAL RUN LENGTH: 3.7 ft.
% RECOVERY: 2.4'/3.7' = 65%
RQD: 0.0'/3.7' = 0%

DEPTH BELOW SURFACE (FT)	DESCRIPTION/COMMENTS	LITHOLOGY
125.8		
126	Maximum core length = 3" Minimum core length = 1/2" Average core size = 1-1/2"	Vuggy DOLOMITE, light brown to buff color with some orange iron oxide staining. Thinly bedded with a couple of fractures
127		
128		
129		
130		
131	EOB @ 131.3'	

CH2M HILL

PROJECT NUMBER	BORING NUMBER				
L24319.A2	GT-04	SHEET	1	OF	2

SOIL BORING LOG

PROJECT Dupont Impoundment RI/FS LOCATION Todtz Farm Landfill
ELEVATION 586.4 ft., amsl DRILLING CONTRACTOR ETI
DRILLING METHOD AND EQUIPMENT CME 750; Mud Rotary (4-7/8" Roller Bit); Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)
WATER LEVEL AND DATE START 2/23/88 FINISH 2/24/88 LOGGER J. Gannon

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0							OVA Bkgd = 1.0 ppm
	4.0						Water @ 5 ft.
5	5.5'	01	0.25	1-2-1 (3)	FINE to COARSE POORLY GRADED SAND with GRAVEL (15%) gravel is 0.5 - 2.0 cm diam., clean, mostly coarse sand, loose, moist	(SP)	OVA = Bkgrd Drilling Rate Fast 2.5 ft./min.
	9.0						
10	10.5'	02	0.33	4-4-5 (9)	FINE to COARSE POORLY GRADED SAND WITH GRAVEL (~ 15%, 0.5 to 3.0 cm diam.), brown, clean, sand mostly med. grained, loose, moist	(SP)	OVA = Bkgrd Drilling is easy.
	14.0						
15	15.5	03	0.3	5-5-6 (11)	AS ABOVE	(SP)	OVA = Bkgrd 571.81
	19.0						Screened Interval PZ-04
20	20.5	04	1.0	4-4-6 (10)	MED. POORLY GRADED SAND, tr. gravel (<5%); dense (SP) 20.0	(SP)	OVA = bkgrd 566.81
	24.0				SILTY CLAY, LITTLE SAND 6-12" greenish grey, stiff (CL) 24.0	(CL)	OVA = Bkgrd
25	25.5	05	1.0	16-24-28 (52)	Highly weathered, gray dolomite, saprolite, soft, some iron staining		Chattering while drilling. Too soft to core.
30							

PROJECT NUMBER	BORING NUMBER				
L 24319. A2	GT-04	SHEET	2	OF	2

SOIL BORING LOG

PROJECT Dupont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 586.42 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 750; Mud Rotary; 4-7/8" Roller Bit; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/23/88 FINISH 2/24/88 LOGGER J. Gannon

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	29.0						
30	30.5	06	1.0	42-31-23 (54)	GRAY HIGHLY WEATHERED DOLOMITE, Saprolite, Soft		CHATTERING WHILE OVA = Bkgrd
	34.0						
35	35.5	07	0	100/6	No Recovery (Assume Dolomite)		LOTS OF CHATTERING DRILLING IS DIFFICULT
	39.0						
40	40.5	08	0	100/6	No Recovery (Assume Dolomite)		
	44.0						
45	45.5	09	0.2	100/6	GRAY, HIGHLY WEATHERED DOLOMITE		OVA = bkgrd
	49.0						
50	50.5	10	0.1	100/6	AS ABOVE 50.5		OVA = bkgrd
					Rock Core log begins at 50.5 ft.		See Rock Core Log

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-04	SHEET 1	OF 1	

ROCK CORE LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill
ELEVATION 586.4 ft., amsl DRILLING CONTRACTOR ETI
DRILLING METHOD AND EQUIPMENT CME 750: NX Coring
WATER LEVEL AND DATE START 2/23/88 FINISH 2/24/88 LOGGER J. Gannon

