KeySpan Corporation
Environmental Asset Management
One MetroTech Center
Brooklyn, NY 11201

October 30, 2003

Mr. Lech Dolata
Project Manager
NYSDEC - Division of Environmental Remediation
Remedial Bureau C
625 Broadway
Albany, New York 12233-7014

Subject: **Additional Copy of the Final Remedial Design**
Former Brooklyn Borough Gas Works Site
Order on Consent Index No. D2-001-94-12

Dear Mr. Dolata:

As per your request, please find an additional bound copy of the document entitled:

"Final Remedial Design for Operable Unit No. 1, Former Brooklyn Borough Gas Works Site, Brooklyn, New York"

If you have any questions please contact me at 718-403-3053.

Sincerely,

for Tracey Bell
Project Manager

cc: J. Bolan (KeySpan Business Solutions)
R. Olewinski (TtFW, Inc.)

KeySpan Corporation
Environmental Asset Management
One MetroTech Center
Brooklyn, NY 11201

October 7, 2003

Mr. Lech Dolata
Project Manager
NYSDEC – Division of Environmental Remediation
Remedial Bureau C
625 Broadway
Albany, New York 12233-7014

SUBJECT: RESPONSE TO AUGUST 28, 2003 NYSDEC LETTER
REVISED DRAFT FINAL REMEDIAL DESIGN OU-1
FORMER BROOKLYN GAS WORKS SITE, CONEY ISLAND
ORDER ON CONSENT INDEX NO. D2-001-94-12

Dear Mr. Dolata:

KeySpan Corporation (KeySpan) has received and reviewed your letter dated August 28, 2003. Your letter contains the New York State Department of Environmental Conservation's (NYSDEC's) comments on the *Revised Draft Final Remedial Design Report for Operable Unit No. 1, Former Brooklyn Borough Gas Works Site, Brooklyn, New York* (Revised Draft Final RD Report), submitted on July 29, 2003. KeySpan's responses to your comments are provided herein. KeySpan is available to meet with the NYSDEC to discuss any questions that you may have concerning our responses.

This letter also describes changes that were made to the design package during finalization. The changes are presented immediately following the responses to your comments.

NYSDEC Comment 1

INVITATION FOR BID, page 6 Section C, in the first sentence, please insert "and the State of New York" between words "the Field Engineer" and "access".

Response to Comment 1:
The section referenced by the NYSDEC is standard language provided to the Contractors. Advice to the Contractor that there will be an onsite representative of NYSDEC is discussed in several places within KeySpan's Request For Bids, most notably in Attachment 3, Construction Quality Assurance Plan.

NYSDEC Comment 2

AGREEMENT, page 5, Section 4, paragraph A, the referenced "Notice of Solicitation listed in Article 1" was not found in this document. The completion time for the contract work appears undefined.

Response to Comment 2:
KeySpan sent out a Request for Proposal (RFP) to six remedial construction companies. Five of these companies participated in a Bid Walk at the site on August 28, 2003. Bids were received from four companies on September 11, 2003 and are being evaluated by KeySpan. KeySpan will award the contract in September 2003 or as soon as possible therafter.

Although the completion time for the contract work appears undefined, the Revised Draft Final RD Report includes schedules in Appendix A. A more accurate schedule will be available after the contract award

NYSDEC Comment 3

TECHNICAL SPECIFICATIONS, Section 1.2, the installation of relief wells in lieu of Temporary Groundwater Collection System, proposed by KeySpan during our April 9, 2003 meeting, was not addressed in this section.

Response to Comment 3:
Since the April 9, 2003 meeting, there have been design changes agreed to by KeySpan and the NYSDEC. One of these changes involved the elimination of the temporary cover system (the Posi-Shell™ Cover System) during OU-1 activities. KeySpan prepared a groundwater model based on this change, utilizing the depth of the vertical barrier cutoff wall, the average annual rainfall for the area, and the site geology. The results of the groundwater modeling, provided in Section 2.3 of the Revised Draft Final RD Report, indicate that the increase in groundwater levels following the execution of OU-1 remedial activities is negligible. Therefore, KeySpan did not include the relief wells for OU-1 construction activities.

NYSDEC Comment 4

ATTACHMENT 2, Section 5.5.1: If total organic vapor levels are greater than 5 parts per million (ppm), but less than 25 ppm over background, work activities must be temporarily halted, the sources of the vapors identified, corrective actions taken to abate emissions, and monitoring continued in accordance with the NYSDOH Generic Community Air Monitoring Plan. Further if the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown. The Vapor Emission Response Plan must be revised accordingly.

Response to Comment 4:
KeySpan has revised Section 5.5.1 of the *Generic Health and Safety Plan* to comply with the *NYSDOH Generic Community Air Monitoring Plan.*

NYSDEC Comment 5

5 a) ATTACHMENT 3, page 02300-2, PART 2, section 2.1.1, three types of coating are available for WEZ95 sheet piles. Please define the coating to be applied.

5 b) Page 02300-4, subsection 3.5.9, a video inspection should be initially performed on every joint installed. The frequency of the video inspection may be later reduced, if it has been documented that pile joints are of acceptable quality.

Response to Comment 5 a:
Based on the results of a Compatibility Test performed by C3 Environmental Limited (see Attachment 4 of the Revised Draft Final RD Report) and the proposed OU-3 activities (i.e., cutting of the Waterloo Barrier® System to construct the environmental buffer zone), KeySpan does not believe that additional corrosion protection is required for the Waterloo Barrier® System. Therefore, KeySpan has eliminated the need for coal tar coatings on the WEZ sheet pile.

KeySpan has revised Section 3.2.2 of the Report and Section 02400 of Attachment 3 (Technical Specifications) to reflect this design change.

Response to Comment 5 b:
Based on discussions with the NYSDEC, the Contractor will inspect, with video equipment, the first 30 joints installed for the Waterloo Barrier® System. Based on these inspections showing satisfactory results, the Contractor will video inspect one joint out of every 50, thereafter, for the remainder of the Waterloo Barrier® System. KeySpan has revised Section 3.5.9 on Page 02300-4 (Technical Specifications) to reflect this design change.

NYSDEC Comment 6

6 a) Section 02400-2, PART 2, subsection 2.1.1, please define the grade of the steel for the AZ 13 piles.

6 b) Subsection 2.1.3, please define the fabricator of a Coal Tar Epoxy Coating.

Response to Comment 6 a:
Section 02400, Part 1 – section 1.2.2 has been modified to identify the grade of steel as ASTM 690, marine steel.

Response to Comment 6 b:
The upgrade to ASTM 690, marine steel, eliminates the need for the coal tar epoxy coating.

NYSDEC Comment 7

Sheet C-1, the legend seem to be incomplete e.g. The violet line presumably marks a wetland but is not defined, there are two different kinds of undefined red line, the blue line along the western limit of the site is not defined and the existing bulkhead location is unclear.

Response to Comment 7:
KeySpan has revised the Drawing C-1 to address the above comments.

NYSDEC Comment 8

Sheet C-2, please design the interim runoff discharge points (to perform until the final cap has been installed) and show their locations.

Response to Comment 8:
Based upon the current OU-1 design, KeySpan does not believe that stormwater runoff to the creek will be a problem. The basis for this reasoning includes:

- The existing topography of the site is not conducive to stormwater runoff to the creek. This topography will not be affected by OU-1 activities.
- A relatively small area of the site will be disturbed during OU-1 construction activities. Most of the site vegetation will remain undisturbed. This vegetation absorbs moisture from stormwater events thus reducing the amount of potential runoff to the creek
- The subsurface soil is sandy and stormwater will percolate through the soil.
- The top of the sheet pile will, in some areas, be at the top of the surrounding surface. Therefore, there will not be a stick-up of the sheet pile along the entire length of the creek.
- The soil erosion and sediment measures will protect against runoff.

Despite the aforementioned reasoning, KeySpan has instructed the Contractors bidding OU-1 activities to provide a line item cost for installing up to 50, 2-inch by 2-inch openings in the sheet pile along Coney Island Creek. The determination on where these openings will be cut, if needed, will be made in the field with the assistance of the onsite NYSDEC representative.

NYSDEC Comment 9

9 a) Sheet C-3, wetland delineation line does not correspond with that shown in the legend. Also, please define red lines.

9 b) Notes, Item 11, please revise the language to read "the Contractor shall prevent any releases of materials....."

Response to Comment 9 a:
KeySpan has revised Drawing C-3 so that the wetland delineation line will correspond with the legend. As discussed in comment 7, the red lines have also been defined.

Response to Comment 9 b:
KeySpan has revised Drawing C-3 according to the comment.

NYSDEC Comment 10

10 a) Sheet C-4, sheets C-3 and C-4 can be combined.

10 b) Wetland delineation line does not correspond with that shown in the legend.

10 c) Sheet C-5, the Waterloo Wall should stretch between points N989581.00; E15114.00 and N990989.00; E151449, preferably 20 feet beyond each of these points. The North Wall starts at N98785.0; E151599.00, not as shown.

10 d) We recommend that for easy reference the characteristic points of the cut off wall be renamed using alphabetical letters. These points can be tabulated on the same sheet showing related coordinates.

Response to Comment 10 a:
KeySpan agrees that Drawings C-3 and C-4 can be combined. However, due to the logistics of having to change many areas of the text in the Report, KeySpan chooses to keep the drawings separate.

Response to Comment 10 b:
KeySpan has revised Drawing C-3 so that the wetland delineation line will correspond with the legend.

Response to Comment 10 c:
KeySpan has revised Drawing C-5 to adjust northings and eastings and to stretch the Waterloo Barrier System beyond each of the two location points as requested by NYSDEC.

Response to Comment 10 d:
KeySpan thanks the NYSDEC for their recommendation. It should be noted that none of the contractors bidding on the project have expressed concerns. Therefore, KeySpan will retain the present system of identifying the characteristic points.

LIST OF CHANGES MADE DURING FINALIZATION OF THE DESIGN

This part of the letter summarizes substantive changes made to the Remedial Design Package for Operable Unit No. 1 (OU-1) of the Former Brooklyn Borough Gas Works Site. Some of the changes were made in response to the NYSDEC comments set forth above, and additional changes were made during finalization of the design.

Formatting of the Design Package

1. The Remedial Design Package for OU-1 has been re-formatted into three volumes. Volume 1 is the Final Remedial Design Report. Volume 2 is the Bid Package and Technical Specifications. Volume 3 is the Design Drawings.

Adjustments to Volume 1 – Final Remedial Design Report

1. A Global Title Change has been performed in the Text from "Revised Draft Final Remedial Design Report" to "Final Remedial Design Report".

2. A Global Change has been performed in the Drawing Designation from "Drawing" to "Design Drawing".

3. Section 1.0 Introduction: paragraph 2, page 1-1, the text has been revised to clarify the scope of the remedial design.

4. Section 1.1 Remedial Design Objectives and a Summary of OU-1 Activities: paragraphs 6 & 7, page 1-3, the text was revised to clarify the completed action on Element 1 of the ROD. Paragraph 7 was deleted because Element 4 of the ROD is not applicable to the remedial activities addressed by this report.

5. Section 2.3.4 Simulation of Proposed Engineering System: paragraph 1, page 2-8, the reference from "approximately 15 to 25 feet below ground surface" was changed to "approximately 17 to 26 feet below the zero (0) elevation reference point".

6. Section 3.0 Remedial Design: first series of bullets, page 3-1, added a bullet designated "Post-Construction Activities".

7. Section 3.2.2 Standard Steel Sheet Pile Cut-off Wall: last paragraph (top of page), page 3-4, clarified that some of the installed sheet pile may remain exposed above ground.

8. Section 5.5 Federal Permits: page 5-3, referenced the March 2001 ROD and clarified the position of the cutoff wall .

Adjustments to Volume 2 – Bid Package and Technical Specifications

9. A Global change to the Specifications has been performed. All of the words such as "approved, approval, approve, etc." have been replaced by "accepted, acceptance, accept, etc.).

10. Attachment 2 Generic HASP Section 5.0 Air Monitoring Requirements: last bullet on page 14, changed text to clarify that the Photoionization Detector must be equipped with data logging capabilities.

11. Attachment 2 Generic HASP Table 5-2 Frequency and Location of Air Monitoring: page 17, deleted references to the groundwater diversion trench and Posi-Shell Cover system which are not required.

12. Attachment 2 Generic HASP Section 5.5 Community Air Monitoring Plan: page 18 performed a general revision to bring the plan into agreement with the "NYSDOH Generic Community Air Monitoring Plan.

13. Attachment 2 Generic HASP Section 5.5.1 Vapor Emission Response Plan: pages 18 and 19 Performed a general revision to bring the plan into agreement with the "NYSDOH Generic Community Air Monitoring Plan.

Adjustments to Volume 3 – Design Drawings

14. Global Change – Standardized the legends and symbols on all drawings.

15. Global Change – Added a N/E survey grid to all plan drawings.

16. Global Change – Updated the title blocks, added dates, and added stamps to all drawings.

17. Global Change – Adjusted the notes on some of the drawings.

18. Design Drawing C-2 – Added a shaded sheet pile wall alignment to display the location of the wall relative to the soil erosion and sediment control practices. Added Note 3.

19. Design Drawing C-3 – Revised Note 11 to address NYSDEC Comment 9, extended Waterloo Wall at two locations per NYSDEC comment. Added Note 12 per NYSDEC comment. Adjusted N/E stationing. Designated the standard sheet pile wall alignment with a dashed symbol. Designated transition points from waterloo to standard sheet pile.

20. Design Drawing C-4 –Displayed the extended waterloo barrier wall, the adjusted N/E stationing, the standard wall alignment and the transition points as in Drawing C-3.

21. Design Drawing C-5 – Revised the presentation of match lines, transition points, extended wall locations, soil strata lines, top and bottom of sheeting, N/E stationing, and scaled items.

22. Design Drawing C-6 – Added a shaded symbol for the sheet pile wall alignment .

23. Design Drawing C-7 – Revised the piezometer construction diagram and the turbidity barrier notes.

24. Design Drawing C-8 – Adjusted the N/E stationing.

25. Design Drawing C-9 – Made the global changes called out above.

At this time, all of the design drawings have been finalized, signed and sealed by a licensed New York State Professional Engineer, and included in the three volume Remedial Design Package that is issued herein for your information.

We trust that the information presented above is sufficient to clarify the responses to NYSDEC comments and to clarify the changes made during finalization of the Remedial Design Package. If you have any questions concerning our responses to your comments, please contact me at (718) 403-3053.

Sincerely,

for Tracey Bell
Project Manager

cc: K. Anders NYSDOH
L. Liebs, KeySpan
J. Bolan KeySpan Business Solutions
R. Olewinski, Tetra Tech FW, Inc.

Attachment: Three Volume Final Remedial Design Package

Volume 1 of 3
Final Remedial
Design Report

FINAL REMEDIAL DESIGN
for
Operable Unit No.1
Former Brooklyn Borough Gas Works Site
Brooklyn, New York

prepared for:

KEYSPAN ENERGY CORPORATION
ONE METROTECH CENTER
BROOKLYN, NEW YORK 11210-3850

KEYSPAN
CORPORATION

October 2003

prepared by

FOSTER WHEELER ENVIRONMENTAL CORPORATION

1000 THE AMERICAN ROAD
MORRIS PLAINS, NEW JERSEY 07950

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PROFESSIONAL ENGINEER'S CERTIFICATION

In March 2001, the New York State Department of Environmental Conservation (NYSDEC) issued a Record of Decision (ROD) for Operable Unit 1 (OU-1): Plant Site, Former Brooklyn Borough Gas Works (Uplands Site) located in Brooklyn, New York. In March 2002, the NYSDEC issued a second ROD for Operable Unit 2 (OU-2): Portion of Coney Island Creek (Creek Site) adjacent to the Uplands Site. The March 2001 ROD and the March 2002 ROD both present environmental remedies and set forth specific requirements. After both RODs were issued, a phased approach was developed to implement their requirements. Accordingly, short-term actions to mitigate Uplands Site exposure pathways are to be performed as OU-1.

KeySpan Energy Corporation (KeySpan) is the Owner of the Uplands Site and is responsible for implementation of the requirements set forth under the March 2001 and March 2002 RODs. On behalf of KeySpan, Tetra Tech FW, Inc. has prepared this Final Remedial Design Report (Final RD Report) for specific application to the Uplands Site. The purpose of the Final RD Report is to provide the required remedial design program (OU-1, Element 1) for installation of a sheet pile barrier wall around the Site (OU-1 Element 6) and for monitoring of the sheet pile barrier wall (OU-1 Element 14).

I have personally examined and am familiar with the Final RD Report. Based on the portions of the Final RD Report provided by myself, and on the portions of the Final RD Report provided by others, to the best of my knowledge the Final RD Report provides the required remedial design program set forth in OU-1 Element 1 of the March 2001 Record of Decision.

Certified By:
Foster Wheeler Environmental
Engineering Corporation, P.C.

Richard D. Arnold, P.E. 10/6/2003

Richard D. Arnold, N.Y.P.E. #076202

It is a violation of the New York State Education Law, Article 145, for any person, unless under the direction of a New York State Licensed Professional Engineer, to alter an item on this document in any way.

1.0 INTRODUCTION

This Final Remedial Design Report (Final RD Report) has been prepared to address the first phase (OU-1) of the recommended remedial actions for the uplands portion of the former Brooklyn Borough Gas Works Site (the Site) located in Brooklyn, New York. In March 2001, the New York State Department of Environmental Conservation (NYSDEC) issued a Record of Decision (ROD) for *Operable Unit 1: Plant Site, Former Brooklyn Borough Gas Works Site, Coney Island, Kings County, New York (Site Number 2-24-026).* The ROD requires KeySpan Corporation (KeySpan) to remediate the uplands portion of the Site in accordance with the selected remedy described in the ROD.

A phased approach is being implemented to meet the conditions of the ROD. This approach includes short-term actions to mitigate exposure pathways and final restoration consistent with future property use to incorporate the remaining remedial controls of the ROD. The short-term actions to mitigate Uplands Site exposure pathways are to be performed as OU-1 under the Final Remedial Design presented herein.

This Final RD Report provides the basis of the design elements and an understanding of the design concepts for OU-1. It also discusses the findings of the field investigation that was performed to support this design.

The remainder of Section 1.0 discusses the remedial design objectives, summarizes OU-1 activities, provides relevant background information, and provides the organization of this Final RD Report.

1.1 Remedial Design Objectives and a Summary of OU-1 Activities

The objectives for the remediation of the uplands portion of the Site are described in the ROD. These objectives include:

- Eliminate, to the extent practicable, off-site migration of contaminants of potential concern within the Site groundwater;
- Eliminate, to the extent practicable, human exposures to contaminants;
- Eliminate, to the extent practicable, the migration of contamination into Coney Island Creek; and,
- Eliminate, to the extent practicable, the exposure of fish and wildlife to levels of contaminants above standard/guidance values.

The ROD includes a remedy to achieve these objectives. The elements of the selected remedy are as follows:

1. *A remedial design program to verify the components of the conceptual design and provide the details necessary for the construction, operation and maintenance, and monitoring of the remedial program. Any uncertainties identified during the RI/FS will be resolved.*

2. *Excavation of coal tar source areas to the groundwater table. Excavated material will be consolidated under temporary enclosures, as appropriate, and as described in more detail in Sections 3.8 and 4.2 of the Feasibility Study Report to control, among other things, the releases of volatile emissions and odors. If coal tar source is visually observed beyond the excavation boundaries, the source will be removed to the extent feasible without water handling difficulties.*

3. *Off-Site transport and recycling and/or disposal of source area materials.*

4. *Installation of a protective cofferdam along the Coney Island Creek perimeter to minimize potential releases from the Site during creek bank excavation and restoration efforts.*

5. *Use of a temporary construction enclosure along the creek bank when trenching or excavation activities may release significant volatile emissions or odors into the atmosphere.*

6. *Installation of a subsurface steel sheet pile barrier wall (or other equivalent barrier wall) around the Site to an approximate depth of 25 feet, to minimize the migration of NAPL from the Site into the Coney Island Creek, while diverting upgradient groundwater around this Site to the Coney Island Creek.*

7. *Removal of the existing wooden bulkhead and contaminated materials between the barrier wall and the coffer dam with subsequent construction of a stabilized creek bank.*

8. *Installation of a NAPL collection trench along the interior of the creek barrier wall section to capture migrating NAPL.*

9. *Treatment of approximately 72,000 gallons daily of non-aqueous waste and groundwater in a system designed to reduce contaminant concentrations such as that treated effluent may be discharged to the Coney Island Creek. Contaminants in the water will be reduced to non-detectable levels.*

10. *Installation of a multi-component cover system to act as a low permeability barrier to minimize both infiltration and the potential for direct contact of workers with residual contaminants. At least two feet of cover material is necessary for the protection of human health and the environment. The Site will be graded to a common elevation prior to installation of the cover system.*

11. *Passive venting and control of vapors which may form under the cover system. Performance evaluation of the passive system will be used to assess the need, if any, for an active system.*

12. *Restoration of the Coney Island Creek bank to provide a 50-feet wide ecological buffer zone. Monitoring wells will be installed immediately outside of the barrier within the buffer zone to assess the long-term performance of the barrier wall.*

13. Use of institutional controls including deed restrictions, fencing, a health and safety plan, a contingency plan and long-term monitoring after the implementation of remedial actions to ensure continued adherence to the Site's health and safety plan; continued treatment of collected groundwater, maintenance of the multi-component cover system, and to prohibit the use of the Site for other than commercial and industrial purposes without permission from NYSDEC.

14. Since the selected remedy will result in untreated hazardous waste remaining at the Site, a long-term monitoring plan will be instituted. Monitoring wells will be installed across the Site to monitor the effectiveness of the multi-layer cover system and overall remedial plan and will be a component of the operation and maintenance plan for the Site. The effectiveness of the selected remedy will be evaluated at the end of a five-year monitoring period.

15. Any conceptual design for redevelopment, although not part of the remedy, must be evaluated by the NYSDEC for potential impacts to the remedy. However accomplished, redevelopment cannot adversely affect, compromise the integrity of, or disturb the Site remedy.

As has been previously discussed, the selected remedy will be implemented in a phased approach. The objectives for OU-1 include:

- Mitigating the seepage of Non-Aqueous Phase Liquid (NAPL) from the Site into Coney Island Creek; and,
- Eliminating exposure pathways.

Element 1 of the ROD was completed by the verification of the design for the installation of a vertical barrier cut-off wall around the site during OU-1. The field investigation described in the Remedial Design (RD) Work Plan meets this requirement for the vertical barrier cut-off wall. Another component of the ROD that will be completed in its entirety during OU-1 is:

- Element 6 – The construction of a vertical barrier cut-off wall (as described in Section 3.0) along the perimeter of the Site to minimize the migration of NAPL to Coney Island Creek and to divert upgradient groundwater around the Site.

An interim measure will be implemented during OU-1 to meet the requirements of Element 14 of the ROD. This interim measure is:

- Post OU-1 monitoring of the piezometers installed along the vertical barrier cut-off wall.

1.2 Project Background

The Site is located between Neptune Avenue and the Belt Parkway, within the Coney Island section of Brooklyn, New York. It is bordered by the right-of-way (ROW) of the Belt Parkway and a New York City Metropolitan Transit Authority (MTA) railyard to the north and west, and Coney Island Creek to the south and east. The property owned by KeySpan is approximately 16 acres in size. The area surrounding the property is a relatively flat, densely populated commercial and residential zone. The property is covered by vegetation, except for several concrete foundations of former gasholders, process vessels, tanks and buildings and various construction debris. A Site Location Map for the Former Brooklyn Borough Gas Works Site is provided in Design Drawing T-1. Existing Site conditions are shown in Design Drawing C-1.

The Brooklyn Borough Gas Company began construction of the first generator at the Site in 1908. Over the next four years, additional parcels of land were added, the facility was enlarged, and its gas production capability increased.

In the 1930s, two (2) large-capacity gas holders, a station meeting house, two (2) underground gas oil tanks, tar conditioners, tar seal pumps, and a tar separator were located in the western portion of the Site. The main gas manufacturing operations were located in the central portion of the Site and contained:

- Four (4) generators
- A coal storage yard and coal off-loading equipment
- Pump rooms
- Booster and exhauster rooms
- Two (2) condensers
- Eight (8) purifier boxes
- Two (2) relief holders
- An electric tar precipitator
- A tar dehydrator system
- Two (2) tar separators
- Tar storage tanks
- Water tanks
- Oil pumps
- Drip oil tanks

Various storage and work buildings were also located in the central area of the property, including a blacksmith shop in the south-central area. To the east was the gas oil pump house and five gas oil tanks.

The physical facility and property changed little from the 1930s through 1960. Brooklyn Borough Gas transformed its gas delivery operations to a natural gas-based system, and production of manufactured gas at the Coney Island facility ceased in November 1951. According to Brooklyn Borough Gas documents, gas deliveries to customers in 1952 were

natural gas. Between 1952 and 1959, the Site's MGP capability may have been maintained and operated for the purpose of peak shaving. The Brooklyn Union Gas Company (which ultimately became KeySpan) acquired the Brooklyn Borough Gas Company in 1959. KeySpan did not manufacture gas at this facility.

From 1960 to 1966, the facility was almost completely decommissioned and demolished. In 1974, a few buildings associated with a gate station, which included an axial compressor, a small gasholder, and the largest gasholder, remained operational providing natural gas service. KeySpan believes the gate station and gasholders were taken off line at the end of the 1970s and were subsequently decommissioned and demolished in the early 1980s.

In the early 1970s, the easternmost portion of the property was topped with fill and two (2) baseball fields were constructed on top of the fill in the late 1980s. These fields were decommissioned in 1996 and are no longer in use.

In July 1993, a seep releasing light non-aqueous phase liquid (LNAPL) from the Site into Coney Island Creek was reported by KeySpan to the appropriate regulatory agencies. Following an investigation, KeySpan conducted an interim remedial measure (IRM) to mitigate the release of LNAPL into Coney Island Creek. The IRM was constructed from July to November 1994 and included:

- Installation of inland recovery wells;
- Installation of hard boom and end connections in Coney Island Creek; and,
- Installation of a LNAPL skimmer system and hookup of an oil collection system.

The system was tested and demonstrated to be operational in late 1994. It was also observed and verbally accepted by the United States Coast Guard in May 1995.

In May 1995, KeySpan and the NYSDEC negotiated an Order on Consent (Index No. D2-001-94-12) to investigate and clean up the Site. The Order on Consent required KeySpan to perform a Remedial Investigation (RI), a baseline Risk Assessment (RA) and a Focused Feasibility Study (FFS). The RI was completed in 1997, the baseline RA was completed in 1998, and the FFS was completed in 2000.

In October 1997, KeySpan conducted a second IRM at the Site. The purpose of this IRM was to mitigate high concentrations of lead in surface soils that were not simultaneously contaminated with high levels of coal tar. The IRM involved the removal and proper disposal of the top one-foot of soil from approximately four acres on the western portion of the Site. As a result of the IRM, approximately 250 tons of non-RCRA hazardous soil and approximately 1,500 tons of RCRA hazardous soil were removed from the Site and disposed of at approved facilities.

In March 2001, the NYSDEC issued the ROD for the uplands portion of the Site. The ROD presents the selected remedy for remediating the Site.

1.3 Final RD Report Organization (Volume 1)

The text below describes the organization of this Final RD Report.

Section 1.0 – Introduction
The introduction describes the report objective, the remedial design objectives and summary of OU-1 activities and the project background.

Section 2.0 – Field Investigation and Groundwater Modeling for OU-1
Section 2.0 describes the field investigation, provides the results of the geotechnical sampling, and discusses results of the groundwater modeling program.

Section 3.0 – Remedial Design for OU-1
Section 3.0 provides the design basis and describes the remedial systems that will be constructed during implementation of OU-1 remediation activities.

Section 4.0 – Engineering Cost Estimates and Schedule
Section 4.0 provides the engineering cost estimate for OU-1 construction and provides the project schedule.

Section 5.0 – Identification of Federal, Local, and State Permits
Section 5.0 describes the types of permits to be obtained prior to execution OU-1 construction activities.

Section 6.0 – Implementation Method of Construction Activities and the Method for Selecting the Contractor
Section 6.0 describes the implementation of OU-1 construction activities and the contractor selection method.

2.0 FIELD INVESTIGATION AND GROUNDWATER MODELING FOR OU-1

A field investigation was performed to collect data for the preparation of this Final RD Report. The field investigation included:

- Soil borings and the collection of soil samples for geotechnical testing;
- Treatability testing to determine the appropriate materials for the vertical barrier cut-off wall;
- Compatibility testing to determine if the selected materials for the vertical barrier cut-off wall are compatible with the groundwater/free product at the Site; and,
- Groundwater modeling to design the vertical barrier cut-off wall around the Site.

The field investigation was performed in accordance with the *Remedial Design Work Plan for Operable Unit No. 1, Former Brooklyn Borough Gas Works Site (RD Work Plan)*, dated July 2002. The RD Work Plan was prepared by Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) and approved by the NYSDEC on July 11, 2002.

2.1 Field Investigation for OU-1

The field investigation included the collection of the field data and soil samples that were utilized to prepare the remedial design for OU-1. The field investigation was performed from July 29 through August 20, 2002. The field investigation included a survey of 24 boring locations around the perimeter of the Site, the installation of soil borings for soil properties evaluation and sample collection for geotechnical testing, and treatability and compatibility testing.

2.1.1 Survey of Geotechnical Boring Locations

Between July 29, 2002 and August 1, 2002, Massand Engineering L.S., P.C. of Bayville, New York, performed a survey at the Site. The purpose of the survey was to establish control points, identify the 24 locations for the soil borings, and verify limited topographic data from previous Site surveys.

The 24 soil boring locations were marked at approximately 200-foot intervals along the perimeter of the Site except in the NAPL seep area, where they were marked at approximately 50-foot intervals. The new soil boring locations were identified in the field with wooden stakes and ribbon tied to the nearby fence. The new soil borings along with soil borings from previous investigations provide data at 100-foot intervals (or less) along the perimeter of the Site. The soil boring locations along the Site perimeter are shown in Design Drawing C-4.

Approximately 20 spot elevations were taken during the course of the survey. These spot elevations were used to confirm the accuracy of the topographic data from a previous survey at the Site. The coordinates for the boring locations and spot elevations are provided in Table 2-1.

2.1.2 Installation of Geotechnical Borings

2.1.2.1 Mobilization

On-Site mobilization for the geotechnical investigation was performed on August 6, 2002. The mobilization included two (2) geologists from Foster Wheeler Environmental (Now TetraTech FW, Inc.) and a drill rig and crew from Land, Air, Water Environmental Services, Inc (LAWES) of Center Moriches, New York. A second drill rig and crew from LAWES mobilized on-Site on August 8, 2002.

The mobilization consisted of a review of the RD Work Plan which included the Sampling and Analysis Plan (SAP), the Quality Assurance Project Plan (QAPP), and the Site-specific Environmental Health and Safety (EHS) Plan for the field investigation. A Site reconnaissance was also performed to identify the soil boring locations and areas for equipment decontamination and the storage of Investigation Derived Waste (IDW).

2.1.2.2 Site Preparation

LAWES contacted the New York One Call System to mark out the underground utilities outside the Site. This utility markout was completed before the start of the mobilization. KeySpan personnel also reviewed Site drawings to ensure that no underground utilities were located near the soil boring locations.

A temporary decontamination pad was established on the concrete pad located between the former baseball fields and behind the building near the east entrance gate. The building has access to water and electricity. A storage area for IDW containers was also established on the concrete foundation of a gasholder located on the western side of the Site.

Work zones were established near the drill rigs. Vegetation was removed on an as-needed basis to access the soil boring locations.

2.1.2.3 Installation of Soil Borings

Installation of soil borings began on August 6, 2002 and concluded on August 20, 2002. Soil borings were installed at the 24 locations designated B-1 through B-24. These boring locations are shown on Design Drawing C-4. The soil borings were installed using a 4.25-inch hollow stem auger and 140-lb. hammer. Two-inch split spoon sampling devices were used to collect soil samples, while performing the standard penetration test. The standard penetration test was performed using the method specified by the American Society of Testing Materials (ASTM D 1586). The soil borings were advanced to a maximum depth based on meeting one of the following criteria:

- Encountering the low permeability layer (clay/peat/silt);
- Encountering the semi-low permeable layer (silt/sand); or,
- A depth of approximately 45 feet below ground surface (bgs).

There were three soil borings that did not meet this criteria. Boring B-6 was terminated at approximately 19 feet bgs because the lower explosive limit in the borehole exceeded the action level in the EHS Plan. Boring B-16 was advanced to approximately 91 feet bgs in an attempt to locate a low or semi-low permeability layer near the seep area. Boring B-17 was terminated at approximately 18 feet bgs due to running sands in the borehole. The depths of the soil borings are provided in Table 2-2. Geotechnical soil boring logs are provided in Attachment 1.

2.1.3 Sample Collection and Testing

2.1.3.1 Collection and Testing of Geotechnical Samples

Visual soil classification was performed on soil samples to evaluate the soil substructure and properties and to identify the presence of the low or semi-low permeability layer. In addition, soil samples were collected for geotechnical laboratory testing. The purpose of the testing was to obtain index properties, to evaluate the permeability of soils, and to verify the visual classification.

Visual soil classifications were performed on samples collected using a 2-foot long split-spoon sampling device. Continuous sampling was performed during soil boring performed work along Coney Island Creek (Soil borings B-8 through B-21).

A review of soil boring logs from previous investigations indicated that the low or semi-low permeability layer was more prevalent along the north and west sides of the Site than along the Coney Island Creek. Split-spoon samples were collected at 5-foot intervals from the borings on the west (B-22 through B-24) and north (B-1 through B-7) sides of the Site.

During the boring work, standard penetration values (N values) were measured per ASTM D1586 at each split spoon sampling interval. The depth to water was also determined during sample collection. This information is provided on the geotechnical soil boring logs in Attachment 1.

Selected soil samples were collected and delivered to an ASTM-certified geotechnical laboratory for soil index property and permeability testing. Golder Associates, Inc. (Golder Associates) of Cherry Hill, New Jersey performed the geotechnical testing of the soil samples in accordance with the RD Work Plan. Chain-of-Custody forms for the laboratory sample testing are provided in Attachment 2.

Sieve Analysis and Atterberg Limits Analysis

Soil samples were collected for Sieve and Atterberg Limit analysis. Thirteen (13) samples were collected for Sieve Analysis (ASTM D-422) while nine (9) soil samples were collected for Atterberg Limits Analysis (ASTM D-4318). The locations and collection depths of these samples are provided in Table 2-3.

Permeability

Samples were also collected from the low and semi-low permeability layers for permeability testing. In accordance with ASTM Method 5084,twenty-one (21) Shelby Tube samples were collected for permeability testing. The locations and collection depths of these samples are provided in Table 2-4.

2.1.3.2 Treatability Sample Collection and Testing

Samples (soil, groundwater, and free product) were collected from the Site for treatability testing for the proposed vertical barrier cut-off wall. Composite soil samples were collected from the soil cuttings while groundwater and free product samples were collected from existing Site wells. Three 5-gallon buckets of soil cuttings were collected: one bucket from the north side, one bucket from the west side and two (2) buckets from Coney Island Creek. A composite of groundwater and free product was also collected from Site wells. This composite sample was collected in two (2) five-gallon buckets.

The soil samples and one (1) five-gallon bucket of the groundwater and free product sample were sent to Golder Associates for treatability testing. Golder Associates performed the treatability testing in accordance with a procedure provided in the RD Work Plan.

2.1.3.3 Compatibility Sample Collection and Testing

The samples collected for treatability testing were also used for compatibility testing. Golder Associates also performed the compatibility testing in accordance with a procedure provided in the RD Work Plan. The purpose of the compatibility testing was to ensure that the vertical barrier cut-off wall is compatible with the on-site soils, groundwater, and free product. The material compatibility is important to prevent possible deterioration or damage to the vertical barrier cut-off wall.

One (1) five-gallon bucket each containing groundwater/free product and soil were sent to C3 Environmental located in Breslau, Ontario, Canada. C3 Environmental performed compatibility testing for the Waterloo Barrier® cut-off wall.

2.1.4 Demobilization

Following completion of sample collection activities, the investigative crew demobilized. Tasks performed during demobilization included:

- Decontamination of soil boring and sampling equipment;
- Decommission the temporary decontamination pad;
- Containerization, marking, and staging of IDW; and,
- Removal of all contractor equipment.

Demobilization was completed on August 20, 2002.

2.2 Results of the Field Investigation for OU-1

2.2.1 Results of Geotechnical Testing

The laboratory performed sieve analyses on thirteen (13) samples in accordance with ASTM Method D-422. The laboratory tested nine (9) soil samples for Atterberg Limits in accordance with ASTM Method D-4318. The results of this testing are summarized in Tables 2-5, 2-6, and 2-7. The sampling crew sent twenty-one (21) Shelby Tube samples to the geotechnical testing laboratory and sixteen (16) were selected for permeability testing. The results of the permeability testing are summarized in Tables 2-5, 2-6, and 2-7.

Golder Associates performed the geotechnical testing. The test results are provided in Attachment 3.

2.2.1.1 North Side of the Site

Seven soil borings were installed along the north side of the Site. A summary of the test results from these borings (B-1 through B-7) is provided below:

- Six (6) permeability tests were performed and the permeability results ranged from 4.0 $x10^{-6}$ to 8.60 x 10^{-7}centimeters per second (cm/sec). A summary of the locations, sample collection depths, and results of the permeability testing are provided in Table 2-5.

- Sieve analyses were performed on two (2) samples from soil borings B-2 and B-4. and one (1) sample from boring B-4 was tested for Atterberg Limits. A summary of the locations, sample collection depths, and results are provided in Table 2-5. The results of the Sieve and Atterberg Limits analyses were used to confirm the visual soil classifications.

The results are provided in Attachment 3.

2.2.1.2 Area Along Coney Island Creek

Fourteen (14) soil borings were installed along Coney Island Creek. A summary of the test results from these borings (B-8 through B-21) is provided below:

- Ten (10) permeability tests were performed and the permeability test results ranged from 1.9 $x10^{-6}$ cm/sec to 1.40 x 10^{-7} cm/sec. A summary of the locations, sample collection depths, and results of the permeability testing are provided in Table 2-6.

- Nine (9) samples from soil borings B-8, B-9, B-11, B-13, B-15, B-16, B-18 and B-20 were tested for Sieve Analysis and seven (7) samples from soil borings B-8, B-9, B-11, B-13, B-15, B-16 and B-18 were tested for Atterberg Limits. A summary of the locations, sample collection depths, and results are provided in Table 2-6.

The results are provided in Attachment 3.

2.2.1.3 West Side of the Site

Three (3) soil borings were installed along the west side of the Site. A summary of the test results from these borings (B-22 through B-24) is provided below:

- Seven (7) permeability tests were performed and the permeability results ranged from 1.3 $x10^{-5}$ cm/sec to 5.40 x 10^{-7} cm/sec. A summary of the locations, sample collection depths, and results of the permeability testing are provided in Table 2-7.

- Sieve analyses were performed on two (2) samples from soil boring B-23 and one (1) sample from boring B-23 was tested for Atterberg Limits. A summary of the locations, sample collection depths, and results are provided in Table 2-7.

The results are provided in Attachment 3.

2.2.2 Results of Treatability Testing

Golder Associates prepared three (3) soil bentonite samples using 2%, 3%, and 4% bentonite by dry weight of soil. Permeability testing was performed on the three (3) soil bentonite samples in accordance with ASTM D 5084. The samples were permeated using de-aired water and the permeability test results were as follows:

Sample Number	*% Bentonite*	*Permeability (cm/sec)*
1	2	3.5×10^{-5}
2	3	5.6×10^{-6}
3	4	4.5×10^{-6}

None of the tested samples reached the target permeability of 1.0 x 10^{-7} cm/sec, probability due to insufficient fines content in the site soils.

2.2.3 Results of Compatibility Testing

Compatibility testing was performed by C-3 Environmental for the Waterloo Barrier® cut-off wall. Compatibility was assessed on the Waterloo Barrier® cut-off wall material and micro-fine cement interlock system using the on-site groundwater/free product sample. The procedure, testing methods, and conclusions for the compatibility are included in Attachment 4.

2.3 Groundwater Modeling

Groundwater flow modeling was performed for the Site. The modeling was performed with the most recent version of the Department of Defense Groundwater Modeling System (GMS version 3.1 built on June 4, 2002). GMS provides an interface with MODFLOW that was used for the groundwater flow simulation of the Site.

The purpose of the groundwater flow modeling was to simulate the hydraulic response to the proposed OU-1 remedial systems. The groundwater flow modeling consisted of the following key tasks:

- Development of a conceptual hydrogeologic model;
- Development of a numerical groundwater flow model;
- Calibration of the numerical flow model; and,
- Simulation of the proposed vertical containment barriers.

2.3.1 Development of a Conceptual Model

A Site-specific conceptual hydrogeologic model was developed to represent the groundwater flow system underneath the Site. The conceptual model was built to simplify the field conditions and represent geologic/hydrologic conditions, physical boundaries and sources and sinks identified at the Site.

The model domain includes the Site area and extends to the north, northeastern, and northwestern areas in order to reduce boundary effects. The model contains three layers that represented the upper sand/fill layer, the discontinuous low permeability unit (clay/peat/silt) and the underlying sand unit.

A head-dependent boundary, with long-term mean river stages, is used to simulate the Coney Island Creek in layers one and two. Constant head boundaries are used for the northern portion of the model domain in the sand/fill unit and both the northern and southern portions of the lower sandy unit. No flow boundaries are used in all three layers, on both the western and eastern sides, which are approximately perpendicular to the groundwater flow (Figure 1 - Model Boundary Conditions).

The model consists of three layers that with a variable-spacing grid and a refined grid (10 feet by 10 feet cells) concentrated in the Site area (Figure 2 - 2D Finite Difference Model Grid). The grid is composed of 148 rows and 231 columns and the entire model domain had a total of 102,564 discrete grid cells and 138,272 nodes.

2.3.2 Development of a Numerical Model

The conceptual hydrogeologic model was converted into a numerical model by assigning physical and hydrogeologic parameters and transferring field data to the model grid.

Variable elevations are used for the top and bottom of the sand/fill unit and the bottom of the clay/peat/silt unit to define thickness of both geologic units (Figure 3 - Cross Section of Model Domain). Elevation data are based on the survey of monitoring wells and soil borings.

Variable hydraulic conductivities ranging between 10 and 60 ft/day, based on slug test results from previous Site investigations, are interpolated to the upper sand/fill and lower sand units. A constant hydraulic conductivity of 0.0028 ft/day, based on recent geotechnical testing data, is used for the clay/peat/silt unit. An area along the southern portion of the Site, near the creek, is assigned approximately the same hydraulic conductivity as the sand/fill unit. This assumption was made in order to represent the missing clay/peat/silt layer in this area (Figure 4 - Extended Sand/Fill). A common ratio of 10 to 1 is used for horizontal to vertical hydraulic conductivities for all three layers.

Previous investigations have indicated that the annual recharge to the Site ranges up to 41 inches of water per year. For the purposes of the groundwater flow model, as discussed in Section 2.3.3, calibration of the model using the above Site data yielded an infiltration rate of 10.6% of the annual recharge.

2.3.3 Calibration of Numerical Model

The groundwater flow model was calibrated for a steady-state simulation using groundwater measurements taken in November 1996. Hydraulic conductivities of all three layers, boundary conditions, and infiltration rate were manually adjusted during model calibration.

The calibrated infiltration rate was 4.38 inches/year, which is 10.6% of the annual rainfall rate that has been reported for the Site area. The calibrated horizontal hydraulic conductivities ranged from 6.8 to 57.3 feet per day, which is within the range of values obtained from slug tests conducted at the Site.

Calibrated results showed that simulated hydraulic heads matched field observations for the upper sand/fill unit where most monitoring wells are screened (Figure 5 - Calibrated Groundwater Contours). A mean error of 0.04 ft., mean absolute error of 0.44 ft., and root mean square error of 0.52 ft. were achieved during the calibration. Mass balance error, as indicated by the hydrologic (volumetric) budget in the output file, was less than 0.1 percent of discrepancy.

2.3.4 Simulation of Proposed Engineering System

The proposed engineering system, the vertical barrier cut-off wall, was simulated with the calibrated flow model. The vertical barrier cut-off wall will consist of the Waterloo Barrier® cut-off wall and a standard steel sheet pile cut-off wall. The vertical barrier cut-off wall will reduce the flow of groundwater from the Site to Coney Island Creek. The vertical barrier cut-off wall will be installed to the top of the clay/peat/silt unit, which has a variable elevation, as indicated in Design Drawing C-5 in this Final RD Report. As shown in Design Drawing C-5, the depth of the wall ranges from approximately 17 to 26 feet below the zero (0) elevation reference point. The vertical barrier cut-off wall was simulated using the horizontal flow barrier package within MODFLOW 96 with different hydraulic characteristics. The hydraulic characteristics were calculated from the 0.25 inch thickness of the cut-off walls. Hydraulic conductivities of 1×10^{-9} cm/sec and 1×10^{-7} cm/sec were used for Waterloo Barrier® cut-off wall and the standard steel sheet pile cut-off wall, respectively.

The results of the steady state modeling showed that the vertical barrier cut-off wall had minimal impact on the groundwater elevations inside the wall compared to the elevations prior to the installation of the wall. In the northeast portion of the Site, inside the wall, the calculated drop in the water level was approximately 0.25 feet. In the southwest portion of the Site, the calculated water level is approximately the same elevation with or without the vertical barrier cut-off wall.

With the barrier in place, Figure 6 shows that the upgradient groundwater mounds approximately 0.25 feet higher than the ambient groundwater elevation outside the northern section of the vertical barrier cut-off wall. The groundwater mounds at the wall and then is forced to move around the wall, effectively diverting it from migrating through the Site. Even with the

mounding outside the wall and the decrease of the groundwater elevation inside the wall, the difference in head inside and outside the wall is only approximately 0.5 feet. The groundwater elevation becomes equilibrated toward the southern portion of the Site where the elevations are approximately equal inside and outside the vertical barrier cut-off wall.

2.3.5 Conclusions and Recommendations

The results of the modeling evaluation indicate that the OU-1 remedial design will have minimal effect on groundwater levels at the Site following the construction of the vertical barrier cut-off wall. In fact, the model indicates that there will be a minimal reduction (approximately 0.25 feet) in the groundwater level across the northeast portion of the Site, while the southwest portion of the Site will remain essentially the same when compared to current groundwater conditions.

3.0 REMEDIAL DESIGN

The proposed remedial design for OU-1 includes several tasks that will be implemented to meet the objectives for this phase of the project as described in Section 1.0. These tasks are:

- Installation of soil erosion and sediment control measures;
- Limited clearing and grubbing along the Site perimeter;
- Removal of existing chain link fence fabric and the installation of a temporary security fence;
- Installation of Waterloo Barrier® cut-off wall;
- Installation of standard steel sheet pile cut-off wall;
- Installation of piezometers;
- Installation of new chain link fence fabric and removal of the temporary security fence;
- Restoration of disturbed area(s); and,
- Post-Construction Activities.

This Final Remedial Design Report discusses the remedial tasks in detail in the format presented below:

- Site preparation;
- Installation of vertical barrier cut-off walls;
- Installation of piezometers;
- Restoration of disturbed area(s); and,
- Post-Construction activities.

3.1 Site Preparation

Site preparation will be performed prior to any construction activities. Site preparation will include establishing temporary facilities and marking the required utility connections. Additional tasks include the installation of soil erosion and sediment control measures, the removal of chain link fence fabric and the installation of temporary security fence, and limited clearing and grubbing.

3.1.1 Soil Erosion and Sediment Control Measures

Soil erosion and sediment control measures will be installed around the perimeter of the Site along the path of the vertical barrier cutoff wall. These measures will include the use of silt fence and hay bales. The location and details of the soil erosion and sediment control measures for the Site are provided in Design Drawings C-2 and C-7, respectively.

3.1.2 Removal of Fence Fabric and the Installation of Temporary Security Fence

The fabric associated with the existing perimeter chain link fence will be removed to facilitate construction activities. The location of the existing chain link fence is shown on Design

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- Installation of standard steel sheet pile cut-off wall;
- Installation of piezometers;
- Installation of new chain link fence fabric and removal of the temporary security fence;
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Drawing C-9. KeySpan anticipates that all fence posts and foundations, associated with the existing perimeter fence, will remain in place during OU-1 construction. Only those posts and foundations that interfere with construction activities, or that are damaged (i.e., rust or by construction equipment) will be removed during OU-1.

A temporary security fence will be installed while the fabric of the existing fence is removed from the posts. The security fence will be placed along the north part of the Site. Security fence will not be needed along the west side of the Site because of two existing perimeter fences. The need for a temporary security fence along Coney Island Creek will be evaluated during construction activities.

The contractor will replace new fence fabric, and any damaged posts, at the conclusion of the project. The temporary security fence will be removed following the repair/re-installation of the existing perimeter fence.

3.1.3 Limited Clearing and Grubbing

A limited area along the Site perimeter will be cleared and grubbed to accommodate the vertical barrier cut-off wall. The clearing limits for the installation of the vertical barrier cut-off wall are shown in Design Drawing C-6.

The area to be cleared and grubbed will be marked with wooden stakes prior to performing this task. Within the staked area all vegetation, including brush and trees, will cut to the ground surface. Cleared vegetation will remain onsite. Branches and trunks larger than six (6) inches in diameter will be cut into manageable sizes and disposed offsite.

Grubbing will consist of removal of stumps and roots to facilitate installation of the vertical barrier cut-off wall.

3.2 Vertical Barrier Cut-off Wall

Based on the final results of the Site groundwater modeling performed during the field investigation activities, a barrier wall will be installed around the perimeter of the Site to minimize the potential for migration of compounds from source areas into soils, groundwater, and the Coney Island Creek. The vertical barrier cut-off wall will be installed around the perimeter of the Site. Design Drawings C-3 through C-5 and C-8 depict the proposed location of the vertical barrier cut-off wall and provide design information.

The Preliminary Remedial Design Report identified three (3) types of vertical barrier cut-off walls for the Site. The three types were the Soil/Bentonite slurry wall, the vibrated beam slurry wall and the Waterloo Barrier® System. Treatability testing has shown that Site soil has insufficient clay content to provide the required permeability for a Soil/Bentonite slurry wall without the use of additional expensive additives. Furthermore, excavation is problematic. Therefore, the Soil/Bentonite slurry wall will not be used for OU-1 remediation. Compatibility testing has indicated that the vibrated beam wall would be suitable for OU-1 remediation.

However, the Site conditions (subsurface debris) could impair installation and the required quality control of the vibrated beam cut-off wall. The Waterloo Barrier® cut-off wall is suitable and will provide the necessary containment for the Site.

The use of regular standard sheet pile has also been evaluated for containment at the Site. This type of sheet pile would provide the necessary containment over portions of the Site in lieu of the slurry wall and vibrated beam slurry wall approaches.

3.2.1 Waterloo Barrier® Cut-off Wall

A Waterloo Barrier® cut-off wall will be installed along Coney Island Creek (see Design Drawing C-3).
This type of cut-off wall uses interlocking steel sheet pile with permanently sealed interlocks. The interlock between the sheet sections is oversized to allow for injection of a sealant into the void. The joint sealant is a prepackaged silica fume modified cementitious based grout. The sealant is designed for high compressive strength, groundwater washout resistance, improved pumpability, reduced permeability, and approximately 4-8% volumetric expansion.

The low and semi-low permeability layers are not continuous along Coney Island Creek. Design Drawing C-5 provides a vertical cross section of the soil where the Waterloo Barrier® cut-off wall will be installed on the Site. Details on the installation of the cut-off wall along the creek are provided in Design Drawing C-8.

During the installation of the Waterloo Barrier® cut-off wall along the southwest portion of the Site (in front of the existing wooden bulkhead), precautions will be taken to minimize sediment discharge into the creek. These precautions may include the use of a floating chain-weighted turbidity barrier along the wooden bulkhead in Coney Island Creek. Details on the turbidity barrier are provided in Design Drawing C-7.

The short-term (less than five years) use of this cut-off wall is to mitigate NAPL seepage into Coney Island Creek and to serve as shoring during future creek and uplands remedial activities (i.e., excavation of uplands soil and creek dredging). Once the remediation is complete (OU-3), the cut-off wall will be cut to the mean low water level. Based on the use of the Waterloo Barrier® cut-off wall to achieve the remedial objectives, and a study performed by C3 Environmental, corrosion protection is not necessary.

3.2.2 Standard Steel Sheet Pile Cut-off Wall

A standard steel sheet pile cut-off wall will be installed along the north and west portions of the Site (see Design Drawing C3). This cut-off wall will be installed to various depths in accordance with Design Drawing C-5. Details on the installation of the standard steel cut-off wall, along the north and west sides of the Site, are provided in Design Drawing C-8.