TOTAL RUN LENGTH: 3 ft.
% RECOVERY: 2.4'/3.0' = 80%
RQD: 0.0'/3.0' = 0%

DEPTH BELOW SURFACE (FT)	DESCRIPTION/COMMENTS	LITHOLOGY
50		
51		Gray fossiliferous DOLOMITE, vuggy in places. Fossils include gastropods, crinoids, some iron staining. Appears relatively hard with no visibly weathered zones (weathered zones may have been washed out of the sample). Highly fractured.
52		
53		
	EOB @ 53.5'	

PROJECT NUMBER	BORING NUMBER				
L24319.A2	GT-05	SHEET	1	OF	4

SOIL BORING LOG

PROJECT Dupont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 582.7 ft. amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 850; Mud Rotary, 4-7/8" Diameter Roller Bit; Standard Split Spoon Sampling; 6-1/4" ID HSA (Well:

WATER LEVEL AND DATE START 2/19/88 FINISH 2/20/88 LOGGER M.Hinchey,J.LaM

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0					FILL, Ash, Wood, in sand and gravel matrix		Bkgd OVA = 1.0 ppm 1st 6 inches (Black H_2O) with (a sheen) OVA deflection of 4 ppm at
	3.5	01	0.5	2-2-3 (5)	Waste mixed w/ sands and trace gravel 4.5		HNu = background 578.41
5	5.0	Shelby Tube	1.5		CLAY, some Silt grey to brown, moist, soft (CL)	(CL)	Fuel oil smell Color change of H_2O to brown (OVA = 0.2 ppm sample)
	7.0				AS ABOVE	(CL)	Screened Interval DP-05
	8.5	02	1.5	3-4-5 (9)	CLAY with some SILT and V. FINE SAND, brown/grey, moist, soft to medium stiff, alternating brown and gray stratification Trace more silt, v. fine sand in shoe of split spoon	(CL)	t = 1400 Wood fragments 573.41
10							
	13.5	03	1.5	3-3-3 (6)	2" CLAY 6" FINE SANDY SILT, brown 1" CLAYEY SILT, brown 9" SANDY, SILTY CLAY, brown to gray all moist, soft possible mottling, laminated	(CL)	t = 1404 (Backwater lacustrine environment)
15							
	18.5	04	1.5	3-3-9 (12)	SILTY CLAY, brown to gray, moist, med. stiff, uniform sample (no gradation as above) dk. gray, v. stiff clay in shoe of split spoon.	(CL)	Some Organic Matter OVA = 4.5 ppm (headspace)
20							
	23.5	05	1.5	4-5-6 (11)	SILTY CLAY, brown to gray, moist, soft to med. stiff, not as fat, well-laminated, a little v. fine SAND in shoe	(CL)	OVA = 4.5 ppm (Headspace t = 14:15)
25							
	28.5	06	1.5	3-4-6 (10)	SILTY V. FINE SANDY CLAY, brown-gray moist, soft to med. stiff, lamination not so apparent (more homogeneous)	(CL)	OVA = 1.2 ppm (open spoon)
30							

PROJECT NUMBER	BORING NUMBER				
L24319.A2	GT-05	SHEET	2	OF	4

SOIL BORING LOG

PROJECT Dupont Impoundment RI/FS LOCATION Todtz Farm Landfill
ELEVATION 582.7 ft., amsl DRILLING CONTRACTOR ETI
DRILLING METHOD AND EQUIPMENT CME 850; Mud Rotary; 4-7/8" Diameter Roller Bit; Standard Split Spoon Sampling; 6-1/4" ID HSA (Well
WATER LEVEL AND DATE START 2/19/88 FINISH 2/20/88 LOGGER M.Hinchey J.LaM