The interlock between sheet sections will be sealed with an impermeable joint sealant. The anticipated permeability of the standard sheet pile cut-off wall is 1×10^{-7} cm/sec per information received from the supplier.

Based on the current Site topography, some of the installed sheet pile may remain exposed above ground until the completion of future remedial construction. To inhibit corrosion the sheet pile will be fabricated from marine steel (ASTM A690).

3.3 Piezometers

Piezometers will be installed every 400 feet along the vertical barrier cut-off wall. The piezometers will be installed as sets along the north and west cut-off walls. Each set will consist of two piezometers, one installed inside the cut-off wall and the other outside of the cut-off wall. Along the Coney Island Creek perimeter, the piezometers will be installed inside the cut-off wall. No piezometers will be installed in Coney Island Creek. If water level measurements are required outside the cut-off wall along the creek, they will be obtained by other methods. These piezometers will be monitored in accordance with the Operation, Maintenance, and Monitoring (OM&M) Plan included as Attachment 5. The location of the piezometers as well as design details are provided in Design Drawings C-3 and C-7.

3.4 Restoration of Disturbed Areas

Following installation of the vertical barrier cut-off wall around the Site, areas disturbed by construction will be restored to pre-construction condition, to the extent possible. Affected areas will either be covered with stone or seeded to promote the growth of new vegetation and to eliminate erosion concerns. The soil erosion control methods will be discontinued at the conclusion of the project, in areas where stone is present, or once the vegetation has taken in areas that were seeded.

Any fence posts removed at the beginning of OU-1 will be replaced and fence fabric will be attached to the posts. Details on replacing the fence posts are provided in Design Drawing C-9. The temporary security fence will be removed following the repair/replacement of the existing perimeter fence.

3.5 Post Construction Activities

Following the completion of the OU-1 remediation activities, monitoring and maintenance of some of the systems will be required to ensure proper operation. The OU-1 systems requiring monitoring and maintenance include:

- The soil erosion and sediment control measures until the new vegetation has taken; and,
- The piezometers inside and outside the vertical barrier cut-off wall.

The maintenance and monitoring requirements for these systems are provided in the OM&M Plan (Attachment 5).

4.0 ENGINEERING COST ESTIMATE AND SCHEDULE

An engineering cost estimate has been developed for OU-1 construction activities. This estimate is based on the following assumptions:

1. Estimate is for budgetary purposes only. (A 20% contingency has been included in the costs.)
2. Craft Labor rates based on Davis Bacon wage rates obtained for Kings Co. NY.
3. Work to be performed (5) days/week, 10-hrs/day.
4. No active utility lines or any underground obstructions/structures will be encountered during Site work.
5. Existing concrete pads and foundations will be left on-site.
6. A $25,000 allowance has been included for all Site permit requirements (City, State, Federal, etc.)
7. PPE not to exceed Modified Level D requirements.
8. No earthwork is to be done.
9. No more than 40,000 gallons of water will require off-site disposal (non-hazardous).
10. Pricing based upon 2003 dollars – no escalation costs are included.

A detailed cost estimate for OU-1 construction activities is provided in Appendix A.

Appendix A also contains two (2) schedules for this project. The first schedule provides the estimated duration of the OU-1 construction activities. The second schedule provides the estimated duration from issuing submittals (i.e., project plans) through the anticipated completion of post OU-1 construction activities.

These tasks will be implemented following the approval of the Final RD Report. A projected schedule of OU-1 activities, from the approval of the Final RD Report, is provided below:

TASK	ESTIMATED COMPLETION
Approval of Final RD Report	0
Obtain Permits for OU-1 Construction	15 Days after Approval
Procurement of Contractor	15 Days after Approval
Mobilization	30 Days after Approval
Limited Site Clearing and Grubbing	40 Days after Approval
Erosion and Sediment Control Measures	45 Days after Approval
Construction of Cut-off Walls	60 Days after Approval
Restoration/Demobilization	90 Days after Approval
Post-Construction Activities	730 Days after Approval

5.0 IDENTIFICATION OF FEDERAL, LOCAL, AND STATE PERMITS REQUIRED FOR OU-1 REMEDIATION

5.1 General

This section describes the local, state, and federal permits required for the OU-1 construction activities. In addition, it discusses the property agreements and deed restrictions.

The permits and agreements referred to in this section are based on the proposed OU-1 remedial construction activities described in Section 3.0. These activities include:

- The installation of a vertical barrier cut-off wall around the Site; and,
- Temporary facilities constructed by the contractor.

5.2 Property Agreements/Deed Restrictions

Parcels of land owned by the City of New York and the MTA are within the area enclosed by the vertical barrier cut-off wall. Therefore, access agreements may be needed to install the vertical barrier cut-off wall in these areas.

Easements and rights of way may be required for the OU-1 remedial action activities. The final use of the Site has not been determined; however, the ROD requires a deed restriction to limit the use of the Site to commercial or industrial purposes only. A deed restriction will be pursued after the final use of the Site is determined.

5.3 Local Permits

As per 6 NYCRR 375-1.7c, no permit, consent, approval, or other authorization under any local zoning, land use or other regulatory program is required for OU-1 remedial action activities. Therefore, a soil erosion/sediment control plan, prepared in accordance with local requirements, will not be required for the disturbance along the path of the vertical barrier cut-off wall. However, the contractor installing the cut-off wall will meet the substantive aspects of the soil erosion/sediment control standards.

5.4 State Permits

A Waterloo Barrier® cut-off wall will be installed along Coney Island Creek. A section of the cut-off wall will be located on the creek side of the existing wooden bulkhead along the southwest side of the Site. In this section of the creek, the cut-off wall will be installed in unvegetated mud flats. The remainder of the Waterloo Barrier® cut-off wall will be installed above the mean high water mark and landward of the delineated wetlands. For the section waterward of the existing wooden bulkhead, the Contractor will follow substantive aspects of 6 NYCRR Parts 608 (Use and Protection Waters) and 661 (Tidal Wetlands).

Installation of the vertical barrier cut-off wall along Coney Island Creek, to prevent seepage of additional MGP impacted material into the creek, meets the standards promulgated in 6 NYCRR Part 661.9 for activities in tidal wetlands and adjacent areas as follows:

- The proposed activity is compatible with the policy of the Tidal Wetlands Act to preserve and protect tidal wetlands and to prevent their despoliation and destruction. The installation of a cut-off wall will have a beneficial impact on the present and potential value of the affected tidal wetland area and adjoining tidal wetland areas in the Coney Island Creek by eliminating the seepage of residual MGP products into the creek. Vegetated wetlands, as well as tidal mudflats, will be restored in Coney Island Creek upon completion of the final remediation (OU-2 and OU-3). In addition, a 50-foot wide ecological buffer will be established adjacent to the creek. These activities will result in enhanced wetland values as compared to existing conditions. The proposed activity is compatible with public health and welfare, as it will prevent further seepage into the creek of hazardous waste present at the site, thereby, mitigating future threats to the public and/or the environment.

- The proposed activity is reasonable and necessary to prevent continued seepage of residual MGP products into the creek as required by the Order on Consent with the NYSDEC. Placement of the cut-off wall as close to the existing bulkhead as feasibly possible will minimize impacts to tidal wetlands adjacent to the existing bulkhead. Impacts to tidal wetlands for the remainder of the creek were avoided by placing the barrier wall landward of the delineated wetland boundary.

The proposed activity also complies with the pertinent development restrictions promulgated in 6 NYCRR Part 661.9:

- Pilings are exempt from minimum setback requirements.

- Existing and new structures and other impervious surfaces will cover less than 20 percent of the adjacent area.

- Placement of the vertical barrier cut-off will not result in an increase in surface water runoff to tidal waters.

5.5 Federal Permits

Installation of the vertical barrier cut-off wall within the southwestern portion of Coney Island Creek adjacent to the existing wooden bulkhead will be done under a Section 10 Nationwide Permit (NWP) Number 38 – Cleanup of Hazardous and Toxic Waste. This nationwide permit authorizes activities to contain, stabilize, or remove hazardous waste provided these activities are performed, ordered or sponsored by a government agency. Remedial activities will meet the conditions for this NWP, since will be completed under an existing Order on Consent (Index No. D2-001-94-12 and a March 2001 Record of Decision with the NYSDEC. The closest face of the proposed cut-off wall will be placed approximately one-foot waterward of the existing structure. The width of the structure is approximately 10 inches and will extend 22 inches from the existing bulkhead. In areas where physical obstructions are encountered, the vertical barrier cut-off wall will be placed waterward of the obstruction. No removal of accumulated sediments is anticipated or planned. For the remaining area along the bank of Coney Island Creek, the cut-off wall will be placed landward of the mean high water mark and any adjacent wetland boundary. A NYSDEC Water Quality Certification will not be required since the proposed activity will be authorized under Section 10 of the Rivers and Harbors Act of 1899.

6.0 IMPLEMENTATION METHOD OF CONSTRUCTION ACTIVITIES AND A METHOD FOR SELECTING THE CONTRACTOR

6.1 Construction Implementation

The OU-1 construction activities will be performed in accordance with project plans, Design Drawings, and specifications described in the Final Remedial Design Report. The selected contractor will be responsible for the preparation of project plans and KeySpan will review and comment on these plans.

These plans will identify the major construction activities planned for OU-1. These major construction activities include but are not limited to:

- Installation of soil erosion and sediment control measures;
- Limited clearing and grubbing around the perimenter of the Site;
- Removal of fence fabric and minimal posts from the existing chain link fence and providing temporary security fencing;
- Installation of vertical barrier cut-off wall;
- Installation of piezometers;
- Restoration of disturbed area(s) and repair/replacement of the perimeter chain link fence.

The project plans will address methods, procedures, and equipment needed to complete each of the major construction issues. The plans will also provide the organization of the personnel performing the work. The organization will include personnel from both the selected contractor and KeySpan. In addition to providing the organization, these project plans will also provide the responsibilities of the various individuals and the line and methods of communication.

It is important that both the selected contractor and KeySpan agree on the organization, responsibilities, and the line and methods of communication. This will ensure that the construction activities are implemented in a seamless manner.

6.2 Method for Contractor Selection

KeySpan will select a contractor for the OU-1 construction activities, in accordance with corporate policies and procedures. The key elements of contractor selection will include:

- Identifying a sufficient number of contractors with the experience to perform the OU-1 construction activities;
- Preparation of a Request for a Proposal (RFP) package that provides sufficient background, technical, and contractual information for the contractors to submit appropriate technical and cost proposals;
- Preparing a criteria to evaluate the contractor's technical and commercial proposals;

- Ensuring that questions from the contractor on the RFP and questions from KeySpan on the contractor's proposals are answered; and
- Selection of a contractor based on the evaluation criteria and responses to KeySpan questions.

Following the selection of the contractor, KeySpan will negotiate a contract. When the contract is signed by both representatives of KeySpan and the selected contractor, KeySpan will notify the non-selected contractors that their technical and commercial proposals were not successful.

APPENDICES

APPENDIX A

Engineering Cost Estimate and Construction Schedules

OU-1 CONSTRUCTION COST ESTIMATE

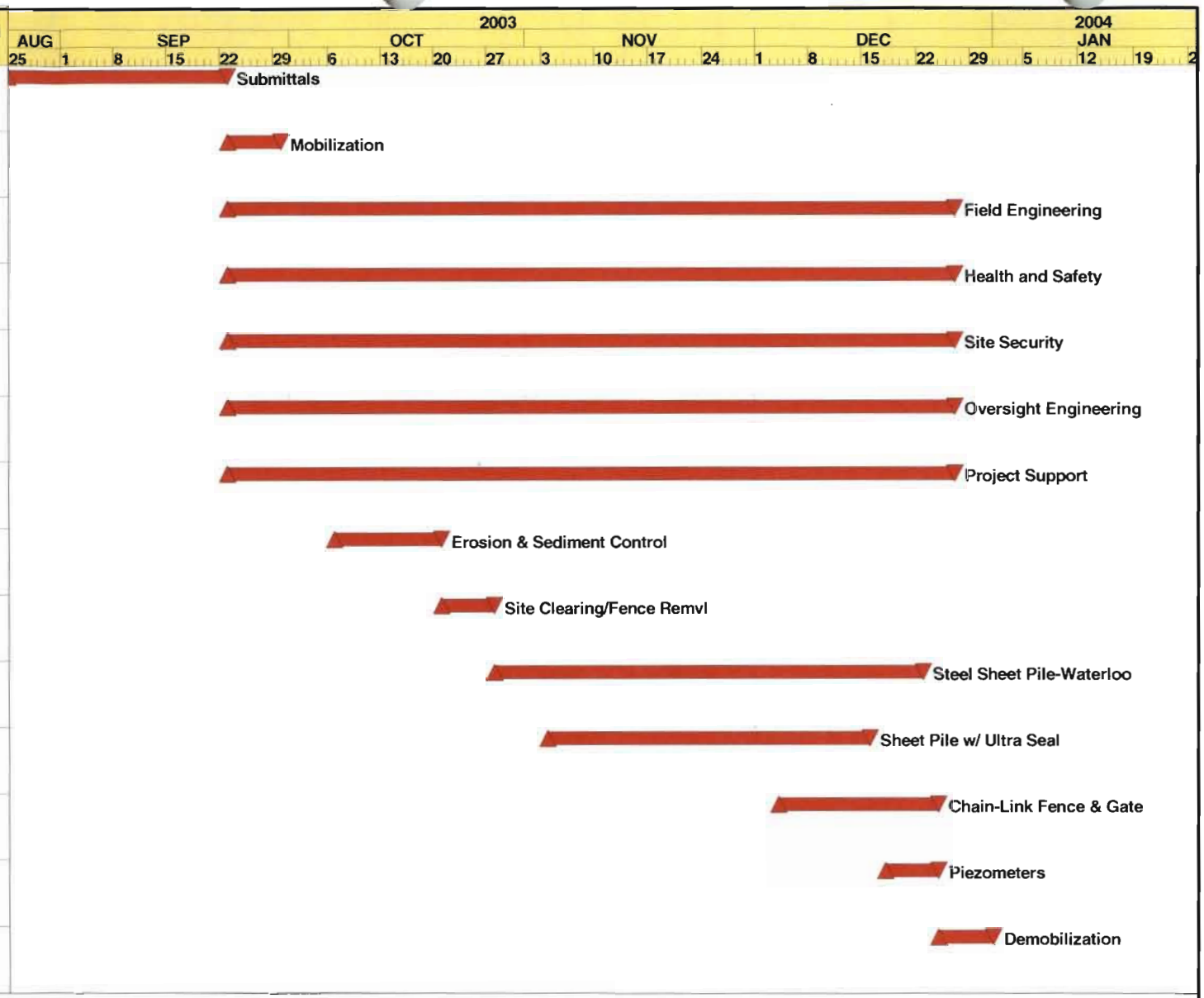
Former Brooklyn Borough Gas Works Site
Coney Island, New York

Construction Task	Units	Quantity	Unit Price	Total Price
Mobilization	LS	1	N/A	$108,000
Submittals	LS	1	N/A	$49,000
Field Engineering	LS	1	N/A	$27,000
Health and Safety	LS	1	N/A	$96,000
Site Clearing and Removal of the Fence Fabric from the existing Chain Link Fence	LS	1	N/A	$59,000
Site Security	LS	1	N/A	$111,000
Soil Erosion and Sediment Control Measures	LS	1	N/A	$132,000
Waterloo Steel Sheet Pile Cut-Off Wall	SF	70,000	$42	$2,940,000
Standard Steel Sheet Pile Cut-off Wall	SF	47,000	$36	$1,692,000
Piezometers (to depth of Cutoff wall)	LF	450	$37	$16,650
New Fence Fabric for the Chain Link Fence	LS	1	N/A	$84,040
Demobilization	LS	1	N/A	$37,000

TOTAL ESTIMATED OU-1 CONSTRUCTION COSTS $5,400,000

Notes:
LS – Lump Sum
SF – Square Foot
LF – Linear Foot
N/A – Not Applicable

Activity ID	Activity Description	Orig Dur
90	Submittals	21
10	Mobilization	5
310	Field Engineering	69
320	Health and Safety	69
430	Site Security	69
600	Oversight Engineering	69
610	Project Support	69
460	Erosion & Sediment Control	10
400	Site Clearing/Fence Remvl	5
490	Steel Sheet Pile-Waterloo	40
500	Sheet Pile w/ Ultra Seal	30
540	Chain-Link Fence & Gate	15
510	Piezometers	5
550	Demobilization	5



Start Date	04AUG03
Finish Date	31DEC03
Data Date	25AUG03
Run Date	11SEP03 08:38

Early Bar
Progress Bar
Critical Activity

KYC2

Sheet 1 of 1

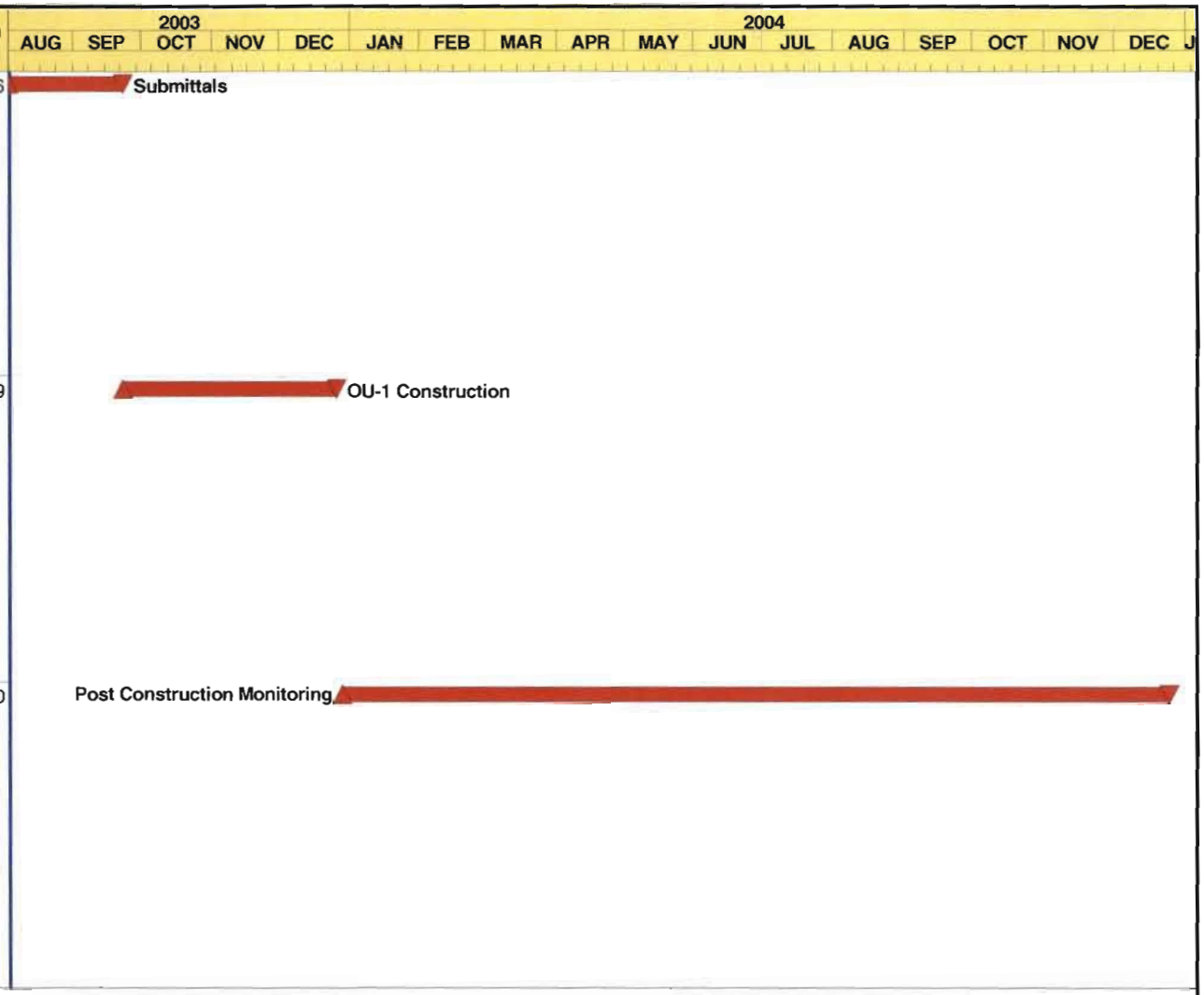
Keyspan Corporation

Former Brooklyn Gas Works Site

OU-1 Construction Activities

Date	Revision	Checked	Approved

Activity ID	Activity Description	Orig Dur	Rem Dur
120	Submittals	36	36
310	OU-1 Construction	69	69
10	Post Construction Monitoring	260	260



Start Date	04AUG03
Finish Date	24DEC04
Data Date	04AUG03
Run Date	11SEP03 08:37

Early Bar
Progress Bar
Critical Activity

KYA3

Sheet 1 of 1

Keyspan Corporation

Former Brookyln Borough Gas Works Site

OU-1 Construction and Post Construction Monitoring

Date	Revision	Checked	Approved

ATTACHMENTS

ATTACHMENT 1

Geotechnical Soil Boring Logs

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 6.68'
Site Id: B-1	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 30.00'
Date(s): 08/16/02 - 08/19/02	X Coordinate: 989882.41
Remarks: 2" O.D. Split-Spoon Mobile B-61 HD 4 1/4" I.D. Hollow Stem Auger	Y Coordinate: 151547.39
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
2			GM				5
4	4		PT		Coal ash (GRAVEL/SILT/SAND) (GM) to 4.5', then brown peat, some CLAY, very soft, wet (PT)	2 ppm	
6							0
8							
10	2 2 3 6		SP		Gray-brown fine SAND, loose wet (SP)	5 ppm	
							-5

Location: Keyspan Energy Company	Site Id: B-1

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
14	5 8 16 12				Gray-brown fine SAND, medium dense, wet (SP)	10 ppm	
16							-10
18							
20	7 5 3 4		PT		Gray-brown fine SAND, loose, wet to 20.8', then brown peat (SP/PT)	8 ppm	
22							-15
24							
26							-20

Location: Keyspan Energy Company	Site Id: B-1

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
					~ 28.8 CLAY begins		
					Green-gray CLAY		
30					End of Borehole		
							-25
32							
34							
36							
							-30
38							
40							
							-35
42							

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 6.69'
Site Id: B-2	Completed Depth: 0.00'
Logged By: A. Tognon	Total Depth: 28.00'
Date(s): 08/09/02 - 08/09/02	X Coordinate: 989980.08
Remarks: Split-Spoon(2"), 130lb Safety Hammer, 1.75" dr. Shelby Tube (3") Direct Push Mobile B-67 Truck-Mounted Hollow Stem Auger (4.25" I.D.)	Y Coordinate: 151529.15
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
			SP/Fl		Poorly graded SAND-brown, dry (loam/topsoil) (SP)		
			GW		Top 6" medium to fine SAND (auger cutting) (FILL)		
			Fl		Well graded gravel w/ SAND-25% coarse gravel, 35% fine gravel, 20% coarse SAND, 10% medium SAND, 10% fine SAND, dry to moist, black (augur cuttings)	0 ppm	
2							5
4	1 1 1 1		PT			0 ppm	
6			SP		Coarse to medium SAND, wet, dark brown, trace gravel (SP/PT)		0
			PT				
8			SP				
	4 5 5 7				Poorly graded SAND-brown, loose, wet, slow dilatancy-20% medium SAND	0 ppm	
10							-5

Location: Keyspan Energy Company | Site Id: B-2

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
14	4 4 6 7				Poorly graded SAND, medium to fine–brown, slow to no dilatancy, loose (SP)	0 ppm	
16							-10
18							
20	4 7 7 10				Poorly graded SAND–grey, medium, dense, wet–35& medium SAND, 65% fine SAND. (SP) Bottom 2" PT organic odor, dark brown, fiberous (woody), medium plasticity, medium stiffness	0 ppm 10 ppm	
			PT		peat–dark brown, strong organic odor (woody), medium plasticity, medium stiffness (PT)	10 ppm	
22							-15
24	5 8 7 8				Top 7"–poorly graded SAND, medium to fine, trace of PTon top (0.1")(SP) Bottom 6"–lean CLAY, fines 100% (CLAYEY) greenish light grey, medium stiffness, wet, medium to high plasticity (CL)	1 ppm 3 ppm	
26							-20
					Lean CLAY, light gray (greenish) medium stiffness, wet, past or close to plastic limit, small SILT content, medium to high plasticity (CL)	0 ppm	
					End of Borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 6.84'
Site Id: B-3	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 26.00'
Date(s): 08/19/02 - 08/19/02	X Coordinate: 990055.21
Remarks: 2" O.D. Split-Spoon Mobile B-61 HD 4 1/4" I.D. Hollow Stem Auger	Y Coordinate: 151510.92
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
2			GM		Coal ash (dark gray gravel and SAND, same SILT size) loose, wet to 5.5' (GM), then no recovery of soft zone	4 ppm	5
4	5 3 3 WOH						
6							0
8							
10	1 WOH 1 WOH		CH/SP		Gray-brown CLAY, some peat, high plasticity, very soft to 10.8', then gray brown fine SAND (CH/SP)	15 ppm	-5

Location: Keyspan Energy Company	Site Id: B-3

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
14	1 3 6 11		CH/PT		Gray brown CLAY and peat, very soft, high plasticity, wet to 15' (CH/PT)	0.5 ppm	
16							-10
18							
20	3 3 4 3		SP		Gray brown fine SAND (SP/PT), loose, high plasticity, greenish grey brown CLAY (19.4'–19.6'), peat, wood at 20.8'	20 ppm	
22			PT		~ 23' gray–green CLAY		-15
24							
26					End of Borehole		-20

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 11.81'
Site Id: B-4	Completed Depth: 0.00'
Logged By: A. Tognon	Total Depth: 46.00'
Date(s): 08/19/02 - 08/19/02	X Coordinate: 990419.62
Remarks: Split-spoon(2") 150lb safety hammer Shelby Tube (3") Direct Push Mobile B-67 Truck-Mounted Hollow Stem Auger (4.25" I.D.)	Y Coordinate: 151474.27
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
			Fl/GW		Well graded gravel w/SAND, brown fill, dry (GW)		
			SW/GW		Well graded SAND and gravel, dry, dark brown to black, wood debris (SW/GW)		
2							10
4	4 7 4 13		Fl		Construction debris, wood fibers, asphalt (coal?), SAND and gravel mix, dry, loose to medium dense, black, odor	100 ppm	
6							5
8							
	2 3 2 5		PT GW		1" PT layer on top-largely CLAY, trace root material, well graded gravel w/ SAND-50% fine gravel, 20% coarse SAND, 15% medium SAND, 10% fine SAND, wet, loose, black (GW)	5 ppm	
10			GW/Fl			5 ppm	0

Location: Keyspan Energy Company | Site Id: B-4

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
14	3 1 1 1				No recovery. Piece of wood in TIP.		
16							-5
18							
	2 1 2 1		CH PT				
20			CH		CLAY (w/ PT less than 1"), dark grey, soft, wet-100% fines (CLAYEY), medium to high plasticity. Between liquid and plastic limit, high dry strength 2" poorly graded SAND, grey, medium to fine, wet (CH/PT)	2 ppm	
			SP				
22							-10
24	3 4 5 7				Poorly graded SAND, grayish brown-15% coarse SAND, 50% medium SAND, 35% fine SAND, slow to no dilatancy (SP)	0 ppm	
26							-15

Location: Keyspan Energy Company | Site Id: B-4

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4		SW				
30	6				Well graded SAND—30% coarse SAND, 35% medium SAND, 35% fine SAND, trace gravel, wet, greyish, medium dense, slow dilatancy (SW)	2 ppm	
	7						
	7						
32							-20
34	6		SW/SP				
	8						
	9				Well graded SAND,brown, wet, medium dense, slightly finer SAND, trace coarse gravel (SW/SP)	3 ppm	
	11						
36							
							-25
38							
	6		SP				
	9						
	10				Poorly graded SAND, brown, wet, medium dense—10% coarse sand, 60% medium SAND, 30% fine SAND (SP)	1 ppm	
40	13						
						1 ppm	
							-30
42							

Location: Keyspan Energy Company	Site Id: B-4

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	5 6 8 9		SM		SILTY SAND, redish brown–85% fine SAND, 15% fines (SILTY), wet, rapid dilatancy, medium dense (SM)	1.5 ppm	
46					End of Borehole		
							–35
48							
50							
52							–40
54							
56							
							–45
58							

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 12.65'
Site Id: B-5	Completed Depth: 46.00'
Logged By: Tom Fowler	Total Depth: 46.00'
Date(s): 08/20/02 - 08/20/02	X Coordinate: 990518.27
Remarks:	Y Coordinate: 151471.28
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
			Fl/SW		Well graded SAND w/ gravel, light brown 0'-1', brown 1'-4', gravel, concrete sand mix-15% coarse gravel, 25% fine gravel, 30% coarse SAND, 20% medium SAND, 10% fine SAND, trace cobbles (SW)		
2							10
4	13 6 4 5				Well graded SAND, brown to black-30% fine gravel, 40% coarse SAND, 30% medium SAND, stained black, petroleum odor, tar/asphalt (3"), moist, medium dense (SW)	20 ppm	
6							
8							5
10	8 13 16 9				Well graded SAND-5% fine gravel, 45% coarse SAND, 35% medium sand, 15% fine SAND, dark gray to black, wet, asphalt plug at top of spoon, dense to medium dense (SW)	3.5 ppm	

Location: Keyspan Energy Company | Site Id: B-5

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
							0
14	5 8 9 11		SP		Poorly graded SAND–5% coarse SAND, 60% medium SAND, 35% fine SAND, grayish brown, wet, no dilatancy, medium dense (SP)	3.2 ppm	
16							
18							-5
	6 7 8						
20	7				Poorly graded SAND–grayish brown, wet, medium dense (SP)	7.0 ppm	
22							-10
24	4 5 5 6				Poorly graded SAND, brown–15% coarse SAND, 50% medium SAND, 35% fine SAND, wet, loose. No dilatancy. (SP)	1.5 ppm	
26							
							-15

Location: Keyspan Energy Company	Site Id: B-5

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
30	5 5 6 8		SW		Well graded SAND–5% fine gravel, 35% coarse SAND, 30% medium SAND, 30% fine SAND, brown, wet, no dilatancy, slightly coarser grained (SW)	1.5 ppm	
32							–20
34	4 6 7 7		SP		Poorly graded SAND, brown–5% coarse, 40% medium, 50% fine SAND, 5% fines, wet, dilatancy (rapid), loose to medium dense (SP)	1.9 ppm	
36							
38							–25
40	4 4 6 7				Poorly graded SAND, fine, reddish brown, loose, wet–20% medium SAND, 75% fine SAND, little to no dilatancy, 5% fines (SILTY) (SP)	0 ppm	
42							–30

Location: Keyspan Energy Company	Site Id: B-5

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	5 7 8 10				Poorly graded SAND, reddish brown–30% medium SAND, 70% fines, no dilatancy (SP)	0 ppm	
46					End of Borehole		
							–35
48							
50							
52							
							–40
54							
56							
							–45
58							

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 11.34'
Site Id: B-6	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 19.00'
Date(s): 08/20/02 - 08/20/02	X Coordinate: 990831.96
Remarks: 2" O.D. Split-Spoon Mobile B-61 HD 4 1/4" I.D. Hollow-Stem Auger	Y Coordinate: 151477.43
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
2	6 6 2 2		FI/GM		Light brown SILT and gravel (fill), wood in tip, some SAND, medium stiffness, dry (GM)	25 ppm	10
4							
6							5
8							
10	30 17 12 24		GM		Gray, black, stained gravel and SAND, some SILT, moist, oily, odor to 9', then coal ash (gravel/SAND/SILT), gray, black, moist, oily, odor (GM)	30 ppm	0

Location: Keyspan Energy Company	Site Id: B-6

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
14			GM		Gray, black coal ash (gravel, SAND, SILT), loose, some wood, wet (GM)	15 ppm	
16							-5
18					End of Borehole	0.5 ppm	
20							-10
22							
24							
26							-15

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 10.54'
Site Id: B-7	Completed Depth: 0.00'
Logged By: A. Tognon	Total Depth: 26.00'
Date(s): 08/20/02 - 08/20/02	X Coordinate: 990992.43
Remarks: Split-Spoon (2") 130lb Safety Hammer 1.75" dr Shelby Tube (3") Direct Push Mobile B-67 Truck-Mounted Hollow Stem Auger (4.25" I.D.)	Y Coordinate: 151507.52
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
			Fl/SP		Brown poorly graded SAND with gravel, dry (SP)		10
2							
4	12 8 9 13		Fl SW/SC		Dark brown, poorly graded SAND w/ gravel, dry	2.5 ppm	
6					Well grained SAND w/ CLAY & gravel-20% fine gravel, 10% coarse SAND, 30% medium SAND, 20% fine SAND, 10% fines, rock/wood fragments, moist (SW/SC)		5
8							
10	4 5 6 5		PT GW		Top 1" soft (organic CLAY), dark greenish brown, very soft-30% fine SAND, 20% fines (PT). Bottom-well graded gravel with SAND-55% fine gravel, 20% coarse SAND, 20% medium SAND, 5% fine SAND, black, trace tar. (GW)	3.8 ppm	0

Location: Keyspan Energy Company	Site Id: B-7

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
14	4		PT				
	2						
	1		SM		5" greenish gray SILTY peat, low plasticity, small amount of fibers (root),	0 ppm	
	1				soft, wet (PT). Bottom–SILTY SAND (SM)–80% fine SAND, 20% fines (SILTY),	0 ppm	–5
16					gray, loose, rapid dilatancy, wet. (SM)		
18							
	2		PT				
	2						
	2						
20	3				Peat, dark gray (greenish), soft, wet–30% wood fibers (root material)	25 ppm	
					70% fines (CLAYEY), organic, low plasticity, strong organic odor (egg) (PT)		–10
					Top–peat (fibrous, root material, woody) (PT)		
22			PT				
24	3		PT		Peat, dark gray (greenish), root material (fibrous), soft, wet (PT)	22 ppm	
	3						
	5						
	6		SP		Bottom 4" poorly graded medium to fine SAND, brown, loose, wet (SP)	6 ppm	
							–15
26					End of Borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 11.15'
Site Id: B-8	Completed Depth: 0.00'
Logged By: A. Tognan	Total Depth: 44.00'
Date(s): 08/06/02 – 08/06/02	X Coordinate: 990920.65
Remarks: Split-Spoon (2"),140lb Safety Hammer Shelby Tube (3") Mobile B-67, truck-mounted Hollow Stem Auger (4.25" I.D.)	Y Coordinate: 151398.09
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	5 7 16 20		Fl/SM		Poorly graded SAND w/SILT, fine grained–80% SAND, 15% fines, 5% gravel, reddish brown, dry (loamy), loose (SM)	2 ppm	10
2	26 27 39 31		Fl/SM		Silty SAND, fine grained SAND, reddish brown, w/ trace gravel (5% gravel), 80% fine SAND,15% fines,dry,(loamy) (SM)	4 ppm	
4	7 52 59 46		Fl/SM		Top 9"–same as above. Silty SAND, dry, reddish brown, trace cobble Bottom 7" pulverized white/gray concrete plug waste. (SM)	5 ppm	
6	7 8 9 5		Fl		SILT SAND, brown, slightly moist (SM)	0.2 ppm	5
8	5 3 15 42		Fl SM SC SP		Top 4" wet silty SAND (SM), moist. Middle 5" black stained clayey SAND (SC), medium plasticity, mild odor. Bottom 5" whitish gray medium/coarse fine grained sand, wet (SP)		
10	33 29 6 3		SP/SC SC		Block stained, CLAYEY SAND–10% gravel, 20% coarse SAND, 35% medium SAND, 25% fine SAND,10% fines, wet, loose (SP/SC) CLAYEY SANDY – black stained, asphaltic augur cuttings, strong odor, soft, wet–45% fines (CLAYEY), medium SAND, medium dry strength, medium plasticity, 1' layer poorly graded sand (top 11")/silty sand, gray (SC)	4 ppm	0

Location: Keyspan Energy Company	Site Id: B-8

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 2 2 3						
			SM/ML		Bottom 10"–gray silty SAND–60% fine SAND, 40% fines (silty), medium dilatancy, little to no plasticity, trace CLAY layer, wet, loose (SM)		
14	2 2 3 3		SP/SM		Poorly graded silty SAND–25% medium SAND, 65% fine SAND, 10% fines, wet, gray. Small 1" CLAY seam (soft), wet,fines silt (SP/SM)		
16	1 2 2 3		SP		Poorly graded silty SAND–10% fines, 5% coarse SAND, 45% medium SAND, 40% fine SAND, wet, grayish brown, loose, medium dilatancy (top), low dilatancy (bottom) (SP)	4 ppm	-5
18	4 3 3 3		SP		Grayish, brown, loose (SP)	7 ppm	
20	2 2 2 2		SP		Poorly graded SAND, brown–35% coarse SAND, 35% medium SAND, 25% fine SAND, wet, no dilatancy, loose (SP)	4 ppm	-10
22	3 2 2 2		SP		Poorly graded SAND (coarse grained), wet, brown, grayish (SP)	8 ppm	
24	2 1 2 3		SP		Poorly graded SAND, grayish brown, wet, loose, no dilatancy–20% coarse SAND, 50% medium SAND, 30% fine SAND (SP)	4 ppm	
26	5 4 5 8		SP		Poorly graded SAND, grayish brown, wet, loose to medium dense–5% coarse SAND, 35% medium SAND, 55% fine SAND, no dilatancy (SP)		-15

Location: Keyspan Energy Company | Site Id: B-8

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	2 2 3 4		SP		Poorly graded SAND, wet (SP)	4 ppm	
30	3 3 4 2		SP		Poorly graded SAND, grayish brown, wet, loose, coarse to medium SAND (SP)	4 ppm	-20
32	2 3 3 5		SP		Poorly graded SAND, grayish brown, wet, loose, medium to fine grained, wet-60% fine SAND, 35% medium SAND, 5% fines, no dilatancy (SP)		
34	3 4 6 9		SP		Poorly graded SAND, grayish brown, wet, loose (SP) Bottom 2" reddish brown, fine SAND-80% fine SAND, 20% fines (silty) (SM)		
36	3 3 4 6				Poorly graded SAND, grayish brown, wet, loose, fine to medium SAND-60% fine SAND, 35% medium SAND, 5% fines, wet, loose, no dilatancy (SP)		-25
38	3 3 6 8		SM/SP		Fine reddish brown silty SAND (SM) in tip-80% fine SAND, 10% medium SAND, 10% fines (SM/SP)		
40	4 5 5 7		SM		Silty SAND, reddish brown, wet, loose, low dilatancy-65% fine SAND, 5% medium SAND, 30% fines (silty). (SM)		-30
42	4 4 6 9		SM		Silty SAND, reddish brown, wet-5% medium SAND, 75% fine SAND, 20% fines (silty) (SM) End of Borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 11.86'
Site Id: B-9	Completed Depth: 0.00'
Logged By: A. Tognon	Total Depth: 44.00'
Date(s): 08/07/02 - 08/07/02	X Coordinate: 990824.64
Remarks: Split-Spoon (2") Shelby Tube (3") Mobile B-67, Truck-Mounted Hollow Stem Auger (4.25" I.D.), 130lb Safety Hammer	Y Coordinate: 151304.24
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	14 21 18 27		Fl/SM		Asphalt and gravel base top 6" 1.5" (asphalt thickness)		
					Silty SAND w/gravel, reddish brown, dry-15% gravel, 5% medium SAND, 45% fine SAND, 30% fines, medium dense, loamy (SM)	2 ppm	
2	13 29 48 54		Fl/SM				10
					Silty SAND, mostly gravel, reddish brown/brown, dry (SM)	5 ppm	
4	8 14 18 18		Fl/SM				
					Reddish brown gravel (well graded) (SM)	2 ppm	
6	8 5 4 5		SC/PT				5
					Top 4" silty SAND and 1" peat, loose, fibrous (woody). Bottom 4" CLAYEY SAND-55% fine SAND, 5% medium SAND, 40% fines (CLAYEY) low to no plasticity, moist, soft, trace organic matter (peat) (SC/PT)	2 ppm	
8			Fl				
			SC/SM		Concrete refuse in tip (SC/SM)		
10	3 2 2 2		PT				
					Peat, dark gray black, fiberous peat (root), CLAY matrix, medium plasticity, odor, soft to medium stiffness, wet (silty SAND in tip) (PT)	2 ppm	0

Location: Keyspan Energy Company	Site Id: B-9

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
					Peat on top. Bottom gravely.		
14	3 2 3 3		SM		Gravel in bottom. Silty SAND, fine silty SAND–70% fine SAND, 30% SILT, gray, wet, little to no plasticity, loose, medium dilatancy (SM)	1.6 ppm	
16	5 10 7 8		SP		Poorly groded SAND, coarser grained–20% coarse SAND, 40% medium SAND, 35% fine SAND, 5% fines, wet, medium dense, odor (SP)	2 ppm	–5
18	5 7 5 6		SP		Silty loam in bottom (SP)	2 ppm	
20	4 4 5 7		SP		Poorly graded SAND, gray, medium to coarse grained, wet, loose (SP)	1.6 ppm	–10
22	4 3 9 5		SP		Poorly graded SAND, medium to coarse–but slightly browner (greyish brown) (SP)	2 ppm	
24	3 4 4 4		SP		Poorly graded SAND, medium to coarse grained–5% coarse SAND, 60% medium SAND, 30% fine SAND, 5% fines, loose, wet, not dilatant, brown (SP)	5 ppm	
26	4 5 7 8		SP		Medium density (SP)	7 ppm	–15

Location: Keyspan Energy Company | Site Id: B-9

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 4 6 7		SP		Poorly graded SAND, slurry fine grained–90% medium SAND, 55% fine SAND, 5% fines, brown, wet, medium dense to loose, no dilatancy (SP)	4 ppm	
30	2 3 3 5		SM/SP		Silty SAND–65% fine SAND, 35% fines, medium dilatancy, brown, siltier than rest above, wet, loose (SM/SP)		
							–20
32	3 3 5 6		SP		Poorly graded SAND, brown, not dilatant, loose (SP)		
34	4 5 6 6				No recovery		
36	4 5 7 7		SM/SP		Silty SAND, reddish brown–80% fine SAND, 15% fines (SILTY), high to medium dilatancy, wet, loose to medium dense (SM/SP)	1 ppm	–25
38	3 4 3 4		SP/SM		Poorly graded SAND–25% medium SAND, 65% fine SAND, 10% fines, reddish brown, loose, wet (SP/SP–SM)	2 ppm	
40	3 5 6 5		SP		Poorly graded SAND, reddish brown, wet, medium dense (SP)		
							–30
42	4 4 6 9		SP		Poorly graded SAND, brown, wet, loose (SP)		
					End of Borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 11.65'
Site Id: B-10	Completed Depth: 0.00'
Logged By: A. Tognon	Total Depth: 26.00'
Date(s): 08/08/02 - 08/08/02	X Coordinate: 990654.39
Remarks: Split-Spoon (2") Shelby Tube (3") Mobile B-67 Truck-Mounted Hollow Stem Auger (4.25" I.D.),130lb Safety Hammer	Y Coordinate: 151133.81
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	8 17 14 34		Fl/SM		1.5" asphalt to silty SAND, reddish brown, dry-15% gravel, 20% medium SAND, 50% fine SAND, 15% fines (silty), medium dense, pulverized concrete in bottom 3" (SM)		10
2	23 45 12		Fl/SM		Silty SAND, reddish brown, medium dense, dry (SAND/concrete mix) (SM)	0 ppm	
4	5 3 2 6		Fl/SM		Pulverized concrete in tip, trace silty SAND, reddish brown (SM)	0 ppm	
6	20 12 6 5		Fl/SM		Silty SAND, brown, moist, black staining at bottom, silty sand, moist (SM)	1.2 ppm	5
8	5 6 5 7		Fl/SM		Poor recovery (wood plug in tip), trace brown SILTY SAND, moist, trace gravel (SM)	6 ppm	
10					Greenish, oily (soupy) product, gravely, organic mix (PT), soft		0

Location: Keyspan Energy Company | Site Id: B-10

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	2 2 2 3		SM		Silty SAND, gray, wet–80% fine SAND, 20% fines (SILTY), low dilatancy, loose to medium dense (SM)	7 ppm	
14	2 2 1 2		SP		Silty SAND, gray, wet, loose to medium dense (SM)	2.3 ppm	
16	3 5 6 8		SM		Silty SAND, gray, wet, loose/soft, slightly cohesive (low), fine predominantly silty, low dilatancy (SM)	2.5 ppm	–5
18	4 4 6 9		SP/SM		Poorly graded SAND w/ SILT–90% fine SAND, 10% fines, wet, low dilatancy, gray (SP/SM)	3 ppm	
20	4 7 8 10		SP/SM		Poorly graded SAND w/ SILT–20% medium SAND, 70% fine SAND, 10% fines (silty) wet, gray, loose (SP/SM)		–10
22	5 5 5 7		SP		Poorly graded SAND, 40% medium SAND, 50% fine SAND, 5% fines, wet, brownish gray, loose to medium dense, low dilatancy (SP)		
24			SP		Same as above (SP)		
26					End of Borehole		–15

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 10.41'
Site Id: B-11	Completed Depth: 0.00'
Logged By: A. Tognon	Total Depth: 26.00'
Date(s): 08/08/02 - 08/08/02	X Coordinate: 990513.50
Remarks: Split-Spoon (2") Shelby Tube(3") Mobile B-67,Truck-Mounted Hollow Stem Auger (4.25" I.D.), 130lb Safety Hammer	Y Coordinate: 150994.05
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	6 7 7 4		FI/SM		SILTY SAND w/gravel-20% gravel, 10% coarse SAND, 5% medium SAND, 35% fine SAND, 30% fines (SILTY) (loamy), dry, reddish brown (SM)	0.6 ppm	10
2	6 42 50		FI/SM		Tip blocked w/ metal and concrete (SM)		
4			FI/SM		Cobbles (20%) and coarse gravel, traces of metal sheeting (SM)		5
6	2 2 36		FI/SM		Same as above (SM)	1.6 ppm	
8			PT		Top 5" well graded SAND w/gravel, wet, loose, brown, black 1" stain above PT, trace organics. Bottom-peat, fibrous (woody root material), soft to medium stiffness, wet (PT)	12 ppm	
10					No recovery		0

Location: Keyspan Energy Company | Site Id: B-11

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
					No recovery. Wet 2' sandy, likely thru peat into SAND (SP), product on outer tube		
14	3 2 1 2		SM		Gray, brown, silty SAND		
					8" silty SAND, gray, medium dilatancy–20% medium SAND, 50% fine SAND, 30% fines (silty), wet, loose (SM)	20 ppm	-5
16	3 4 5 7		SM		8" PT, bottom sample, wet, reddish, plastic, soft (PT)	10 ppm	
					Silty SAND, greenish gray–80% medium SAND, 50% fine SAND, 20% fines (silty), wet, medium dilatancy (SP)	3 ppm	
18	4 5 7 7		SP		Poorly graded SAND–30% medium SAND, 65% fine SAND, 5% fines (SILTY), wet, loose, medium dilatancy (SP)	15 ppm	
20	3 6 7 10		SP		Poorly graded SAND, gray, wet–50% fine SAND, 35% medium SAN, 5% fines, low dilatancy (SP)	5 ppm	-10
22	4 6 7 6		SP		Poorly groded SAND, gray, wet (SP)	6 ppm	
24	4 6 7 6		SP		Poorly graded SAND, gray, wet, very low dilatancy (SP)	3 ppm	
					End of Borehole		-15
26							

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 11.69'
Site Id: B-12	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 26.00'
Date(s): 08/08/02 - 08/08/02	X Coordinate: 990439.98
Remarks: 2" O.D. Split-Spoon Mobile B-61 HD 4 1/4" Hollow Stem Auger	Y Coordinate: 150928.41
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 13 8 26		SM		Brown, fine silty SAND, dry, medium dense (SM)	0.5 ppm	
2	14 16 18 16		SM		Brown, fine silty SAND & gravel, some broken concrete, little plastic, trace fabric, dry, dense (SM)		10
4	14 16 18 16		SM		Gray brown, fine to coarse silty SAND and gravel, some broken concrete, little plastics, trace fabric, dry, dense (SM)	0.5 ppm	
6	4 8 16 64		SM		Brown fine to medium silty SAND, fine gravel, little brick, little fabric (SM)	0.5 ppm	5
8	6 6 4 3		GM		Gray-brown silty SAND and gravel, some concrete, medium dense, dry (corrugated metal scraps in auger) (SM)	1.3 ppm	
10					Gray coarse gravel and concrete rubble, some SAND, some SILT, medium dense, damp (pushed into softer layer - no recovery) (GM)	0.5 ppm	0

Location: Keyspan Energy Company | Site Id: B-12

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	2 2 2 2		CH		Dark, gray black CLAY, little to some very fine to fine SAND, high plasticity, medium soft, wet (CH)	15 ppm	
14	1 2 2 7		CH/SP		Dark gray brown CLAY, little medium SAND, soft to 15' then dark gray brown, very fine to fine SAND, medium dense, wet (CH/SP)	9 ppm	
16	3 4 4 5		CH/SP		Dark gray brown CLAY, some peat medium soft, high plasticity to 18.5', then dark gray brown very fine to fine SAND, medium dense to 19' then dark gray brown CLAY, high plasticity, medium stiffness to 18' (CH/SP/CH)	4 ppm	-5
18	3 7 9 14				Gray–brown CLAY, high plasticity, medium stiffness, some peat to 18.5', then gray brown, fine to very fine SAND, medium dense to 19' then gray brown CLAY, high plasticity, stiffness, some peat		
20	9 13 13 13		SP		Gray brown very fine to fine SAND, medium dense (some CLAY 21'–21.5'), wet (SP)	3.5 ppm	-10
22	5 8 13 15		SP		Gray brown, fine SAND, some medium, medium dense, wet (SP)	3 ppm	
24	4 9 11 11		SP		Gray brown, fine SAND, little SILT, little CLAY, wet (SP)	5 ppm	
26					End of borehole		-15

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 7.49'
Site Id: B-13	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 26.00'
Date(s): 08/09/02 - 08/09/02	X Coordinate: 990342.19
Remarks: 2" O.D. Split-Spoon Mobile B-61 HD 4 1/14" Hollow Stem Auger	Y Coordinate: 150867.89
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 7 8 7		SM		Brown gray, silty SAND, some gravel, medium dense, vegetation/top), dry (SM)	2 ppm	
2	5 5 3 3		SM		Gray brown, fine to coarse silty SAND and coal ash to 3' then gray brown, fine to coarse silty SAND, loose, dry (SM)	2 ppm	5
4	2 1 1 1		SM		Gray brown to black stained, fine silty SAND, moist, loose, slight odor (SM)	40 ppm	
6	3 1 1 2		SM		Gray black, silty SAND, fine, wet, odor, very fine (misc. debris near bottom - fabric, stuffing) (SM)	5 ppm	0
8	2 1 1 2		GM/CH		Gray black, SAND and gravel, some SILT, very loose, wet, odor to 9' then gray black, CLAY, some peat, high plasticity, soft (GM/CH)	3 ppm	
10							

Location: Keyspan Energy Company | Site Id: B-13

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	3 3 6 7		SP		Gray brown, fine SAND, wet (SP)	1 ppm	-5
14	4 5 7 8		SP		Dark gray brown, fine to medium silty SAND and gravel (brick fragments), loose to medium dense, wet (SP)	6 ppm	
16	5 7 9 10		SW		Gray brown, fine to medium SAND, medium dense, wet (SP)	1 ppm	-10
18	4 6 7 8		SP		Gray brown, fine SAND, some medium, medium dense, wet (SP)	6 ppm	
20	3 4 7 7		SP/SM		Gray brown, fine SAND, loose to 21', then gray brown very fine to fine silty SAND, medium dense, wet (SP/SM)	1 ppm	
22	2 4 4 6		SP		Gray brown, fine SAND, little SILT, loose, wet (SP)	1.5 ppm	-15
24	3 3 5 6				Gray brown fine SAND, loose, wet	1 ppm	
26					End of borehole		-20