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
30							
	33.5	07	1.5	4-7-11 (18)	SILTY CLAY, brown to grey, moist, med. stiff to stiff, (more homogeneous) no apparent lamination	(CL)	H_2S-like smell OVA = 1.4 ppm from sample head
35							
					ALTERNATING THIN BEDS of CLAY and SAND; CLAY, very stiff; SILTY FINE to MED SAND, tr. CLAY, brown-gray, moist	(CL-SW)	
	38.5	08	1.5	5-8-12 (20)	39.0 SILTY CLAY, brown-gray, moist, med. stiff	(CL)	Sampled Sandy Material OVA = 2 ppm (Sample head)
40							
	43.5	09	1.5	4-9-15 (24)	SILTY CLAY, brown to gray, moist, stiff to v. stiff	(CL)	OVA = bkgrd
45							
	48.5	10	1.5	9-12-18 (30)	AS ABOVE 49.5 SILTY FINE to MED. SANDY CLAY, brown-grey, moist, med. dense, 1" of silty clay	(CL)	OVA = bkgrd (well head)
50							
	53.5	11	1.4	12-18-24 (42)	SILTY CLAY, brown to gray, stiff to v. stiff, moist	(CL)	OVA = bkgrd (open spoon)
55							
	58.5	12	1.5	9-16-20 (36)	SILTY CLAY, brown to gray, moist, stiff 59.5 SILTY, FINE to MED. SANDY CLAY, brown-gray, moist, med. dense	(CL) (CL-ML)	Sampled Sandy Portion
60							

PROJECT NUMBER	BORING NUMBER				
L24319.A2	GT-05	SHEET	3	OF	4

SOIL BORING LOG

PROJECT Dupont Impoundment RI/FS LOCATION Todtz Farm Landfill
ELEVATION 582.7 ft., amsl DRILLING CONTRACTOR ETI
DRILLING METHOD AND EQUIPMENT CME 850: Mud Rotary, 4-7/8" Roller Bit; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)
WATER LEVEL AND DATE START 2/19/88 FINISH 2/20/88 LOGGER M.Hinchey J.LaMorte

DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
60							
	63.5	13	1.2	12-20-80 (100)	SILTY, FINE to MED. SAND, tr. CLAY, brownish orange, nicely laminated, 1-inch subangular chert pebble	(SM)	Sampled (both units) OVA = bkgrd (open spoon)
65					FINE to MED SAND, SILT, tr. CLAY, 10 - 20% GRAVEL, white and dk. greenish, gravel is angular		gravel decomposed rock?
	68.5	14	1.5	16-34-45 (79)	V. FINE SANDY SILT to V. FINE SAND, tr. CLAY, lt. orange brown, dense to v. dense, laminated	(SM to ML)	OVA = bkgrd (open spoon)
70							End shift 17:20 2/19/88 Begin shift 07:30 2/20/88
	73.5	15	1.4	11-23-24 (47)	AS ABOVE	(SM to ML)	OVA = bkgrd (open spoon)
75							
	78.5	16	14.0	15-24-52 (76)	V. FINE CLAYEY SILT to SILTY CLAY, some GRAVEL, reddish brown to gray, v. stiff to hard, some dolomite pebbles and subangular gravel	(CL to ML)	OVA = bkgrd on sample Possibly till.
80							
	83.5	17	1.5	15-20-30 (50)	AS ABOVE with just a little more dolomite gravel and chert	(CL)	OVA = bkgrd sample
85							
	88.5	18	0.0	80/0.1	Refusal No Recovery		Refused at 88.5 ft Appears to be a dolomite (weathered) smear on sampling spoon
90							

PROJECT NUMBER	BORING NUMBER			
L24319.A2	GT-05	SHEET 4	OF 4	

SOIL BORING LOG

PROJECT Dupont Impoundment RI/FS LOCATION Todtz Farm Landfill

ELEVATION 582.7 ft., amsl DRILLING CONTRACTOR ETI

DRILLING METHOD AND EQUIPMENT CME 850; Mud Rotary, 4-7/8" Diameter Roller Bit; Standard Split Spoon Sampling; 6-1/4" ID HSA (Wells)

WATER LEVEL AND DATE START 2/19/88 FINISH 2/20/88 LOGGER M.Hinchey,J.LaMor

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
90							Drilling still easy; continue to drill until more competent rock encountered.
	93.5	No Sample	0.0	145/0.2	Refusal No Recovery 95.0		
95					EOB Rock core begins at 97'		Drilling still easy. Decide to try to core.
100							
105							
110							
115							
120							

PROJECT NUMBER	BORING NUMBER
L24319.A2	GT-05 SHEET 1 OF 1

ROCK CORE LOG

PROJECT DuPont Impoundment RI/FS LOCATION Todtz Farm Landfill
ELEVATION 582.7 ft. amsl DRILLING CONTRACTOR ETI
DRILLING METHOD AND EQUIPMENT CME 850; NX Coring
WATER LEVEL AND DATE START 2/29/88 FINISH 2/20/88 LOGGER J. Lamont

TOTAL RUN LENGTH: 5.5 ft.
% RECOVERY: 4.4'/5.5' = 80%
RQD: 0.0'/5.5' = 0%

DEPTH BELOW SURFACE (FT)	DESCRIPTION/COMMENTS	LITHOLOGY
97		Vuggy dolomite, lt. brown grey to orange color, iron-oxide staining, highly weathered. Thinly bedded. A few fractures.
98		
99		
100		
101		
102		
	EOB @ 102.5	

APPENDIX B

Photographic Record

Site Name: **DuPont/Todtz Farm Site**
Site Location: **Camanche, Iowa**
EPA Work Assignment No.: **006-ROBF-07X7**
Sverdrup Project Reference No.: **000155-006003**

Sverdrup

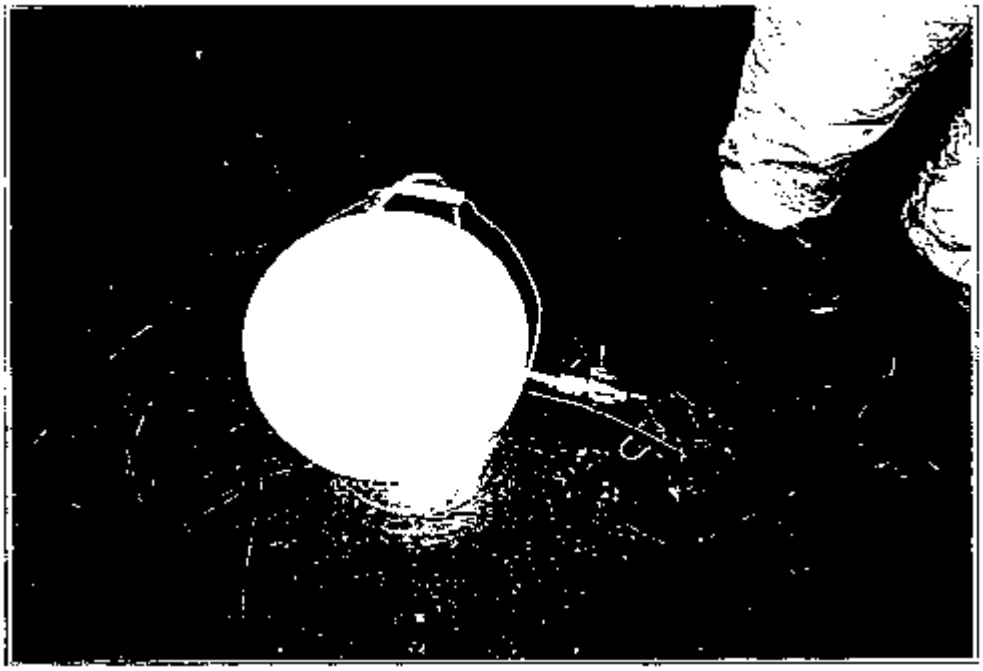
No. 1

Description
"Dirty" purge water at DU-04S.

Direction:
Photo looking down at the ground.

Photographer:
T. Trometer

Date:
September 28, 1999



No. 2

Description:
Monitoring well DU-04S and mounding of the surface completion.

Direction:
Photo looking east.

Photographer:
T. Trometer

Date:
September 28, 1999

Photographic Record

Site Name: **DuPont/Todtz Farm Site**
Site Location: **Camanche, Iowa**
EPA Work Assignment No.: **006-ROBF-07X7**
Sverdrup Project Reference No.: **000155-006003**

Sverdrup

No. 3

Description:
Monitoring well DU-05S and mounding of the surface completion.

Direction:
Photo looking southeast.