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 6.21'
Site Id: B-14	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 44.00'
Date(s): 08/09/02 - 08/12/02	X Coordinate: 989949.80
Remarks: 2" O.D. Split-Spoon Mobileb-61 HDX 4 1/4" Hollow Stem Auger	Y Coordinate: 150771.18
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 6 8 13		FI/SC		Clayey SAND (topsoil), moist, brown black staining at bottom-15% coarse 30% medium SAND, 40% fine SAND, 15% fines, medium dense (SC)	1 ppm	5
2	4 6 8 13		FI/SP		Poorly graded SAND-30% coarse SAND, 30% medium SAND, 5% fines (CLAYEY), 25% gravel, black (asphaltic) stained, moist, brown, trace gravel, medium dense (SP)	7 ppm	
4	8 6 6 4				Poorly groded gravel w/ SAND-20% gravel, 45% coarse SAND, 30% medium SAND, 5% fine SAND, wet, brown w/ black staining, medium dense (SP)	9 ppm	
6	1 3 5 9		SP		Poorly graded SAND, gray-30% medium SAND, 65% fine SAND, 5% fines (silty), 1" soft sandy CLAY on top, wet, odor, oil, loose, low dilatancy, 1" CLAY seam on tip (only confined layer) (SP)	400 ppm	0
8	4 8 14 16				Poorly graded SAND, medium to fine, gray, medium dense, oily, odor (SP)	15 ppm	
10	2 4 8 8				Poorly graded SAND, gray, wet, mededium to fine, odor, loose to medium dense, 1" CLAY seam on top, gray, medium plasticity, soft (SP)	15 ppm	-5

Location: Keyspan Energy Company	Site Id: B-14

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	7 8 13 16				Poorly graded SAND, gray, wet, medium to fine, odor, oily (SP)	300 ppm	
14	5 4 7 7				Poorly graded SAND, gray, wet, medium to fine, odor, oily sheen, medium dense (SP)	800 ppm	
16	5 9 14 16				Same as above (SP)	500 ppm	-10
18	2 8 4 6				Poorly graded SAND, gray, wet, medium to fine, medium dense-25% medium SAND, 80% fine SAND, 5% fines (SILTY), medium dilatancy, odor, sheen (SP)	650 ppm	
20	2 6 8 12				Poorly graded SAND,gray, medium dense, odor, medium to fine SAND (SP)	200 ppm	-15
22	4 5 7 9				Same as above (SP)	100 ppm	
24	4 7 12 19				Poorly graded SAND, gray, medium to fine, odor, medium dense (SP)	400 ppm	
26	9 7 7 9				Poorly graded SAND, gray, medium to fine, oily sheen, odor, medium dense-75% fine SAND, 5% fines (SILTY), 20% medium SAND, low dilatancy (SP)	500 ppm	-20

Location: Keyspan Energy Company	Site Id: B-14

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	7 6 6 7				Poorly graded SAND, grayish brown, slightly finer in bottom (browner)(SP)	400 ppm	
30	8 3 3 4				Poorly graded SAND, brown, wet, loose–85% fine SAND, 10% medium SAND, 5% fines, medium dilatancy, grades to fine top to bottom (SP)	125 ppm	–25
32	2 2 2 7				Poorly graded SAND, grayish brown (SP)	175 ppm	
34	5 6 5 7				Poorly graded SAND, brown grayish, oil sheen, wet (SP)	100 ppm	
36	6 4 4 5				Poorly graded SAND, brown, low dilatancy–80% fine SAND, 15% medium SAND, 5% fines, oil sheen, med. dense to loose (SP)	25 ppm	–30
38	10 6 9 12				Poorly graded SAND, brown, low to no dilatancy–25% medium SAND, 70% fine SAND, 5% fines, wet, little oil sheen, medium dense (SP)	40 ppm	
40	6 9 9 10				Poorly graded SAND, brown, wet, oil droplets, medium dense (SP)	25 ppm	–35
42	2 1 4 3				Poor recovery (SP) End of borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 5.78'
Site Id: B-15	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 44.00'
Date(s): 08/09/02 - 08/12/02	X Coordinate: 989902.53
Remarks: 2" O.D. Split-Spoon Mobile B-61 HDX 4 1/4" Hollow Stem Auger	Y Coordinate: 150786.73
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	15 23 13 19		SM		Gray brown, silty SAND, some gravel (crushed fire brick at about 1.5') dry, dense (SM)	5 ppm	5
2	15 23 12 13		GM		Gray black stained, fine to coarse SAND and gravel, some SILT (coal ash composition), dry, dense (GM)	3 ppm	
4	2 3 2 2		SM		Gray black, fine SAND and CLAYEY/SILT, loose, wet, some odor (SM)	4 ppm	
6	3 4 4 8		SP		Dark gray fine SAND, little SILT, loose, wet (SP)	60 ppm	0
8	4 6 7 8		SM		Gray black, fine SILTY SAND, some gravel, medium dense, wet (SM)	2.3 ppm	
10	4 6 7 6		SP		Gray brown, fine SAND, medium dense, wet (SP)	15 ppm	-5

Location: Keyspan Energy Company	Site Id: B-15

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	5 7 8 11		SP		Gray brown, fine SAND, some medium, medium dense, wet, odor (oily stain at about 13.5') (SP)	200 ppm	
14	4 6 7 9		SP		Gray brown, fine SAND, medium dense, wet (oily lamination ~1/8" near 14.4"), odor (SP)	200 ppm	
							-10
16	5 4 7 7		SP		Gray brown, fine SAND, medium dense, wet, odor (SP)	250 ppm	
18	4 7 9 7		SP		Dark gray brown, fine SAND, some medium, medium dense, wet, odor (SP)	100 ppm	
20	3 4 5 8		SP		Dark gray brown, fine SAND, some medium, medium dense, wet, odor (SP)	120 ppm	
							-15
22	4 7 8 11		SP		Gray brown, fine, some medium SAND, medium, dense, wet (SP)	20 ppm	
24	5 4 5 7		SW		Gray brown, fine to medium SAND, medium dense, wet (SW)	60 ppm	
							-20
26	4 4 6 7				No recovery		

Location: Keyspan Energy Company	Site Id: B-15

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	2 3 3 2		SP		Gray brown, very fine to fine SAND, loose, wet (SP)	4 ppm	
30	2 2 2 3		SP		Brown, very fine to fine SAND, loose, wet (SP)	6 ppm	-25
32	3 4 6 8		SP		Red brown, fine SAND, medium dense, wet, odor (SP)	20 ppm	
34	4 5 7 7		SP		Brown, fine SAND, medium dense, wet, odor (SP)	15 ppm	-30
36	3 3 6 7		SP		Brown to red brown very fine to fine SAND, loose, wet (SP)	12 ppm	
38	3 4 7 8		SP		Gray brown to red brown, fine SAND, wet, odor, loose to medium dense (SP)	30 ppm	
40	3 3 3 5		SP		Gray brown to red brown fine SAND, loose, wet (SP)	10 ppm	-35
42	2 4 5 8		SP		Red brown to gray brown fine SAND, loose, wet (SP)	10 ppm	
					End of borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 5.42'
Site Id: B-16	Completed Depth: 90.00'
Logged By: Tom Fowler	Total Depth: 90.00'
Date(s): 08/13/02 - 08/14/02	X Coordinate: 989854.30
Remarks:	Y Coordinate: 150800.14
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	5 9 10 11		FI				5
			SP/SM		Poorly graded SAND w/ gravel and SILT, brown, dry, 15% gravel, 10% coarse SAND, 20% medium SAND, 40% fine SAND, 15% fines (silty), medium dense, trace brick fragments in tip (SP/SM)	0 ppm	
2	9 8 5 5		FI				
			SP/SM		Bottom 4" stained black, moist (SP/SM)	3 ppm	
4	3 2 1 2		FI		Well graded gravel w/SAND & SILT, 50% gravel, 15% coarse SAND, 10% medium SAND, 10% fine SAND, 10% fines, black stained and oily at bottom, brown at top (GW/GM)	20 ppm	
			GW/GM				0
6	5 5 5 7		SP		Significant amount bricks, water/mud. Poorly graded SAND, brownish black, top 5" poorly graded SAND-20% medium SAND, 75% fine SAND, 5% fines, oily, odor, medium dense, medium dilatancy (slow to rapid) trace amount cinder (white), wet (SP)	1000 ppm	
8	5 7 7 8				Poorly graded SAND, gray, wet, medium dense-20% medium SAND, 75% fine SAND, 5% fines (SILTY), low dilatancy, strong odor (SP)	5000 ppm	
10	3 2 3 4				Poorly graded SAND, gray-5% medium SAND, 90% fine SAND, 5% fines, low to no dilatancy, odor, loose (SP)	2750 ppm	-5

Location: Keyspan Energy Company | Site Id: B-16

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 5 6 9				Poorly graded SAND, oil, staining (SP)	1200 ppm	
14	5 8 9 11				Poorly graded SAND (SP)	2500 ppm	-10
16	5 7 9 11				Poorly graded SAND, dark gray, medium dense to dense, wet, oily, strong odor—10% medium SAND, 85% fine SAND, 5% fines, medium dilatancy (slow to rapid) (SP)	1200 ppm	
18	5 7 9 11				Poorly graded SAND, gray, medium dense—45% medium SAND, 40% fine SAND, 5% fines, strong odor, wet (SP)	1400 ppm	
20	5 6 8 9				Poorly graded SAND, wet, gray, medium dense, strong odor (SP)	200 ppm	-15
22	5 6 7 6				Poorly graded SAND, wet, gray, medium dense, oil sheen (SP)	60 ppm	
24	2 1 2 3				Poorly graded SAND, wet, grayish-brown, no sheen (SP)	20 ppm	-20
26	4 5 5 7		SP/SM		Poorly graded SAND, top 16" (SP/SM) Bottom 6" brown, silty SAND, 80% fine SAND, 20% fines (SILTY) medium dilatancy, medium dense, wet, (composite sample)	100 ppm	

Location: Keyspan Energy Company	Site Id: B-16

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	2 3 3 4		SP		Poorly graded SAND–60% fine SAND, 35% medium SAND, 5% fines (silty), wet, low dilatancy, greyish brown. (SP)	100 ppm	
30	3 2 3 3		SM		Silty SAND redish brown, loose–65% fine SAND, 35% fines (SILTY), wet, medium dilatancy. Slow to rapid. (SM)	10 ppm	–25
32	2 2 3 4		SP/SM		Poorly graded SAND w/ SILT, reddish brown, 10% medium SAND, 80% fine SAND, 10% fines (silty), wet, loose, coarser grained, slow to rapid dilatancy. (SP/SM)	50 ppm	
34	4 4 6 7		SP		Poorly graded SAND, reddish brown, 20% medium SAND, 75% fine SAND, 5% fines (SILTY), wet, loose, dry, coarser (SP)	20 ppm	–30
36	4 5 6 9		SP/SM		Poorly graded SAND w/ SILT, reddish brown, loose, wet, 10% medium SAND, 80% fine SAND, 10% fines, slow to rapid dilatancy. (SP/SM)	10 ppm	
38	3 4 6 2		SP		Poorly graded SAND, reddish brown–35% medium SAND, 60% fine SAND, 5% fines, low dilatancy, loose, wet, (SP)	20 ppm	
40	3 4 6 2				Poorly graded SAND, reddish brown, medium to fine grains, wet, loose (SP)	20 ppm	–35
42	4 4 6 7				Poorly graded SAND, reddish brown–30% medium SAND, 65% fine SAND, 5% fines, wet, loose, no dilatancy (SP)	10 ppm	

Location: Keyspan Energy Company | Site Id: B-16

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 5 6 6		SP/SM		Poorly graded SAND w/ SILT, reddish-brown, 90% fine SAND, 10% fines (SILTY), low dilatancy, wet, loose, same strata, slightly finer grained. (SP/SM)	1 ppm	-40
46							
48							
	4 5 9 11		SP		Poorly graded SAND, brown-5% coarse SAND, 50% medium SAND, 40% fine SAND, 5% fines, medium dilatancy, wet, medium dense, browner/ coarser, same strata, less reddish tint. (SP)	4 ppm	-45
50							
52							
54	3 3 2 3				Poorly graded SAND, brown, loose (SP)	1 ppm	-50
56							
58							
	4 6 7 9				Poorly graded SAND, brown, wet, loose (SP)		

Location: Keyspan Energy Company | Site Id: B-16

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
							-55
62					Poorly graded SAND (fine), brown, wet, medium dense		
64	5 5 6 8		SP/SM		Poorly graded SAND w/ SILT, reddish brown, medium dense, 5% medium SAND, 85% fine SAND, 10% fines (SILTY), medium dilatancy, wet (SP/SM)	0 ppm	-60
66							
68							
	4 3 6 8		SP				
70					Poorly graded SAND, reddish brown, loose, wet, no dilatancy, 5% medium SAND, 90% fine SAND, 5% fines. (SP)	0 ppm	-65
72							
74	4 4 6 7				Poorly graded SAND, reddish brown, loose, slightly coarser, wet— 15% medium SAND, 80% fine SAND, 5% fines, low dilatancy. (SP)	0 ppm	-70

Location: Keyspan Energy Company | Site Id: B-16

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
78							
	4						
	7						
	8						
80	10				Poorly graded SAND, reddish brown, medium dense, wet, medium to fine (SP)	0 ppm	-75
82							
84	5						
	8						
	9						
	12				Poorly graded SAND, reddish brown, wet (SP)	0 ppm	-80
86							
88							
	6						
	9						
	11				Poorly graded SAND, reddish brown-10% coarse SAND, 35% medium SAND, 50% fine SAND, 5% fines, medium dense, wet (SP)	0 ppm	
90	14				End of Borehole		-85

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 5.17'
Site Id: B-17	Completed Depth: 0.00'
Logged By: A. Tognon	Total Depth: 18.00'
Date(s): 08/12/02 - 08/12/02	X Coordinate: 989798.27
Remarks: Shelby Tubes (3"), 130lb Safety Hammer Split-Spoon (2") 1.75" Dr. Mobile B-67 Truck-Mounted Hollow Stem Auger (4.25" I.D.)	Y Coordinate: 150811.51
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	10 6 6.5		Fl				5
			SW/SM		Well graded SAND w/ SILT-30% gravel, 10% coarse SAND, 15% medium SAND, 45% fine SAND, 10% fines (SILTY), dry, brown, loose to medium dense, bottom 6" black stained (SW/SM)	2 ppm	
2	4 3 3 3		Fl SM		Poorly graded SAND-bottom gray to top gray brown, bottom 3" wet, top moist to dry, loose-70% fine SAND, 20% fines (SILTY), 10% medium SAND (SM)	1 ppm	
4	6 10 37 16		SM		Poorly graded SILTY SAND, gray, wet, mild odor, wood plug in tip, fines slightly cohesive (SM)	20 ppm	0
6	3 3 4 6		SP		Poorly graded SAND, grayish black, loose-15% medium SAND, 80% fine SAND, 5% fines, low dilatancy, strong odor, oily (SP) 1" soft CLAY at top of spoon (auger separate)	2500 ppm	
8	3 9 5 6		SP		Poorly graded SAND, black, wet, loose, strong odor, oily (SP)	10000 ppm	
10	4 6 5 7		SP		Poorly graded SAND, medium to fine, black, oily, medium dilatancy, loose (SP)	3000 ppm	-5

Location: Keyspan Energy Company	Site Id: B-17

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	6 7 6 9		SP		Poorly graded SAND, black–20% medium SAND, 75% fine SAND, 5% fines (SILTY), medium dilatancy, medium dense,strong odor, oily (SP)	3000 ppm	
14	2 5 12 13		SP		Same as above (SP)	4000 ppm	–10
16	4 6 7 12		SP		Poorly graded SAND, dark gray, medium to fine, medium dilatancy, odor, not as oily (SP) End of borehole	1000 ppm	
18							
20							–15
22							
24							–20
26							

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 5.81'
Site Id: B-18	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 44.00'
Date(s): 08/13/02 - 08/14/02	X Coordinate: 989759.66
Remarks: 2" O.D. Split-Spoon Mobile B-61 HD Hollow-Stem Auger	Y Coordinate: 150873.85
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	11 24 24 10		SM/MH		Gray brown, fine SAND, medium dense (very dense in brick fill) and gravel (brick), wood in tip, dry, odor (SG)	1000 ppm	5
2	6 6 7 9				Red gray, fine SILTY SAND, damp, medium dense to 3', then dark gray brown clayey SILT, medium stiffness, high plasticity, wet, wood in tip (SM/MH)	10 ppm	
4	7 4 4 3		MH		Dark brown, clayey SILT, some SAND, little peat, moderate to high plasticity, soft to medium soft (MH)	1 ppm	
6	6 6 7 10		SP		Gray brown, very fine to fine SAND, medium dense, wet (SP)	3 ppm	0
8	4 4 7 7		SP		Gray brown, fine SAND, medium dense, wet (SP)	2 ppm	
10	3 4 6 9		SM		Gray brown to dark gray, medium dense, fine SILTY SAND, wet, slight odor (SM)	10 ppm	-5

Location: Keyspan Energy Company | Site Id: B-18

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	3 5 9 12		SP		Gray black stained, fine SAND, medium dense, wet, slight odor (SP)	100 ppm	
14	7 14 27 28		SP		Gray brown, very fine to fine SAND, dense, wet (SP)	60 ppm	
							-10
16	5 7 13 16		SP/SW		Gray brown, fine to medium SAND, medium dense, wet, odor, some dark staining (SP/SW)	900 ppm	
18	6 7 9 7		SP		Dark gray brown fine SAND, medium dense, wet (SP)	30 ppm	
20	2 4 4 7		SP		Dark gray brown fine SAND, loose, wet (SP)	30 ppm	-15
22	7 7 11 7				Dark gray brown, fine SAND, medium dense, wet, odor (SP)		
24	8 6 7 8		SP		Gray brown, fine SAND, medium dense, wet, odor (SP)		
							-20
26	6 7 9 7		SW		Gray brown, fine to medium SAND, medium dense, wet, odor (SW)	50 ppm	

Location: Keyspan Energy Company | Site Id: B-18

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	5 9 14 18		SP		Dark gray brown, fine SAND, medium dense, wet, odor (SP)	40 ppm	
30	5 6 5 8		SP		Gray brown, fine SAND, medium dense, wet, slight odor (SP)	20 ppm	-25
32	7 7 9 13		SP		Gray brown, very fine to fine SAND, wet (SP)	20 ppm	
34	6 6 5 7		SW/SP		Gray brown, fine to medium SAND, some very fine, medium dense, wet (SW/SP)	15 ppm	-30
36	5 6 6 8		SP		Gray brown to red brown, very fine to fine SAND, medium dense, wet, slight odor (SP)	6 ppm	
38	8 8 11 13		SP		Red brown, very fine to fine SAND, medium dense, wet (SP)	12 ppm	
40	6 6 8 8		SP		Red brown, fine SAND, little medium, little SILT, wet, slight odor (SP)	3 ppm	-35
42	5 7 10 12		SP		Red brown to gray brown, fine SAND, medium dense, wet (SP)	5 ppm	
					End of borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 5.51'
Site Id: B-19	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 24.00'
Date(s): 08/14/02 - 08/14/02	X Coordinate: 989720.10
Remarks: 2" O.D. Split-Spoon Mobile B-61 HD 4 1/4" Hollow Stem Auger	Y Coordinate: 150933.65
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	7 8 15 20		SM		No recovery - cobbly fill		5
2	13 13 12 12				Dark gray SILTY SAND, little gravel, slightly moist (SM)	4 ppm	
4	8 5 3 3		SM		Brown silty SAND, little gravel (coal ash), dry (SM)	8 ppm	0
6	2 2 2 2		CH/SM		Brown sandy CLAY, little peat, high plasticity, soft wet to 7', then gray brown, very fine to fine SILTY SAND, loose, wet (CH/SM)		
8					No recovery		
10	2 5 6 5		SP		Gray brown, fine SAND, medium dense, wet (some peaty CLAY - 10.8'-11') (SP)	1 ppm	-5

Location: Keyspan Energy Company	Site Id: B-19

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 8 10 14		SP		Gray brown fine SAND, medium dense, wet (SP)	2 ppm	
14	4 10 18 20		SP		Gray brown, very fine to fine SAND, medium dense, wet, slight odor (SP)	5 ppm	-10
16	10 14 17 20		SP		Gray brown, fine SAND, medium dense, wet, slight odor (SP)	25 ppm	
18	4 8 10 10		SP		Gray brown, fine SAND, medium dense, wet, slight odor (SP)	50 ppm	
20	8 12 15 13		SW		Gray brown, fine to medium SAND, little gravel, medium dense, wet, odor (SW)	30 ppm	-15
22	5 8 10 11		SW		Gray brown, fine to medium SAND, medium dense, wet, odor (SW)	80 ppm	
24					End of borehole		-20
26							

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 5.59'
Site Id: B-20	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 44.00'
Date(s): 08/15/02 - 08/15/02	X Coordinate: 989679.75
Remarks: 2" O.D. Split-Spoon Mobile B-61 HD 4 1/4" Hollow Stem Auger	Y Coordinate: 151021.32
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	7		FI				5
	6						
	5						
	6		ML/GM		Brown SILT, some SAND, little gravel (fill), medium dense, dry to 1' then dark gray gravel & SAND, some SILT size (coal ash) medium dense, dry (ML/GM)	3 ppm	
2	8		GM/CH				
	6						
	2				Gray black (coal ash) SAND & gravel, some SILT, moist, medium dense to 3', then gray brown peaty CLAY, soft, wet, high plasticity (GM/CH)	3 ppm	
	1						
4							
							0
6	5						
	7						
	7				Gray brown clayey peat to 6.5', then gray brown, fine SAND, medium dense, wet	1 ppm	
	6						
8	2		SM				
	3						
	4				Dark gray brown, silty fine SAND, little shell fragments, loose, wet (SM)	1 ppm	
	4						
10	2		SP/SM				-5
	2						
	4						
	3				Dark gray brown, very fine to fine SAND, little SILT, loose, wet (SP/SM)	3 ppm	

Location: Keyspan Energy Company | Site Id: B-20

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	6 10 17 15		SP		Gray brown, fine SAND, medium dense, wet (SP)	2 ppm	
14	10 16 24 20		SP		Gray brown, fine SAND, dense, wet (SP)	2 ppm	-10
16	6 10 15 12		SP		Gray brown, fine SAND, wet, medium dense (SP)	6 ppm	
18	2 6 9 7		SP		Gray brown, very fine to fine SAND, medium dense, wet (SP)	3 ppm	
20	4 8 7 9		SW		Gray brown, fine SAND to 21', then gray brown to red brown fine to coarse SAND and gravel to 21.5' then red brown to gray brown to coarse SAND, medium dense, wet (SW)	2 ppm	-15
22	4 8 7 10		SP		Red brown, fine SAND, medium dense, wet (SP)	1 ppm	
24	3 7 12 10		SP/SW		Red brown to red gray, fine to medium SAND, medium dense, wet (SP/SW)	2 ppm	-20
26	2 5 9 7		SP/SW		Red gray to red brown, fine to medium SAND, medium dense, wet (SP/SW)	2 ppm	

Location: Keyspan Energy Company | Site Id: B-20

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 3 5 9		SW/SP		Red brown to red gray, fine to coarse SAND to 29', then fine SAND, medium dense to loose, wet (SW/SP)	5 ppm	
30	4 7 6 8		SP		Gray brown, fine to coarse SAND, medium dense, wet (SP)	0.5 ppm	-25
32	5 7 7 11		SP		Gray brown, fine SAND, medium dense, wet (SP)	1.5 ppm	
34	3 5 5 8		SP		Gray brown, fine SAND, some medium, medium dense, wet (SP)	0.5 ppm	-30
36	9 7 9 13		SP		Gray brown, fine SAND, some medium, medium dense, wet (SP)	0.5 ppm	
38	4 7 8 10		SP		Gray brown, fine SAND, medium dense, wet (SP)	0.2 ppm	
40	4 6 4 9				Gray brown, fine SAND, some medium, medium dense, wet		-35
42	6 7 7 9				Red brown, fine SAND, medium dense, wet	2 ppm	
					End of borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 5.66'
Site Id: B-21	Completed Depth: 44.00'
Logged By: Tom Fowler	Total Depth: 44.00'
Date(s): 08/15/02 - 08/15/02	X Coordinate: 989617.24
Remarks:	Y Coordinate: 151104.93
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	5 8 10 9		Fl		Silty SAND (top 4") brown, dry, trace vegetation—60% fine SAND, 40% fines, loam (FILL) Bottom 4" – gravelly SAND, black,—30% gravel (fine), 30% coarse SAND, 40% medium SAND, dry	0 ppm	5
2	6 7 9 9		Fl/SP		medium dense to loose		
					No recovery (FILL/SP)	0 ppm	
4	6 6 5 8						
					Poorly graded SAND, light brown, moist—10% medium SAND, 85% fine SAND, 5% fines, dilatancy mededium (new fill?) medium dense (FILL/SP)	0 ppm	0
6	6 6 6 7		Fl				
			SP		Poorly graded SAND, light brown, wet (new fill?), medium dense, medium to fine grained (SP)	0 ppm	
8	5 6 6 7						
					Poorly graded SAND, brown, wet—4% medium SAND, 50% fine SAND, 5% fines, medium dense (SP)	0 ppm	
10	3 4 4 5						-5
					Poorly graded SAND, brown—40% medium SAND, 55% fine SAND, 5% fines, wet, not dilatant, loose (SP)	0 ppm	

Location: Keyspan Energy Company | Site Id: B-21

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	5 8 9 13				Poorly graded SAND, brown, medium to fine SAND (SP)	0 ppm	
14	6 9 11 14				Poorly graded SAND–15% coarse SAND, 50% medium SAND, 35% fine SAND, grayish brown, medium dense, wet (SP)	0 ppm	–10
16	9 17 25 23				Same as above, grayish brown (SP)	0 ppm	
18	6 7 9 13				Poorly graded SAND, gray–5% coarse SAND, 65% medium SAND, 30% fine SAND, no dilatancy, wet, medium dense (SP)	0 ppm	
20	5 6 6 9				Poorly graded SAND, medium to fine, gray, wet (SP)	0 ppm	–15
22	5 7 8 14		SW		Well graded SAND, 20% coarse, 50% medium SAND, 30% fine SAND, gray, wet, medium dense, no dilatancy, trace gravel (SW)	0 ppm	
24	5 7 8 10				Same as above, well graded SAND, gray, trace gravel, wet, medium dense. (SW)	0 ppm	–20
26	5 6 10 11				Well graded SAND–35% coarse SAND, 45% medium SAND, 20% fine SAND, wet, medium dense, no dilatancy (SW)	0 ppm	