Photographer:
T. Trometer

Date:
September 28, 1999

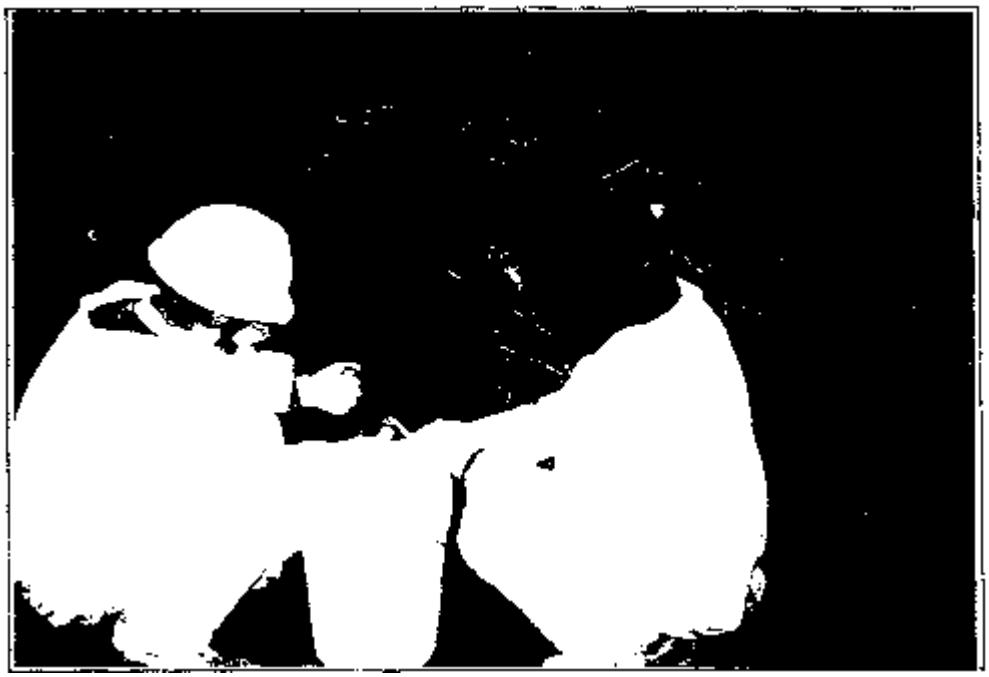
No. 4

Description:
Sample collection at DU-05S.

Direction:
Photo looking down.

Photographer:
T. Trometer

Date:
September 28, 1999



Photographic Record

Site Name: **DuPont/Todtz Farm Site**
Site Location: **Camanche, Iowa**
EPA Work Assignment No.: **006-ROBF-07X7**
Sverdrup Project Reference No.: **000155-006003**

Sverdrup

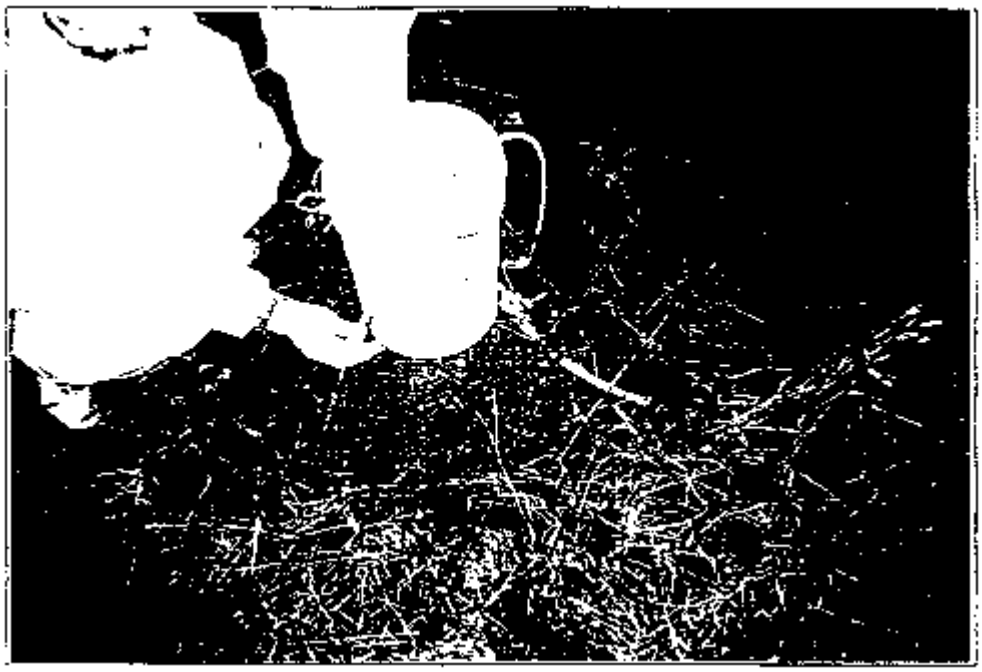
No. 5

Description:
Sample collection at DU-04S.

Direction:
Photo looking down.

Photographer:
T. Trometer

Date:
September 28, 1999



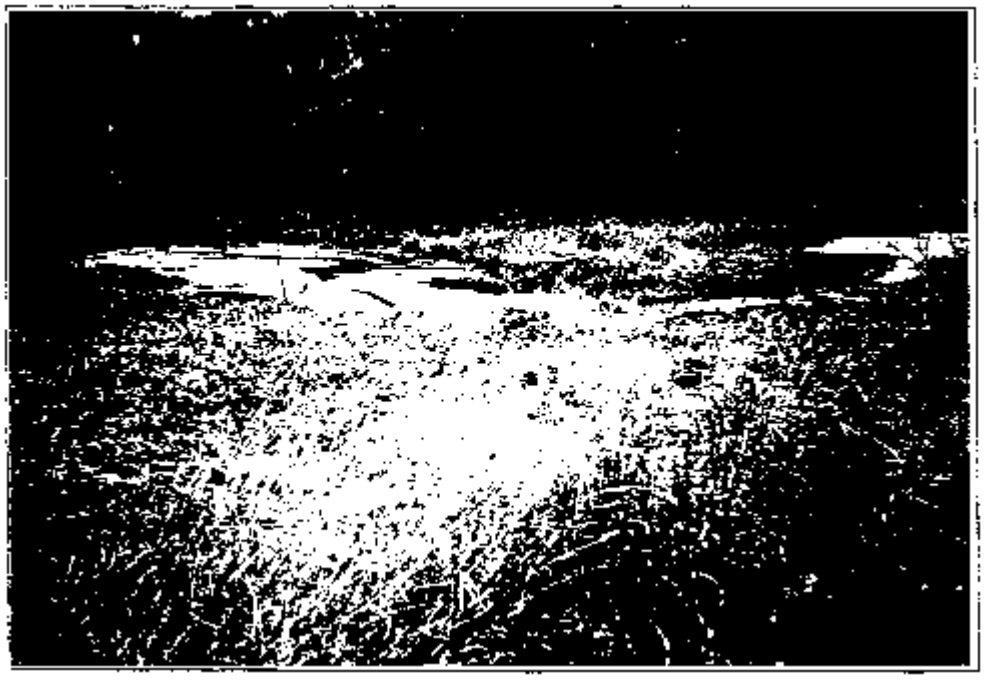
No. 6

Description:
Bog/swamp located adjacent to DU-04S.

Direction:
Photo looking northeast.

Photographer:
T. Trometer

Date:
September 28, 1999



Photographic Record

Site Name: **DuPont/Todtz Farm Site**
Site Location: **Camanche, Iowa**
EPA Work Assignment No.: **006-ROBF-07X7**
Sverdrup Project Reference No.: **000155-006003**

Sverdrup

No. 7

Description:
DuPont/Todtz Farm impoundment.

Direction:
Photo looking northeast.

Photographer:
T. Trometer

Date:
September 28, 1999

Appendix C

#83541

THE UNIVERSITY OF IOWA

June 28, 1999

Ms. Nancy Swyers
EPA Region VII
901 N. 5th Street
Kansas City, KS 66101

Dear Ms. Swyers:

Enclosed is a copy of the letter I sent to Mr. Bob Summers, Clinton County Sanitarian, summarizing the detects from the results of analyses for the Clinton County Groundwater Monitoring Project. These samples were collected May 18, 1999.

Please give me a call if you have any questions about these results.