Location: Keyspan Energy Company	Site Id: B-21

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
	4 6 8 9				Well graded SAND, gray, wet (SW)	0 ppm	
30	3 3 5 6				Well graded SAND, 50% coarse SAND, 35% medium SAND, 15% fine SAND, grayish brown, wet (SW)	0 ppm	-25
32	4 5 7 8				Well graded SAND, slightly finer, grayish brown (SW)	0 ppm	
34	7 7 8 10				Same as above, grayish brown, med dense (SW)	0 ppm	-30
36	5 7 8 7				Well graded SAND, wet, grayish brown, med dense (SW)	0 ppm	
38	6 9 8 11		SP		Poorly graded SAND, grayish brown-10% coarse SAND, 60% medium SAND, 30% fine SAND, wet, no dilatancy, medium dense (SP)	0 ppm	
40	6 7 10 10				Poorly graded SAND, grayish brown, medium dense (SP)	0 ppm	-35
42	4 6 2 10				Poorly graded SAND-5% coarse SAND, 40% medium SAND, 55% fine SAND, low dilatancy, wet, grayish brown (SP)		
					End of borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 6.37'
Site Id: B-22	Completed Depth: 29.00'
Logged By: Tom Fowler	Total Depth: 29.00'
Date(s): 08/06/02 - 08/06/02	X Coordinate: 989620.54
Remarks:	Y Coordinate: 151251.49
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
			Fl/SP		0-2'-fill (SP)		5
2			PT		Peat, black, some root fibers-30% fine SAND, 70% fines (CLAYEY), soft, low plasticity (PT)		
4	1 1 2 1				Peat, black, fibrous (woody) soft-30% wood fiber, 40% fines (CLAYEY), 30% fine SAND, low plasticity, wet (PT)	800 ppm	
6					PT		0
8							
	3 4 6 2		SP				
10					Poorly graded SAND-40% medium SAND, 60% fine SAND, loose, wet, no plasticity, brown (greyish) (SP)	4 ppm	
							-5

Location: Keyspan Energy Company | Site Id: B-22

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
14	6 9 11 15				Poorly graded SAND–55% medium SAND, 40% fine SAND, 5% coarse SAND brown (greyish), medium dense, wet (SP)	0 ppm	
16							–10
18							
	4 7 7 9		SP/SM		Poorly graded SAND w/ SILT, gray, wet, medium dense, medium dilatancy, slow to rapid–15% medium SAND, 75% fine SAND, 10% fines silty (SP/SM)		
20							
22							–15
24	5 7 12 16		SP		Poorly graded SAND, gray, wet, slightly coarse (medium grained) (SP)	2 ppm	
26		38	MH		Silty CLAY (CC or MH), medium stiffness, light gray, medium plasticity, wet, greenish Elastic SILT, light gray (greenish), medium stiffness, medium to low plasticity, wet, past plastic limit (low dilatancy), SILTY texture, low day strength (MH)		–20

Location: Keyspan Energy Company	Site Id: B-22

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
					CLAY encountered		
					End of borehole		
30							
							-25
32							
34							
36							
							-30
38							
40							
							-35
42							

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 6.36'
Site Id: B-23	Completed Depth: 0.00'
Logged By: Tom Fowler	Total Depth: 28.00'
Date(s): 08/16/02 - 08/16/02	X Coordinate: 989680.25
Remarks: 2" O.D. Split-Spoon Mobile B-61 4 1/4" Hollow Stem Auger	Y Coordinate: 151376.69
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
2			PT/CH		Brown clayey peat, very soft, wet (PT/CH)	20 ppm	5
4	1 1						
6							0
8							
10					~12' becoming fine SAND		-5

Location: Keyspan Energy Company | Site Id: B-23

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
14	8 19 37 35		SW		Gray brown, fine to medium SAND, very dense, wet (SW)	3 ppm	
16							-10
18							
	4 7 9 16	50	SP				
20					Gray brown to gray, fine SAND, medium dense, wet (SP)	8 ppm	
22							-15
24	2 2 3 3	54	CH/MH		Green gray clay, moderate plasticity, medium soft, some SILT, little SAND, slightly moist (CH/MH)		
26		96					-20
					End of borehole		

FOSTER WHEELER ENVIRONMENTAL CORPORATION

Location: Keyspan Energy Company	Elevation: 8.21'
Site Id: B-24	Completed Depth: 0.00'
Logged By: A. Tognon	Total Depth: 30.00'
Date(s): 08/16/02 - 08/16/02	X Coordinate: 989754.71
Remarks: Split-Spoon (2"), 130lb Safety Hammer,1.75" Dr Shelby Tube (3"), DirectPush Mobile B-67 Truck-Mounted Hollow Stem Auger (4.25" I.D.)	Y Coordinate: 151517.21
	Drilling Subcontractor: Foster Wheeler
	Drilling Method: Hollow Stem Auger

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
0			Fl/GP		Black gravel and SAND, trace tar lumps, low effort (gravel)		
2							
							5
4	6 4 1 1				Poorly graded gravel w/ SAND-10% coarse gravel, 40% fine gravel, 30% coarse SAND, 20% medium SAND, black, wet, trace coal bits, odor, wet, trace slag (GP)	16 ppm	
6					Coarse gravel (1-1/2 minimal) SAND black stained, coal traces		
8							0
	3 3 5 6		SP/SM		Poorly graded SAND w/ SILT, gray, wet, oily-10% medium SAND, 80% fine SAND, 10% fines (SILTY), slow to rapid dilatancy (SP/SM)	25 ppm	
10					Poorly graded SAND w/ gravel (approximetly 5% fine gravel), wet		

Location: Keyspan Energy Company	Site Id: B-24

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
							-5
14	6 8 11 13		SP		Poorly graded SAND–10% medium SAND, 85% fine SAND, 5% fines, wet, medium dense, grayish brown, oily, odor (SP)	185 ppm	
16					Oily return, fine SAND		
18							-10
	7 10 11						
20	12				Poorly graded SAND, gray, wet, medium dense, no oil (SP)	20 ppm	
22							-15
24	3 4 6 7		PT		Top 5" poorly graded SAND, gray, oily laminations. (SP)		
26			CL/MH		Bottom 13" peat (organic, fibrous) dark brown, woody, medium plasticity, strong egg odor (organic) different from other PT encountered, soft, light weight. (PT) Top oily peat. (PT). Bottom–gray CLAY. (greenish/gray) (CL/MH)	165 ppm	

Location: Keyspan Energy Company	Site Id: B-24

Depth (ft)	Blow Count	Recovery %	USCS Code	Graphic Log	Material Description	PID (ppm)	Elevation (ft)
			CH/MH		CLAY–greenish–light gray, medium plasticity, no dilatancy, firm (medium stiffness), wet, past plastic limit (CH/MH)		-20
30					End of borehole		
32							
							-25
34							
36							
38							-30
40							
42							
							-35

ATTACHMENT 2

Chain-of-Custody Forms for Geotechnical and Treatability/Compatibility Samples

FOSTER WHEELER ENVIRONMENTAL CORPORATION
CHAIN OF CUSTODY RECORD

PROJECT: TreySpan Coney Island

SAMPLERS: (Signature) Tom Fowler

SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	NO. CONTAINERS	Treatability Test GW	Treatability Test Soils	REMARKS OR SAMPLE LOCATION	PRESERVATION ICED	PRESERVATION SPECIFY CHEMICALS ADDED AND FINAL pH IF KNOWN
MW04/CI6D	8/7/02	1700	✓		1	✓		2ga/MW04/½ga/CI6D	—	—
B14/B15/B16/B17	8/13/02	1400	✓		1		✓	Auger cuttings Coney Is Cr	—	—
B22/B23/B24	8/16/02	1400	✓		1		✓	Auger cuttings MW	—	—
B1/B3/B5	8/20/02	1000	✓		1		✓	Auger cuttings NE	—	—

Relinquished by: (Signature) ① Tom Fowler	Date / Time 8/20/02 1200 8/8/02 1800	Received by: (Signature) Robert Olewski JF 8/8/02	Relinquished by: (Signature) ④ / Date / Time / Shipped via:
Relinquished by: (Signature) ②	Date / Time	Received by: (Signature) Al Case	Received for Laboratory by: (Signature) / Date / Time / Shipped via:
Relinquished by: (Signature) ③	Date / Time	Received by: (Signature)	Remarks

FOSTER WHEELER ENVIRONMENTAL CORPORATION
CHAIN OF CUSTODY RECORD

PROJECT: Kosy Span Coney Island

SAMPLERS (Signature): Jon Tonkin, Andrew Tsyhon

SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	NO. CONTAINERS	* Use Shelby tube	Hydrometer and Grain Size	Atterberg Limits	REMARKS OR SAMPLE LOCATION	PRESERVATION: ICED	PRESERVATION: SPECIFY CHEMICALS ADDED AND FINAL pH IF KNOWN
B2-U2-26-28'	8/14/2	1400		✓	*	✓	✓	✓	Test Clay NOT PEAT Extrude (Lab) (Fallinghead)	—	—
B4-S4-19-21'	8/19/2	1930		✓	1		✓	✓	PEAT	—	—
B2-S3-14-16'	8/19/2	1300		✓	1		✓		Fine Sand	—	—
B23-S3-19-21'	8/16/2	1300		✓	1		✓		Fine Sand	—	—
B23-U3-26-28'	8/16/2	1400		✓	*	✓	✓	✓	Test Clay (Fallinghead)	—	—
B20-S19-38-40'	8/15/2	1400		✓	1		✓		Fine Sand	—	—
B18-S2-2-4'	8/14/2	1300		—	1		✓	✓	Clay/Silt	—	—
B16-S17 [illegible]	8/14/2	1100		✓	1		✓	✓	Silty SAND	—	—
B16-S9-16-18'	8/13/2	1400		✓	1		✓		Fine Sand	—	—
B15-S3-4-6'	8/9/2	1300		✓	1		✓	✓	Clayey Silt	—	—
B13-U1-10-12'	8/9/2	1130		✓	*	✓	✓	✓	Clay/Peat (Falling Head)	—	—
B11-S5-8-10'	8/6/2	1300		✓	1		✓	✓	Peat	—	—
B8-S6-10-12'	8/6/2	1100		✓	1		✓	✓	Sandy Clay	—	—
B9-S6-10-12'	8/7/2	1200		✓	1		✓	✓	Peat	—	—

Relinquished by: (Signature) ① Jon Tonkin	Date / Time 8/20/2 1200	Received by: (Signature) Al Case	Relinquished by: (Signature) ④	Date / Time / Shipped via:
Relinquished by: (Signature) ②	Date / Time	Received by: (Signature)	Received for Laboratory by: (Signature)	Date / Time / Shipped via:
Relinquished by: (Signature) ③	Date / Time	Received by: (Signature)	Remarks	

FOSTER WHEELER ENVIRONMENTAL CORPORATION
CHAIN OF CUSTODY RECORD

PROJECT: Key Span Coney I-5

SAMPLERS: (Signature) Jon Fowler, Andrew Tuohon

SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	NO. CONTAINERS	Shelly-fish permeability	REMARKS OR SAMPLE LOCATION	PRESERVATION: ICED	PRESERVATION: SPECIFY CHEMICALS ADDED AND FINAL pH IF KNOWN
B7-41-21-23	8/20/2	1200		✓	1	✓		—	✓

Relinquished by: (Signature) ① Jon Fowler	Date / Time 8/20/02 1800	Received by: (Signature) Robert Oleson	Relinquished by: (Signature) ④ Robert Oleson	Date / Time 8/21/02 1630	Shipped via: DHL
Relinquished by: (Signature) ②	Date / Time	Received by: (Signature)	Received for Laboratory by: (Signature)	Date / Time	Shipped via:
Relinquished by: (Signature) ③	Date / Time	Received by: (Signature)	Remarks		

FOSTER WHEELER ENVIRONMENTAL CORPORATION
CHAIN OF CUSTODY RECORD

PROJECT: New Spain Corey Is

SAMPLERS: (Signature) Jon Tuhn

SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	NO. CONTAINERS	Shellfish pesticides									REMARKS OR SAMPLE LOCATION	PRESERVATION: ICED	PRESERVATION: SPECIFY CHEMICALS ADDED AND FINAL pH IF KNOWN
B2-46-8	8/9/2	1300		✓	1	✓											
B2-42-2123	8/9/2	1330		✓	1	✓											
B1-41-2123	8/9/2	1300		✓	1	✓											
B1-42-2931	8/9/2	1300		✓	1	✓											
B2-43-2628	8/9/2	1400		✓	1	✓											
B22-42-2628	8/9/2	1400		✓	1	✓											

Relinquished by: (Signature) ①	Date / Time	Received by: (Signature)	Relinquished by: (Signature) ④	Date / Time	Shipped via:
[signature]	8/20/2 1200	Al Case			
Relinquished by: (Signature) ②	Date / Time	Received by: (Signature)	Received for Laboratory by: (Signature)	Date / Time	Shipped via:
Relinquished by: (Signature) ③	Date / Time	Received by: (Signature)	Remarks		

FOSTER WHEELER ENVIRONMENTAL CORPORATION
CHAIN OF CUSTODY RECORD

PROJECT: Kew Span Coney Island

SAMPLERS: (Signature) Tom Fowler, Andrew Toghan

SAMPLE NUMBER	DATE	TIME	COMP.	GRAB	NO. CONTAINERS	Shelby tube plenetrometer	REMARKS OR SAMPLE LOCATION	PRESERVATION: ICED	PRESERVATION: SPECIFY CHEMICALS ADDED AND FINAL pH IF KNOWN
B18-41-6-8'	8/3/2	1400		✓	1	✓		—	—
B9-42-6-14'	8/7/2	1500		✓	1	✓		—	—
B12-41-9-11'	8/6/2	1400		✓	1	✓		—	—
B12-42-10-12'	8/6/2	1430		✓	1	✓		—	—
B13-41-10-12'	8/9/2	1400		✓	1	✓		—	—
B20-41-4-6'	8/15/2	1300		✓	1	✓		—	—
B20-42-6-8'	8/15/2	1330		✓	1	✓		—	—
B23-41-9-11	8/16/2	1300		✓	1	✓		—	—
B23-41-24-26	8/19/2	1300		✓	1	✓		—	—
B24-41-26-28	8/16/2	1300		✓	1	✓		—	—
B24-42-28-30	8/16/2	1330		✓	1	✓		—	—
B22-41-6-8'	8/16/2	1300		✓	1	✓		—	—
B23-41-5.5-7.5	8/16/2	1230		✓	1	✓		—	—

Relinquished by: (Signature) ① Tom Fowler	Date / Time 1200 8/20/2	Received by: (Signature) A. Case	Relinquished by: (Signature) ④	Date / Time	Shipped via:
Relinquished by: (Signature) ②	Date / Time	Received by: (Signature)	Received for Laboratory by: (Signature)	Date / Time	Shipped via:
Relinquished by: (Signature) ③	Date / Time	Received by: (Signature)	Remarks		

ATTACHMENT 3

Sample Results from Geotechnical Laboratory

Golder Associates Inc.

1951 Old Cuthbert Road, Suite 301
Cherry Hill, NJ 08034
Telephone (856) 616-8165
Fax (856) 616-1874

November 13, 2002 023-6128

Dr. Faouzi Ahtch-Ali
Foster Wheeler Environmental Corporation
1000 The American Road
Morris Plains, NJ 07950

RE: FORMER BROOKLYN BOROUGH GAS WORKS SITE (041466)

Dear Dr. Faouzi Ahtch-Ali:

Please find enclosed Particle-Size Distribution (ASTM D 5084) test results for submitted samples B2-S3, B4-S4, B8-S6, B9-S6, B11-S-5, B13-U1, B15-S3, B16-S9, B16-S17, B18-S-2, B20-S19, B23-S23 and B23-U3.

The following samples also had an Atterberg Limits (ASTM D 4318) performed: B4-S4, B8-S6, B9-S6, B11-S-5, B13-U1, B15-S3, B16-S17, B18-S-2, B23-U1 and B23-U3.

Also enclosed are Flexible-Wall Permeability (ASTM D 5084) test results for submitted samples Impermix 612 17% Solids, Impermix 612 17% Solids with Groundwater as the permeant, B22/B23/B24 2% Bentonite, B14/B15/B16/B17 3% Bentonite, B1/B3/B5 4% Bentonite, Composite 4% Bentonite, Composite 6% Bentonite, Composite 6% Bentonite with Groundwater as the permeant, 5.5-12.5-01, 5.5-12.5-02, B1-U1, B1-U2, B2-U2 (6'-8'), B2-U2 (21'-23'), B2-U3, B3-U1, B12-U2, B13-U1, B20-U2, B22-U1, B22-U2, B23-U1, B23-U2, B23-U3, B24-U1 and B24-U2.

Please note that samples Impermix 612 17% Solids and Impermix 612 17% Solids with Groundwater as the permeant were tested under long-term conditions (27-Days and 43-Days respectively).

If you have any questions, please contact us at (856) 616-8166.

Very truly yours,

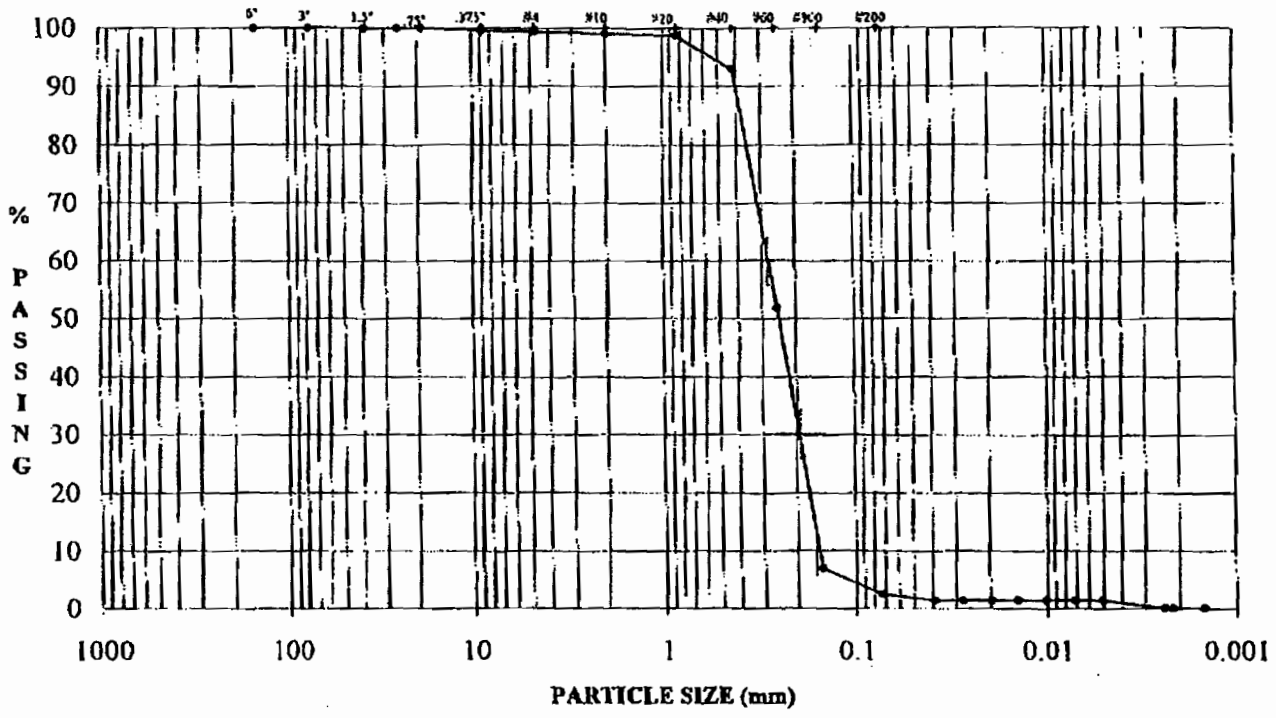
GOLDER ASSOCIATES INC.

Robert M. Wilkinson
Laboratory Manager

Enclosures

PARTICLE-SIZE DISTRIBUTION ASTM D 422

US STANDARD SIEVE OPENING SIZES



COBBLE	GRAVEL		SAND			FINES
	Coarse	Fine	Cor	Med	Fine	Silt or Clay

Sieve Data	
Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	99.5%
#4	99.3%
#10	99.0%
#20	98.7%
#40	93.0%
#60	51.8%
#100	6.9%
#200	2.4%

Hydrometer Data	
Particle Diameter	% Finer
0.039	1.3%
0.028	1.3%
0.020	1.3%
0.014	1.3%
0.010	1.3%
0.007	1.3%
0.005	1.3%
0.002	0.0%
0.002	0.0%
0.001	0.0%

DESCRIPTION

Sample: B2-S3 Depth: 14'-16'

USCS: SP

Wet Color: Dark gray

Description: Poorly graded sand

Comments:

SAMPLE DATA

W_C (%):	23.9	(ASSUMED)
G_S:	2.65	
% Gravel	0.7	
% Sand	96.9	
% Fines	2.4	

C_C	0.8
C_U	1.7
LL	-
PL	-
PI	-

Date: 09/11/02

Technician: AJ

Reviewer: RDD

FWENC/KEYSPAN PROJECT/NY

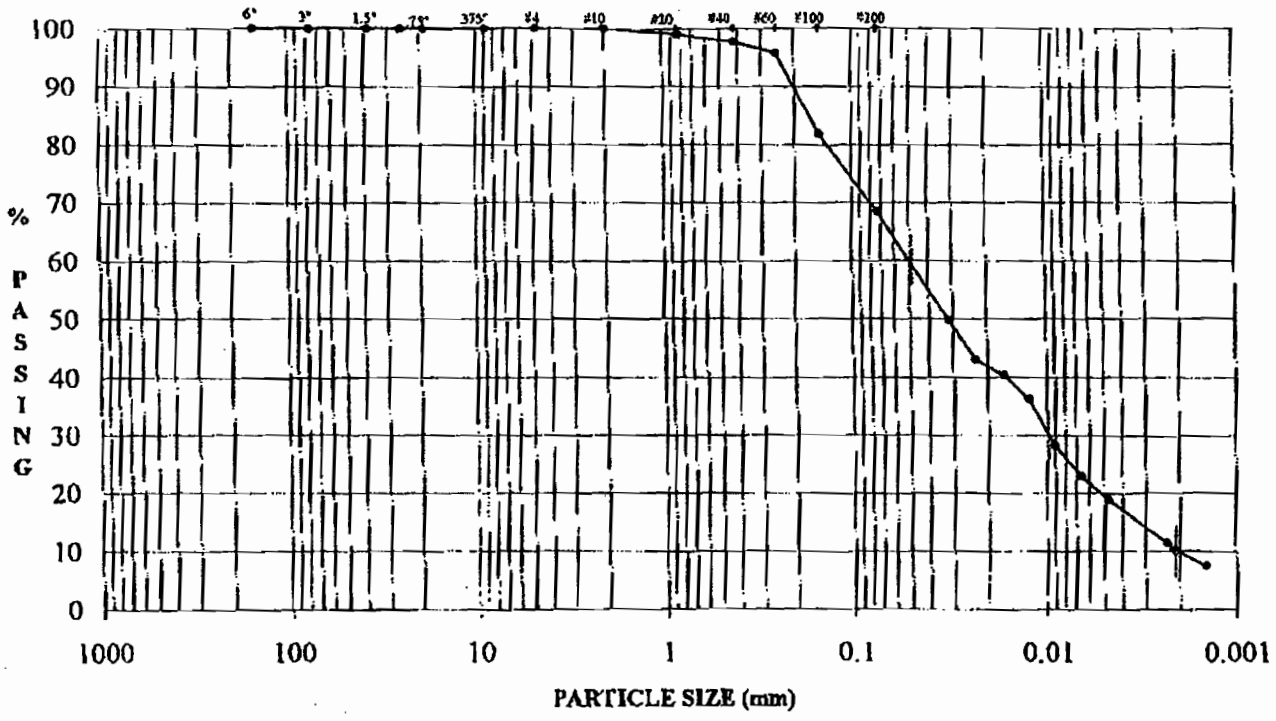
023-6128-001

GOLDER ASSOCIATES INC.

CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422

US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	99.9%
#20	99.0%
#40	97.6%
#60	95.7%
#100	81.7%
#200	68.4%

Hydrometer Data

Particle Diameter	% Finer
0.031	49.6%
0.023	42.9%
0.017	40.3%
0.012	36.2%
0.009	28.2%
0.007	22.8%
0.005	18.8%
0.002	11.4%
0.002	10.1%
0.001	7.4%

DESCRIPTION

Sample:	B4-S4	Depth:	19'-21'
		USCS:	MH
Wet Color:	Black		
Description:	Sandy elastic silt		
Comments:			

SAMPLE DATA

W_C (%):	80.2	
G_s:	2.65	(ASSUMED)
% Gravel	0.0	
% Sand	31.6	
% Fines	68.4	

C_C	N/A
C_U	N/A
LL	106
PL	44
PI	62

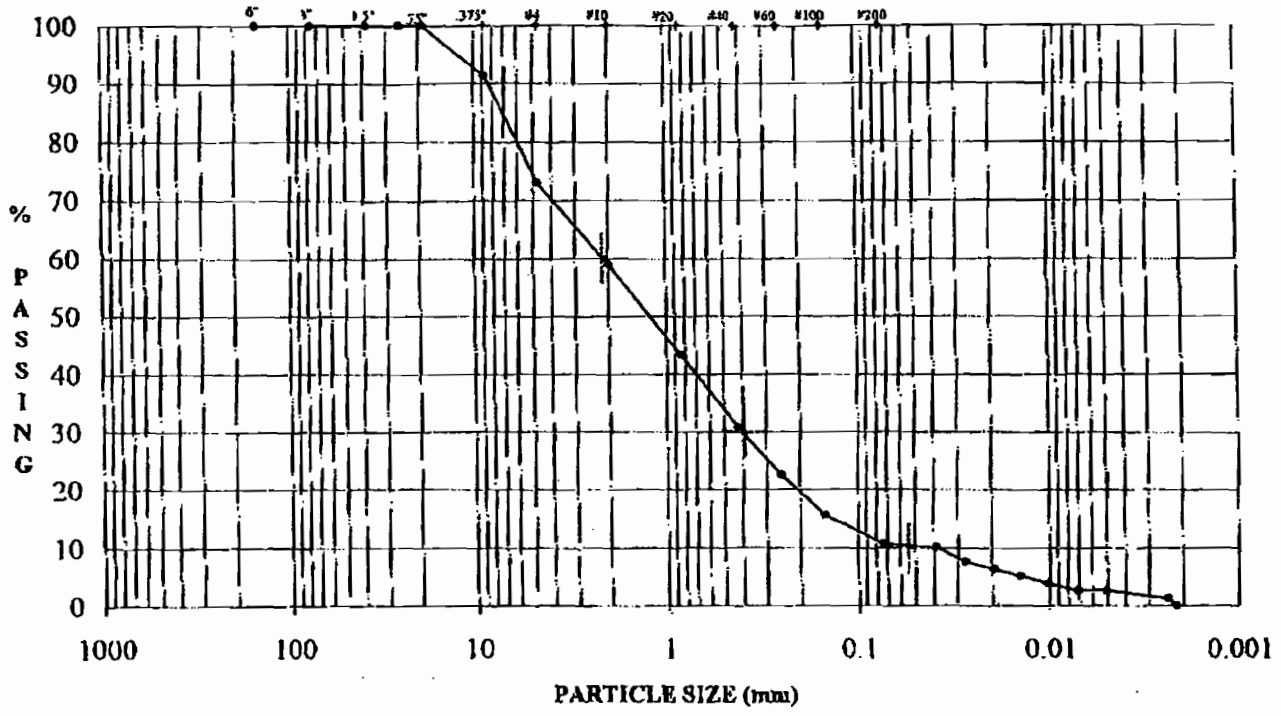
Date:	09/12/02
Technician:	AJ
Reviewer:	RDD

FWENC/KEYSPAN PROJECT/NY
023-6128-001

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422

US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data	
Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	91.4%
#4	73.0%
#10	59.0%
#20	43.2%
#40	30.8%
#60	22.4%
#100	15.6%
#200	10.7%

Hydrometer Data	
Particle Diameter	% Finer
0.039	10.1%
0.028	7.6%
0.020	6.3%
0.014	5.0%
0.010	3.8%
0.007	2.5%
0.005	2.5%
0.002	1.3%
0.002	0.0%

DESCRIPTION

Sample:	B8-S6	Depth:	10'-12'
		USCS:	SW-SM
Wet Color:	Olive		
Description:	Well graded sand with silt and gravel		
Comments:			

SAMPLE DATA

W_C (%):	13.5		C_C	1.3
G_S:	2.65	(ASSUMED)	C_U	39.6
% Gravel	27.0		LL	NP
% Sand	62.3		PL	NP
% Fines	10.7		PI	NP

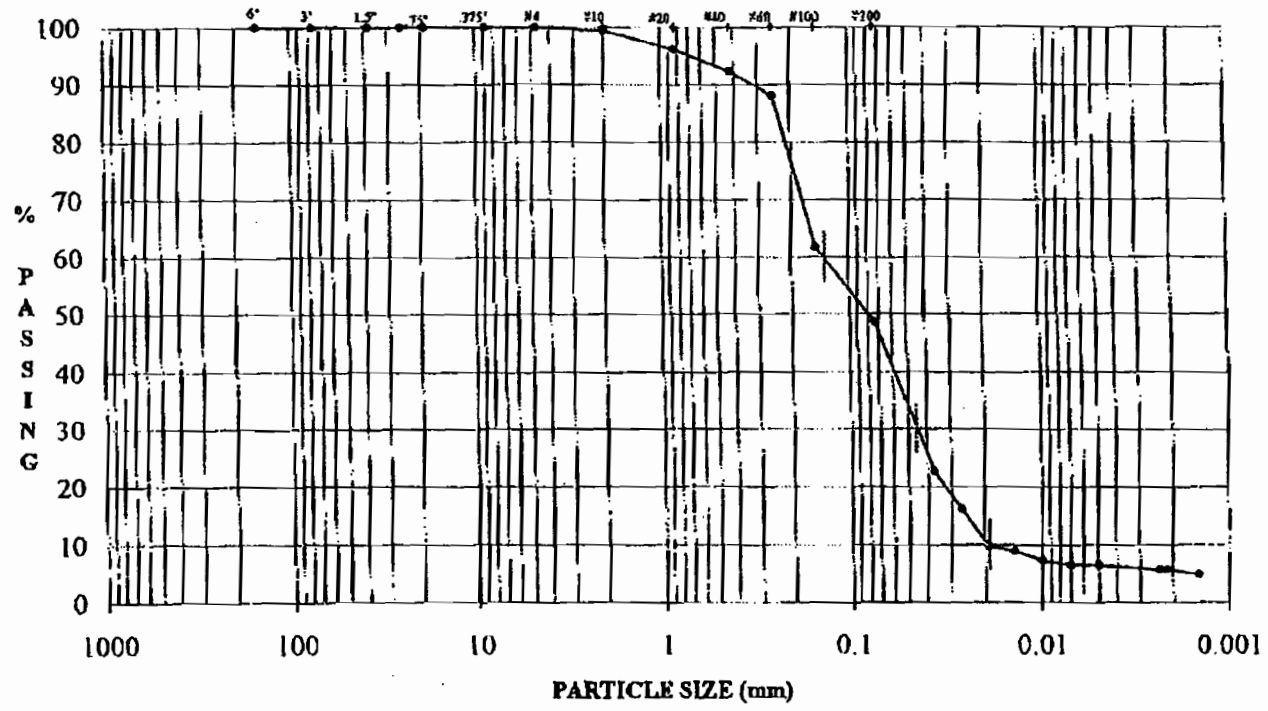
Date:	09/11/02
Technician:	AJ/AC
Reviewer:	RDD

FWENC/KEYSPAN PROJECT/NY
023-6128-001

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422

US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	99.9%
#10	99.4%
#20	96.1%
#40	92.4%
#60	88.1%
#100	61.8%
#200	48.7%

Hydrometer Data

Particle Diameter	% Finer
0.037	22.4%
0.027	16.0%
0.019	9.6%
0.014	8.8%
0.010	7.2%
0.007	6.4%
0.005	6.4%
0.002	5.6%
0.002	5.6%
0.001	4.8%

DESCRIPTION

Sample:	B9-S6	Depth:	10'-12'
		USCS:	SM
Wet Color:	Dark olive		
Description:	Silty sand		
Comments:			

SAMPLE DATA

W_C (%):	131.8	
G_S:	2.65	(ASSUMED)
% Gravel	0.1	
% Sand	51.2	
% Fines	48.7	

C_C	N/A
C_U	N/A
LL	86
PL	67
PI	19

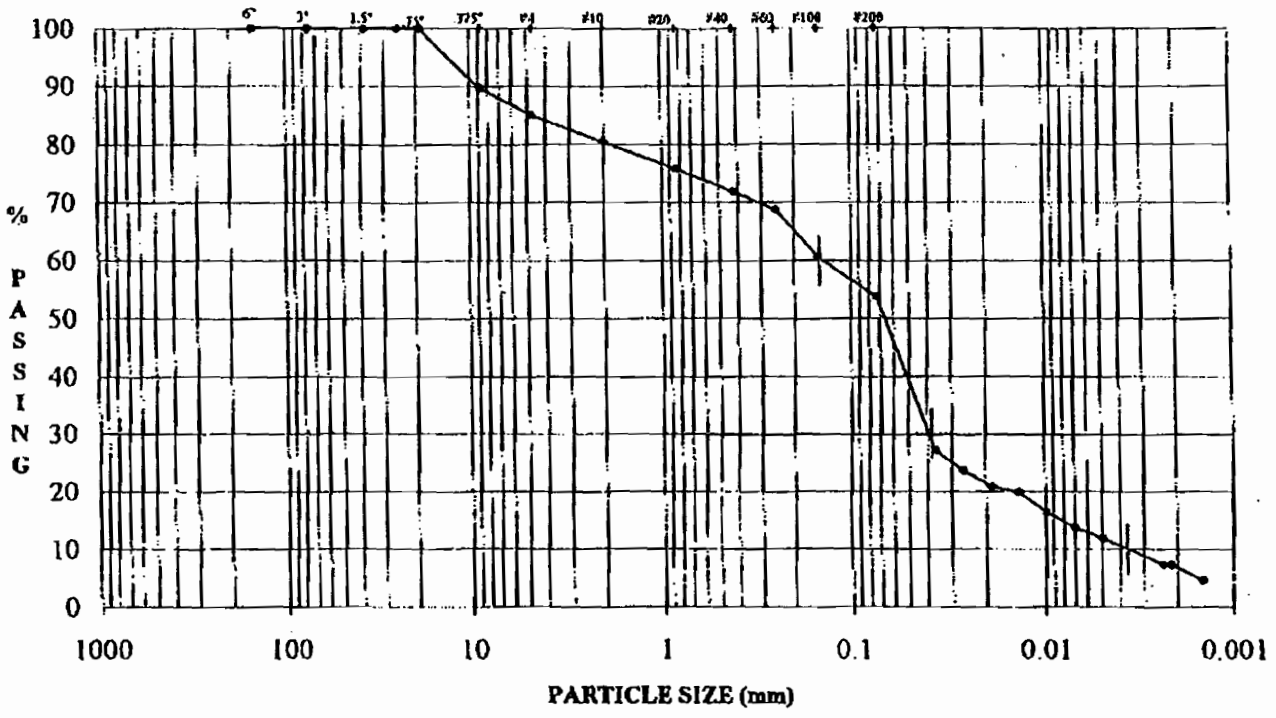
Date:	09/11/02
Technician:	AJ
Reviewer:	RDD

FWENC/KEYSPAN PROJECT/NY
023-6128-001

GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

PARTICLE-SIZE DISTRIBUTION ASTM D 422

US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse GRAVEL	Fine GRAVEL	Cor SAND	Med SAND	Fine SAND	Silt or Clay FINES

Sieve Data	
Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	89.7%
#4	85.0%
#10	80.4%
#20	75.7%
#40	71.8%
#60	68.7%
#100	60.5%
#200	53.8%

Hydrometer Data	
Particle Diameter	% Finer
0.037	27.2%
0.026	23.6%
0.019	20.9%
0.014	19.9%
0.010	16.3%
0.007	13.6%
0.005	11.8%
0.002	7.3%
0.002	7.3%
0.001	4.5%

DESCRIPTION			
Sample:	B11-S5	Depth:	8'-10'
		USCS:	MH
Wet Color:	Dark olive		
Description:	Sandy elastic silt		
Comments:			

SAMPLE DATA				
W_C (%):	77.3	(ASSUMED)	C_C	N/A
G_S:	2.65		C_U	N/A
% Gravel	15.0		LL	65
% Sand	31.2		PL	54
% Fines	53.8		PI	11

Date:	09/12/02
Technician:	AJ/AC
Reviewer:	RDD

FWENC/KEYSPAN PROJECT/NY
023-6128-001

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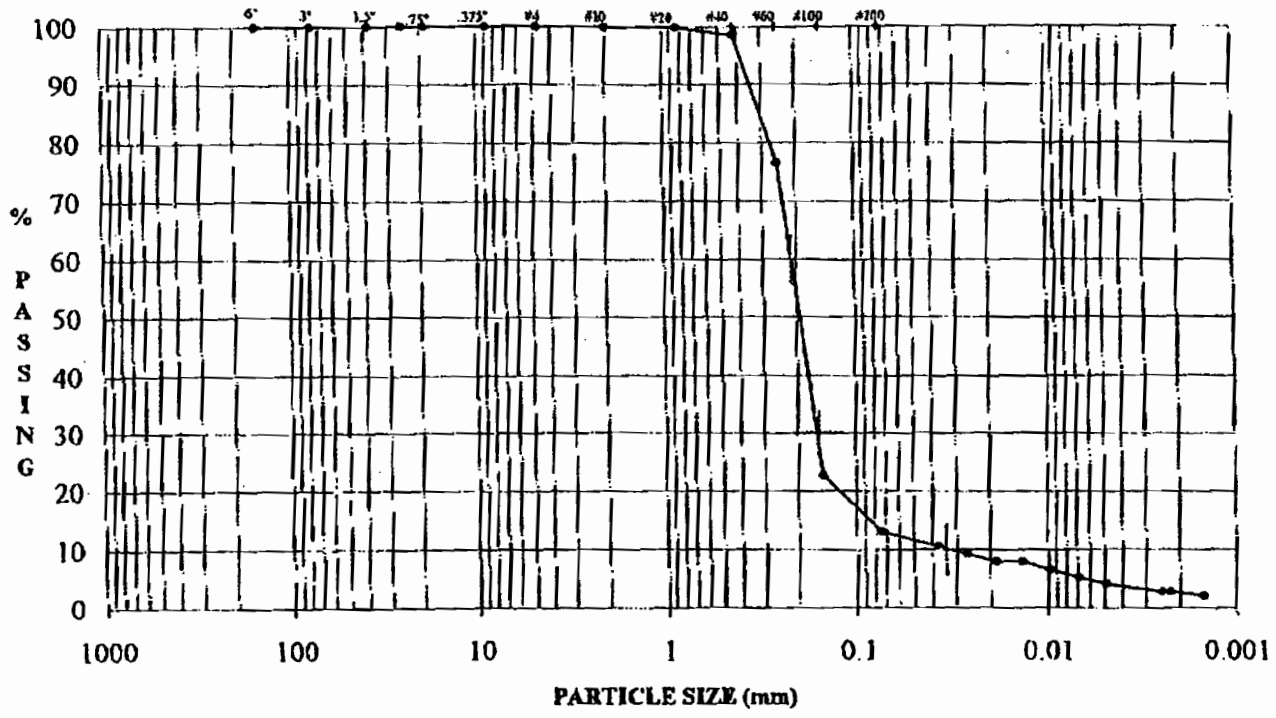
US STANDARD SIEVE OPENING SIZES



COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data	
Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	100.0%
#20	99.9%
#40	98.5%
#60	76.5%
#100	22.7%
#200	12.9%

Hydrometer Data	
Particle Diameter	% Finer
0.037	10.4%
0.027	9.1%
0.019	7.8%
0.014	7.8%
0.010	6.5%
0.007	5.2%
0.005	3.9%
0.002	2.6%
0.002	2.6%
0.001	2.0%

DESCRIPTION			SAMPLE DATA			
Sample:	B13-U1	Depth: 10'-12'	W_C (%):	31.8	C_C	N/A
		USCS: SM	G_S:	2.73	C_U	N/A
Wet Color:	Dark olive		% Gravel	0.0	LL	29
Description:	Silty sand		% Sand	87.1	PL	25
			% Fines	12.9	PI	4
Comments:						

Date:	08/30/02
Technician:	AC
Reviewer:	RDD

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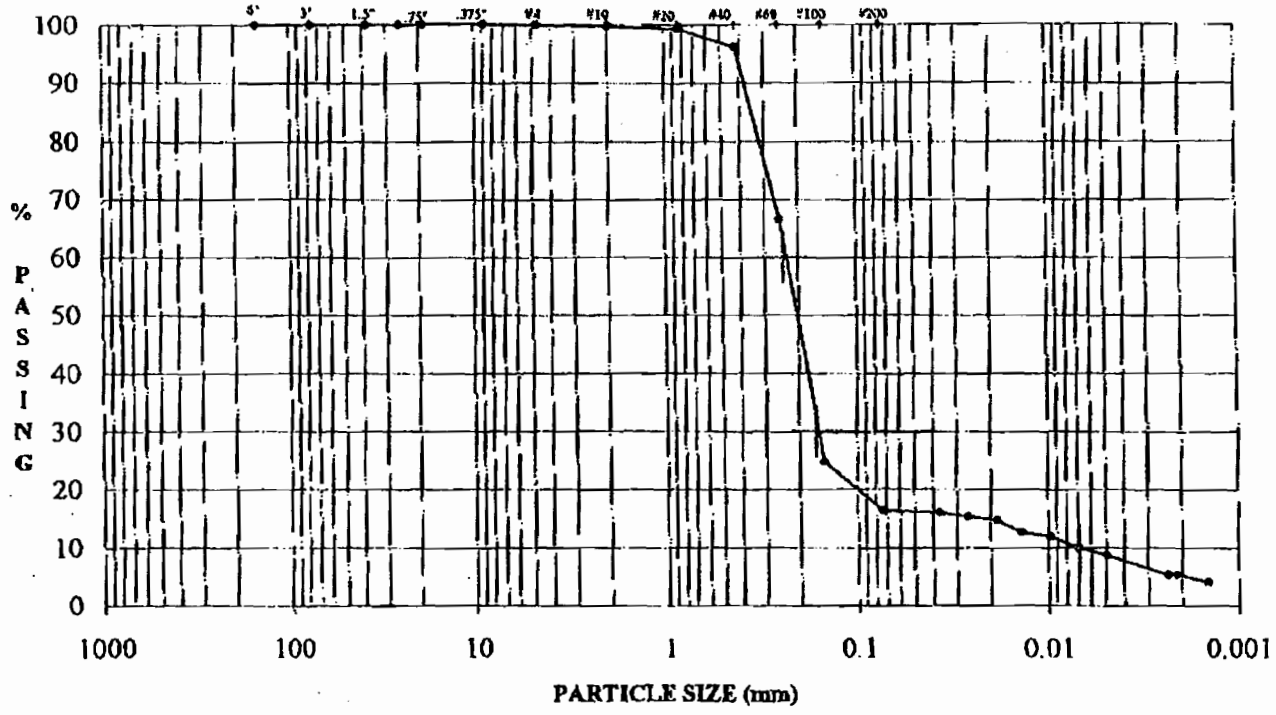

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	99.9%
#10	99.7%
#20	99.3%
#40	96.1%
#60	66.6%
#100	24.7%
#200	16.4%

Hydrometer Data

Particle Diameter	% Finer
0.037	15.9%
0.026	15.3%
0.019	14.6%
0.014	12.6%
0.010	11.9%
0.007	10.0%
0.005	8.6%
0.002	5.3%
0.002	5.3%
0.001	4.0%

DESCRIPTION

Sample:	B15-S3	Depth:	4'-6'
		USCS:	SM
Wet Color:	Dark olive		
Description:	Silty sand		
Comments:	NP = NON-PLASTIC		

SAMPLE DATA

W_C (%):	24.2	
G_S:	2.65	(ASSUMED)
% Gravel	0.1	
% Sand	83.5	
% Fines	16.4	

C_C	N/A
C_U	N/A
LL	NP
PL	NP
PI	NP

Date:	09/11/02
Technician:	AJ
Reviewer:	RDD

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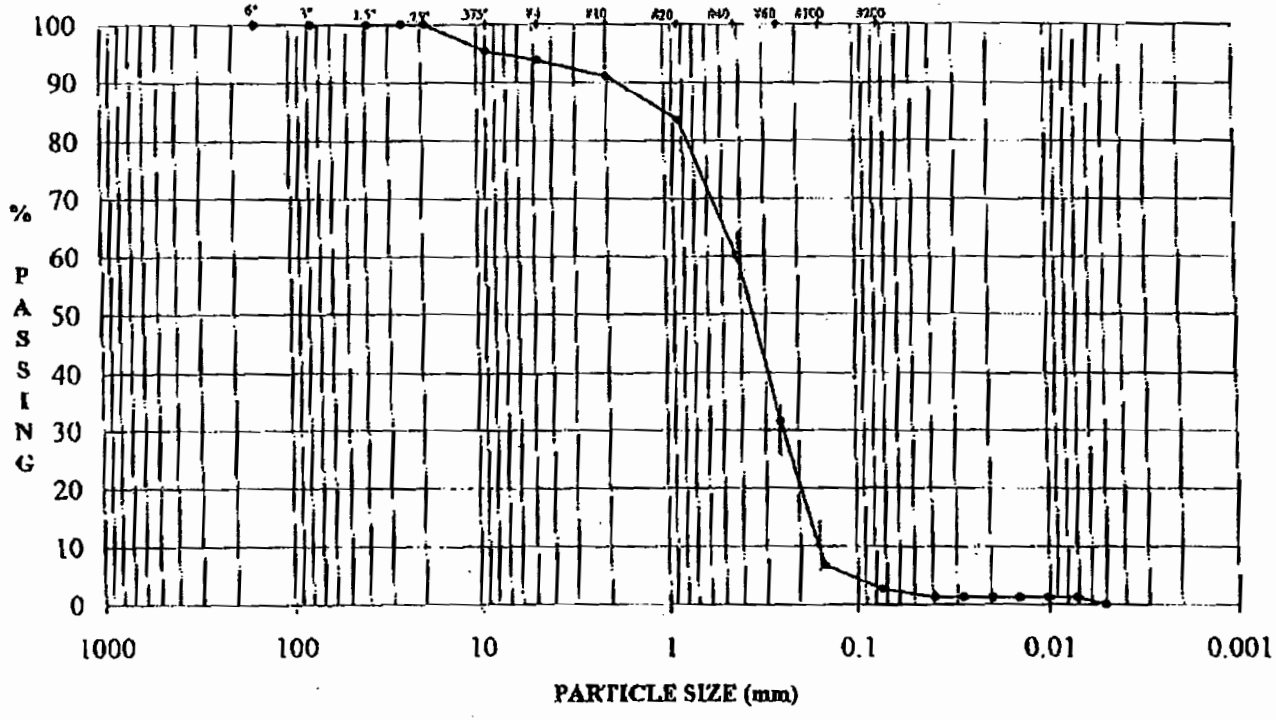

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data	
Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	95.4%
#4	93.8%
#10	91.1%
#20	83.6%
#40	60.2%
#60	31.5%
#100	6.7%
#200	2.5%

Hydrometer Data	
Particle Diameter	% Finer
0.039	1.2%
0.028	1.2%
0.020	1.2%
0.014	1.2%
0.010	1.2%
0.007	1.2%
0.005	0.0%

DESCRIPTION			SAMPLE DATA				
Sample:	B16-S9	Depth: 16'-18'	W_C (%):	17.3		C_C	1.0
		USCS: SP	G_S:	2.65	(ASSUMED)	C_U	2.6
Wet Color:	Dark brown		% Gravel	6.2		LL	-
Description:	Poorly graded sand		% Sand	91.2		PL	-
			% Fines	2.5		PI	-
Comments:							

Date:	09/12/02
Technician:	AJ/AC
Reviewer:	RDD

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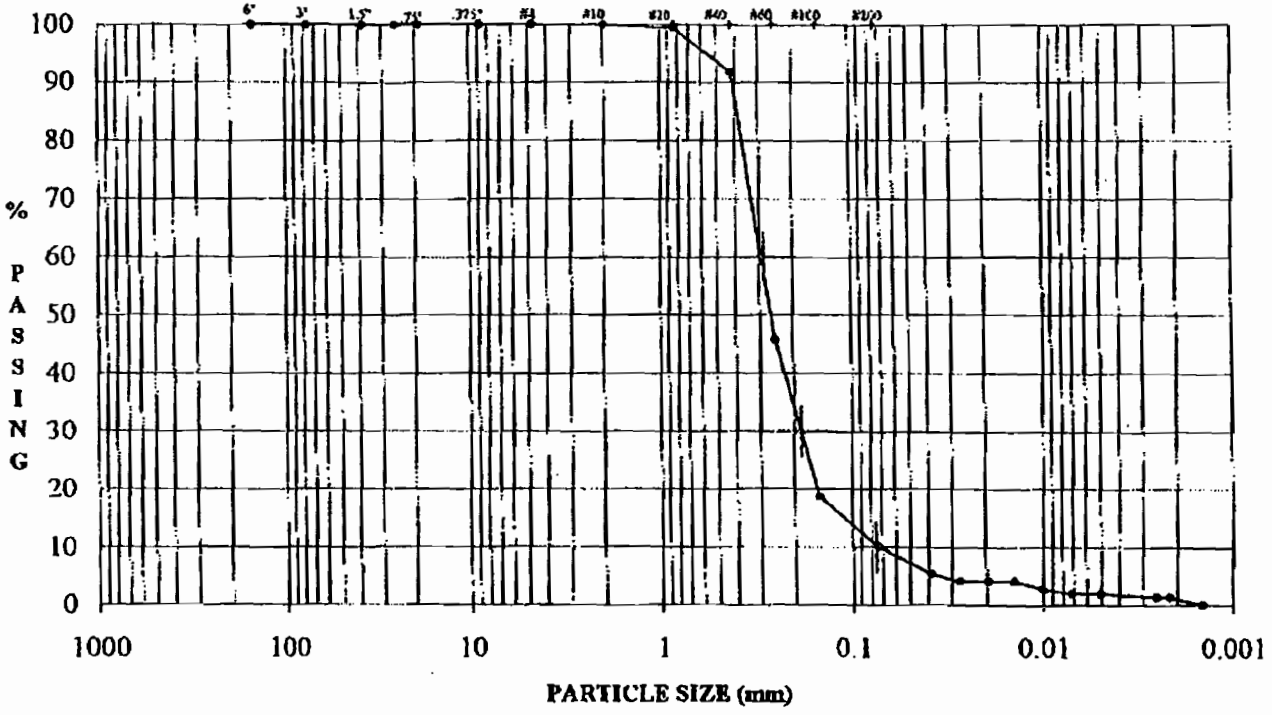

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data	
Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	99.9%
#20	99.4%
#40	91.8%
#60	45.8%
#100	18.6%
#200	10.0%

Hydrometer Data	
Particle Diameter	% Finer
0.039	5.3%
0.028	4.0%
0.020	4.0%
0.014	4.0%
0.010	2.6%
0.007	2.0%
0.005	2.0%
0.003	1.3%
0.002	1.3%
0.001	0.0%

DESCRIPTION			SAMPLE DATA				
Sample:	B16-S17	Depth: -	W_C (%):	22.5	(ASSUMED)	C_C	1.6
	32'-34'	USCS: SP-SM	G_S:	2.65		C_U	3.8
Wet Color:	Dark brown		% Gravel	0.0		LL	NP
Description:	Poorly graded sand		% Sand	90.0		PL	NP
	with silt		% Fines	10.0		PI	NP
Comments:	NP = NON-PLASTIC						