Sincerely,

M. Lynn Hudachek

M. Lynn Hudachek
Program Associate

Enclosure

HYGIENIC LABORATORY
102 Oakdale Campus, #H101 OH
Iowa City, Iowa 55242-5002
319/335-4500

Iowa's Environmental and Public Health Laboratory

FAX: 319/335-4555
http://www.uhl.uiowa.edu

THE UNIVERSITY OF IOWA

June 18, 1999

Mr. Bob Summers
Clinton County Sanitarian
428 East 11 th Street
DeWitt, IA 52742-1416

Dear Bob:

Following is a summary of results from the Clinton County Groundwater Monitoring Project samples collected May 18, 1999. I also mailed each individual their respective analytical report.

SODIUM - Sodium is a naturally occurring element in the earth and all levels detected in the following samples are considered normal background concentrations in most midwestern groundwater supplies.

Location	UHL Sample ID#	Concentration (ppm)
L. Arns	9902724	30
L. Bandixen	9902727	6.7
W. Bandixen	9902729	17
J. Bark	9902726	4.5
S. Bark	9902725	5
R. Bierly	9902716	9.3
L. Foley	9902715	7.2
L. Huizenga	9902719	16
R. Kilgore	9902717	150
E. LeDoux	9902721	26
C. LeQue	9902718	11
A. Murphy	9902728	5
J. Payne	9902722	12
J. Pieczynski	9902731	29
T. Sachsenmaier	9902723	4.1
H. Thompson	9902720	17
L. Todtz	9902730	4.2

HYGIENIC LABORATORY
102 Oakdale Campus, #H101 OH
Iowa City, Iowa 55242-5002
319/335-4500
Iowa's Environmental and Public Health Laboratory
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RADON - Radon is a naturally occurring gas. At the present time EPA is debating the MCL for radon, so there is no set standard for radon in drinking water. The health risks associated with radon come from breathing air containing high levels of radon gas. The risk of having radon in your water is not from drinking the water. When water is used for drinking, cooking, washing, etc. the gas is released into the air.

Location	UHL Sample ID#	Concentration (pCi/L)
L. Arns	9902724	290
L. Bandixen	9902727	43
W. Bandixen	9902729	118
J. Bark	9902726	94
S. Bark	9902725	192
R. Bierly	9902716	46
J. Bousman	9902736	153
L. Foley	9902715	281
J. Gluesing	9902737	296
L. Huizenga	9902719	380*
R. Kilgore	9902717	208
E. LeDoux	9902721	418*
C. LeQue	9902718	238
L. Munck	9902734	313*
A. Murphy	9902728	83
J. Payne	9902722	124
J. Pieczynski	9902731	29
T. Sachsenmaier	9902723	82
J. Thomas	9902733	294
H. Thompson	9902720	560*
L. Todtz	9902730	73
A. VanZee	9902738	58
J. Wisor	9902735	188

*If you would like further information about radon you can call the Iowa Department of Public Health's radon information line at 1-800-383-5992.

You have already received the nitrate and coliform bacteria results, however, I went ahead and listed the samples with detects.

NITRATE & NITRITE AS $N0_3$ -

Location	UHL Sample ID#	Concentration (mg/L)
L. Arns	9902724	25
L. Bandixen	9902727	69
W. Bandixen	9902729	57
J. Bark	9902726	11
S. Bark	9902725	22
J. Bousman	9902736	61
E. LeDoux	9902721	2
L. Munck	9902734	101
A. Murphy	9902728	4
T. Sachsenmaier	9902723	13
L. Todtz	9902730	16
A. VanZee	9902738	6
J. Wisor	9902735	84

TOTAL COLIFORM BACTERIA -

Location	UHL Sample ID#	Concentration (MPN)
R. Bierly	9902716	2.2
J. Bousman	9902736	5.1
J. Gluesing	9902737	16
R. Kilgore	9902717	2.2
T. Sachsenmaier	9902723	16

LEAD - The EPA's action level for lead in drinking water is .015 ppm. The lead level detected in the sample below is greater than the action level. Typically lead in drinking water comes from lead pipes. It is advisable to let the water run awhile before using it for drinking or cooking purposes.

Location	UHL Sample ID#	Concentration (ppm)
J. Wisor	9902735	0.14