Date:	09/12/02
Technician:	AJ
Reviewer:	RDD

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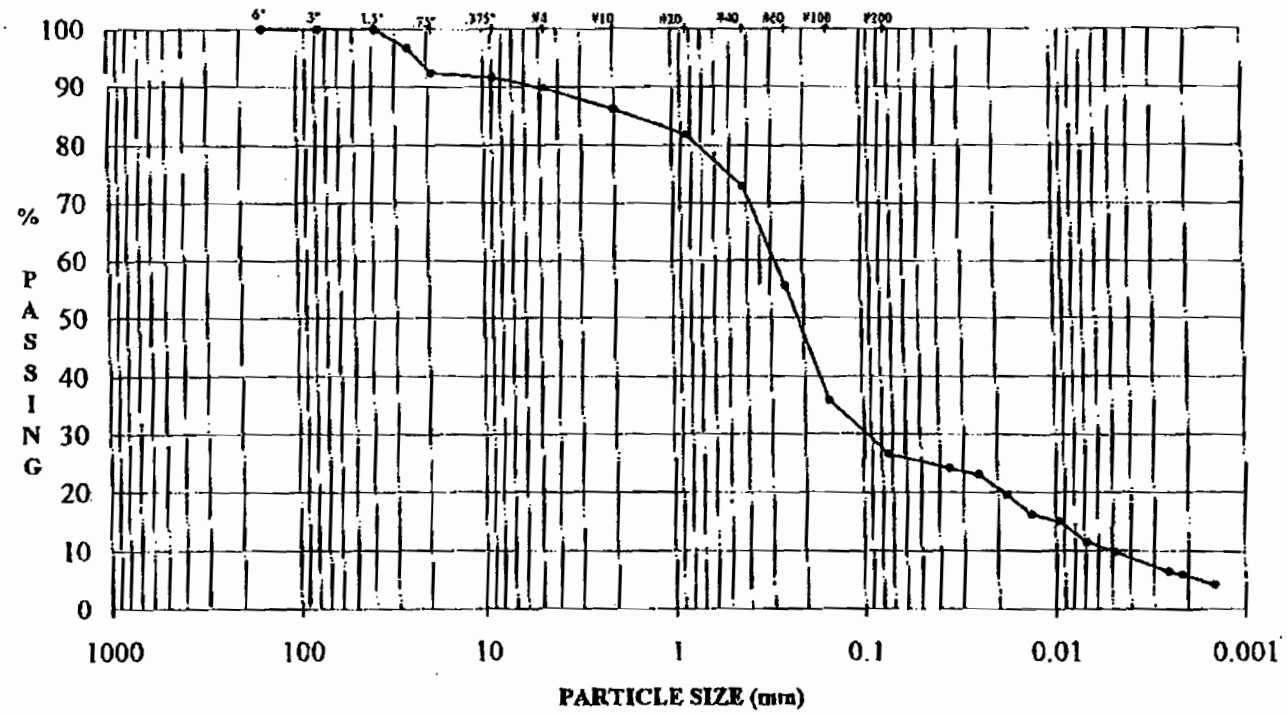

COBBLE	Coarse GRAVEL	Fine GRAVEL	Cor SAND	Med SAND	Fine SAND	Silt or Clay FINES

Sieve Data	
Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	96.7%
3/4"	92.4%
3/8"	91.6%
#4	89.6%
#10	86.1%
#20	81.6%
#40	72.9%
#60	55.7%
#100	35.9%
#200	26.5%

Hydrometer Data	
Particle Diameter	% Finer
0.035	24.2%
0.025	23.0%
0.018	19.6%
0.013	16.1%
0.010	15.0%
0.007	11.5%
0.005	9.8%
0.003	6.3%
0.002	5.8%
0.001	4.0%

DESCRIPTION			SAMPLE DATA				
Sample:	B18-S2	Depth: 2'-4'	W_C (%):	29.2	(ASSUMED)	C_C	N/A
		USCS: SC-SM	G_S:	2.65		C_U	N/A
Wet Color:	Dark brown		% Gravel	10.4		LL	26
Description:	Silty, clayey sand		% Sand	63.1		PL	20
			% Fines	26.5		PI	6
Comments:							

Date:	09/12/02
Technician:	AJ
Reviewer:	RDD

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023-6128-001

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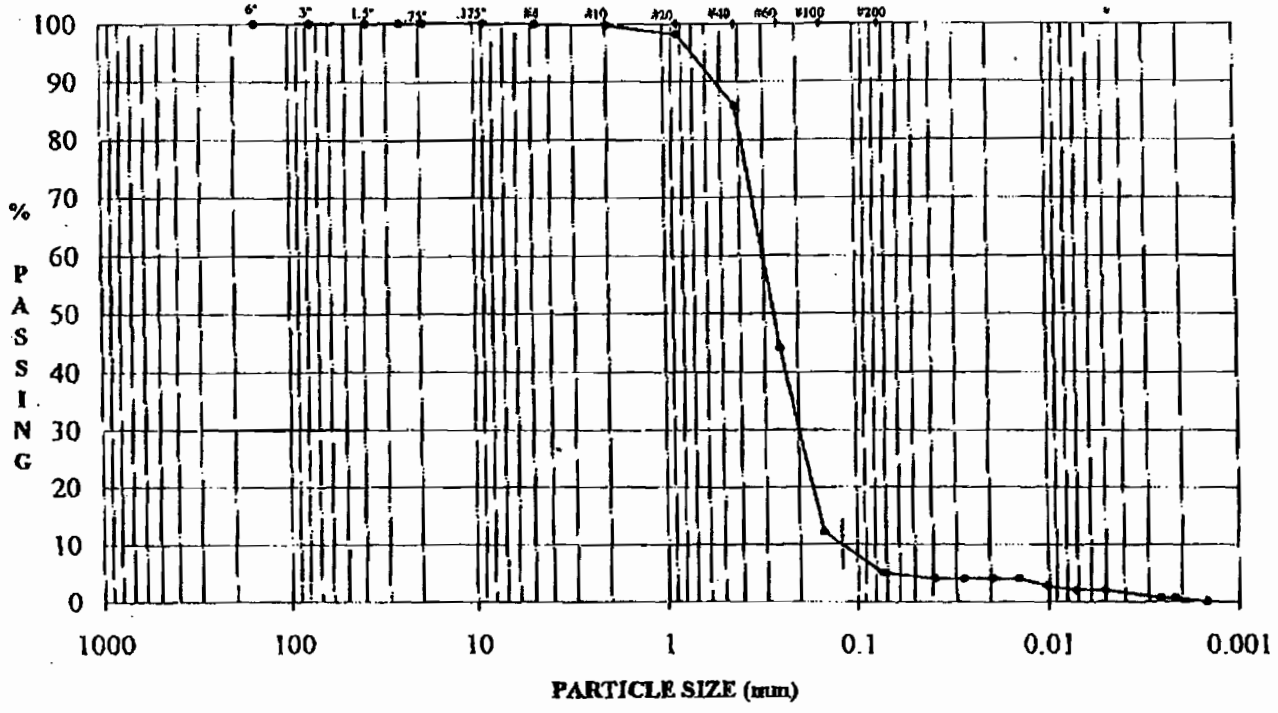

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	99.9%
#10	99.7%
#20	98.2%
#40	85.8%
#60	44.1%
#100	12.1%
#200	5.0%

Hydrometer Data

Particle Diameter	% Finer
0.039	4.0%
0.028	4.0%
0.020	4.0%
0.014	4.0%
0.010	2.6%
0.007	2.0%
0.005	2.0%
0.003	0.7%
0.002	0.7%
0.001	0.0%

DESCRIPTION

Sample:	B20-S19	Depth: 38'-40'	
		USCS: SP-SM	
Wet Color:	Dark brown		
Description:	Poorly graded sand with silt		
Comments:			

SAMPLE DATA

W_C (%):	21.3	
G_S:	2.65	(ASSUMED)
% Gravel	0.1	
% Sand	94.9	
% Fines	5.0	

C_C	1.1
C_U	2.5
LL	-
PL	-
PI	-

Date: 09/11/02
Technician: AJ
Reviewer: RDD

FWENC/KEYSPAN PROJECT/NY
023-6128-001

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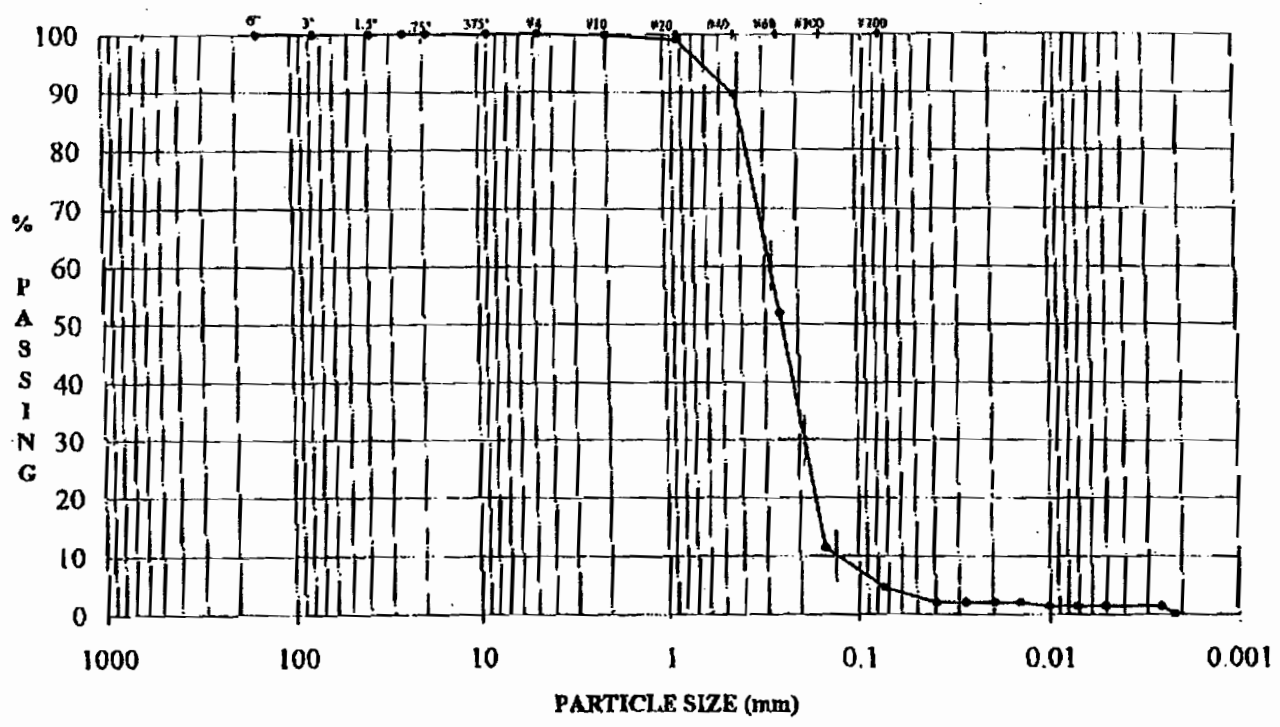

COBBLE	Coarse	Fine	Cor	Med	Fine	Silt or Clay
	GRAVEL		SAND			FINES

Sieve Data

Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	100.0%
#4	100.0%
#10	99.9%
#20	99.1%
#40	89.7%
#60	52.0%
#100	11.4%
#200	4.6%

Hydrometer Data

Particle Diameter	% Finer
0.039	2.0%
0.028	2.0%
0.020	2.0%
0.014	2.0%
0.010	1.3%
0.007	1.3%
0.005	1.3%
0.003	1.3%
0.002	0.0%

DESCRIPTION

Sample:	B23-S3	Depth:	19'-21'
		USCS:	SP
Wet Color:	Dark gray		
Description:	Poorly graded sand		
Comments:			

SAMPLE DATA

W_C (%):	24.9	
G_S:	2.65	(ASSUMED)
% Gravel	0.0	
% Sand	95.4	
% Fines	4.6	

C_C	1.0
C_U	2.1
LL	-
PL	-
PI	-

Date:	09/12/02
Technician:	AJ/AC
Reviewer:	RDD

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023-6128-001

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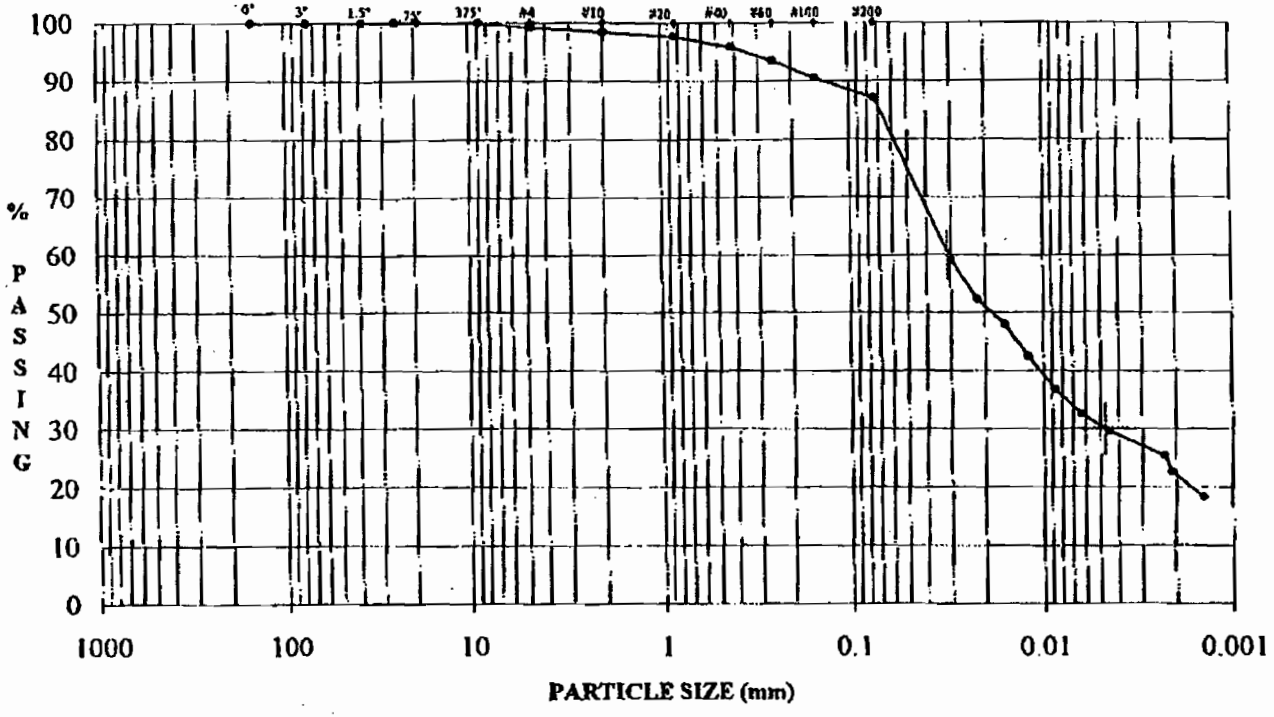

	Coarse	Fine	Cor	Med	Fine	Silt or Clay
COBBLE	GRAVEL		SAND			FINES

Sieve Data	
Particle Diameter	% Finer
3"	100.0%
1 1/2"	100.0%
1"	100.0%
3/4"	100.0%
3/8"	99.9%
#4	99.2%
#10	98.5%
#20	97.6%
#40	95.8%
#60	93.4%
#100	90.4%
#200	87.0%

Hydrometer Data	
Particle Diameter	% Finer
0.030	59.3%
0.022	52.2%
0.016	48.0%
0.012	42.3%
0.009	36.7%
0.006	32.4%
0.005	29.6%
0.002	25.4%
0.002	22.6%
0.001	18.3%

DESCRIPTION

Sample:	B23-U3	Depth:	26'-28'
		USCS:	CH
Wet Color:	Light gray		
Description:	Fat Clay		
Comments:			

SAMPLE DATA

W_C (%):	34.1	C_C	N/A
G_S:	2.68	C_U	N/A
% Gravel	0.8	LL	59
% Sand	12.1	PL	30
% Fines	87.0	PI	29

Date:	08/30/02
Technician:	AC
Reviewer:	RDD

FWENC/KEYSPAN PROJECT/NY
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GOLDER ASSOCIATES INC.
CHERRY HILL, NEW JERSEY

MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	B1-U1	TYPE:	ST	TECH REVIEW	NT
023-6128-001		21'-23'				RMW

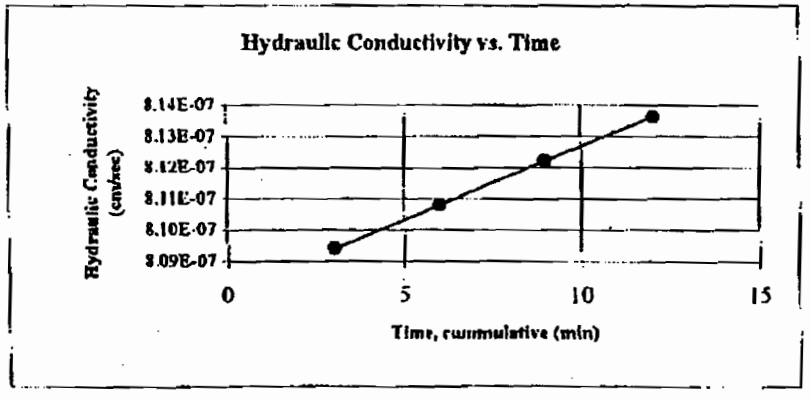
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.493	B-value	0.96	height, cm	7.361
diameter, cm	7.297	cell pressure, psi	59.80	diameter, cm	7.238
area, cm^2	41.82	bottom pressure, psi	51.00	area, cm^2	41.15
volume, cm^3	313.39	top pressure, psi	50.00	volume, cm^3	302.88
weight, g	323.69	head, cm	70.3	weight, g	303.39
% moisture	416.30	maximum gradient	16.64	% moisture	264.56
dry density, pcf	12.48	minimum gradient	16.52	dry density, pcf	17.14
volume solids, cm^3	25.91	total back pressure, psi	50.00	volume solids, cm^3	34.39
volume voids, cm^3	287.48	maximum effective stress	9.8	volume voids, cm^3	268.50
void ratio	11.10	minimum effective stress	8.8	void ratio	7.81
% saturation	90.79	specific gravity	2.42	% saturation	82.00

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a_c =	0.94	cm^3	
L_f =	7.36	cm	
A_f =	41.15	cm^2	
t =	180	sec	** Reading #4
h_1/h_2 =	1.00	cm	** Reading #4
k =	8.1E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/29/02	8	21	0	0	0	0.40	49.60	122.45		16.64		
08/29/02	8	24	3	180	180	0.50	49.50	122.24	1.00	16.61	8.1E-07	#1
08/29/02	8	27	6	360	180	0.60	49.40	122.03	1.00	16.58	8.1E-07	#2
08/29/02	8	30	9	540	180	0.70	49.30	121.82	1.00	16.55	8.1E-07	#3
08/29/02	8	33	12	720	180	0.80	49.20	121.60	1.00	16.52	8.1E-07	** #4
					INFLOW RATE,cm^3/sec	5.56E-04			PERMEABILITY REPORTED AS		8.1E-07	AVG
					OUTFLOW RATE,cm^3/sec	5.56E-04			POROSITY REPORTED AS		0.89	
					INFLOW / OUTFLOW RATIO	1.00						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084) METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	NT
023-6128-001	BI-U2 29'-31'	ST	REVIEW	RMW

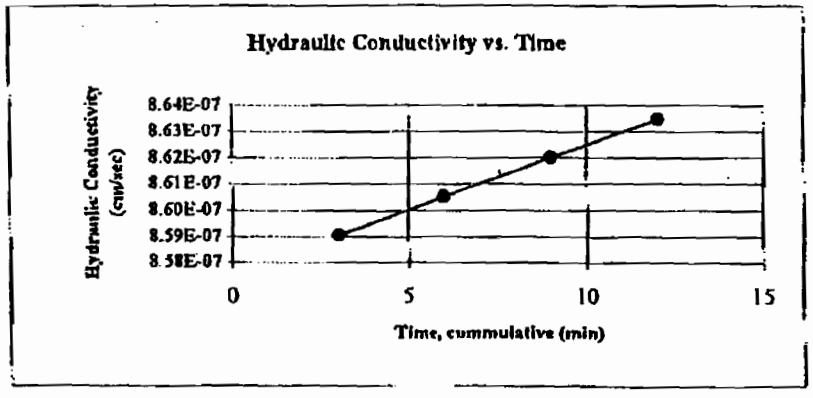
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.510	B-value	0.96	height, cm	7.518
diameter, cm	7.355	cell pressure, psi	72.90	diameter, cm	7.126
area, cm^2	42.49	bottom pressure, psi	51.00	area, cm^2	39.88
volume, cm^3	319.07	top pressure, psi	50.00	volume, cm^3	299.78
weight, g	563.45	head, cm	70.3	weight, g	534.13
% moisture	43.01	maximum gradient	16.22	% moisture	34.36
dry density, pcf	77.05	minimum gradient	16.11	dry density, pcf	82.75
volume solids, cm^3	148.67	total back pressure, psi	50.00	volume solids, cm^3	150.01
volume voids, cm^3	170.40	maximum effective stress	22.9	volume voids, cm^3	149.77
void ratio	1.15	minimum effective stress	21.9	void ratio	1.00
% saturation	99.45	specific gravity	2.65	% saturation	91.21

$$k = \frac{a\,L_t}{2\,A\,t}\ln(h_1/h_2)$$

a =	0.96	cm^2	
L_t =	7.52	cm	
A_t =	39.88	cm^2	
t =	180	sec	** Reading #4
h_1/h_2 =	1.00	cm	** Reading #4
k =	8.6E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/29/02	8	21	0	0	0	0.40	49.60	121.96		16.22		
08/29/02	8	24	3	180	180	0.50	49.50	121.76	1.00	16.20	8.6E-07	#1
08/29/02	8	27	6	360	180	0.60	49.40	121.55	1.00	16.17	8.6E-07	#2
08/29/02	8	30	9	540	180	0.70	49.30	121.34	1.00	16.14	8.6E-07	#3
08/29/02	8	33	12	720	180	0.80	49.20	121.13	1.00	16.11	8.6E-07	** #4
					INFLOW RATE, cm^3/sec	5.56E-04				PERMEABILITY REPORTED AS	8.6E-07	AVG
					OUTFLOW RATE, cm^3/sec	5.56E-04				POROSITY REPORTED AS	0.50	
					INFLOW / OUTFLOW RATIO	1.00						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY 023-6128-001	SAMPLE #: B2-U2 5'-8'	TYPE: ST	TECH REVIEW	NT RMW	

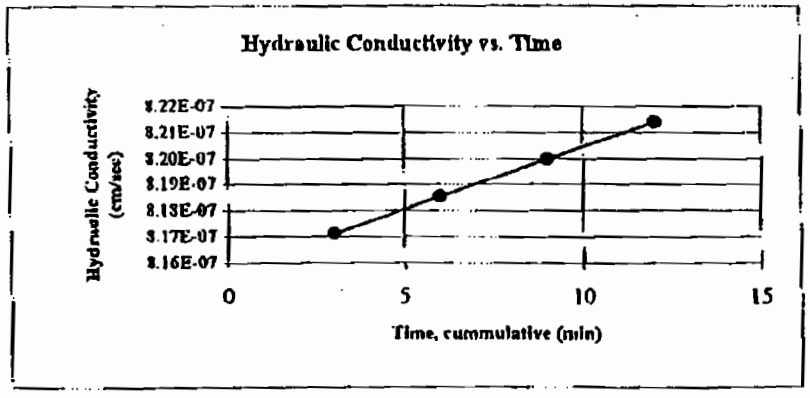
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.330	B-value	0.96	height, cm	7.449
diameter, cm	7.341	cell pressure, psi	55.00	diameter, cm	7.274
area, cm^2	42.32	bottom pressure, psi	51.00	area, cm^2	41.55
volume, cm^3	310.19	top pressure, psi	50.00	volume, cm^3	309.53
weight, g	513.52	head, cm	70.3	weight, g	530.35
% moisture	39.56	maximum gradient	16.44	% moisture	37.19
dry density, pcf	74.02	minimum gradient	16.32	dry density, pcf	77.93
volume solids, cm^3	146.01	total back pressure, psi	50.00	volume solids, cm^3	153.40
volume voids, cm^3	164.18	maximum effective stress	5.0	volume voids, cm^3	156.12
void ratio	1.12	minimum effective stress	4.0	void ratio	1.02
% saturation	88.66	specific gravity	2.52	% saturation	92.09

$$k = \frac{a\,L_f}{2\,A\,t} \ln(h_1/h_2)$$

a =	0.95	cm^2	
L_f =	7.45	cm	
A_f =	41.55	cm^2	
t =	180	sec	** Reading #4
h_1/h_2 =	1.00	cm	** Reading #4
k =	8.2E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/29/02	8	21	0	0	0	0.40	49.60	122.45		16.44		
08/29/02	8	24	3	180	180	0.50	49.50	122.24	1.00	16.41	8.2E-07	#1
08/29/02	8	27	6	360	180	0.60	49.40	122.03	1.00	16.38	8.2E-07	#2
08/29/02	8	30	9	540	180	0.70	49.30	121.82	1.00	16.35	8.2E-07	#3
08/29/02	8	33	12	720	180	0.80	49.20	121.60	1.00	16.32	8.2E-07	** #4
					INFLOW RATE,cm^3/sec	5.56E-04	PERMEABILITY REPORTED AS				8.2E-07	AVG
					OUTFLOW RATE,cm^3/sec	5.56E-04	POROSITY REPORTED AS				0.50	
					INFLOW / OUTFLOW RATIO	1.00						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084) METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	
023-6128-001	B2-U2 21'-23'	ST	REVIEW	NT RMW

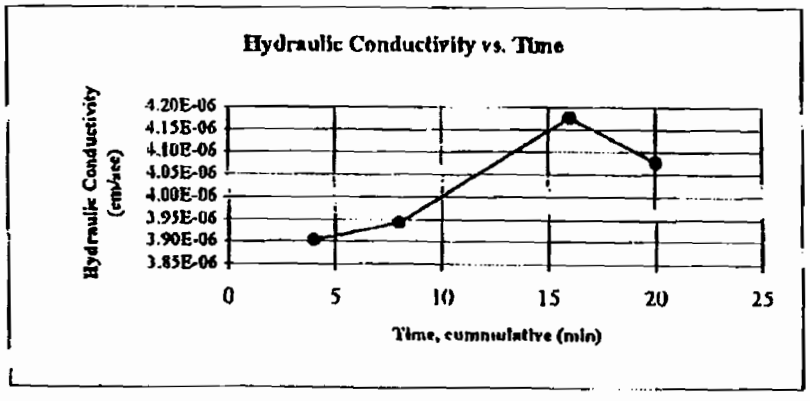
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.774	B-value	0.96	height, cm	7.668
diameter, cm	7.314	cell pressure, psi	59.40	diameter, cm	7.163
area, cm^2	42.01	bottom pressure, psi	51.00	area, cm^2	40.30
volume, cm^3	326.58	top pressure, psi	50.00	volume, cm^3	309.00
weight, g	323.91	head, cm	70.3	weight, g	323
% moisture	442.22	maximum gradient	15.93	% moisture	298.08
dry density, pcf	11.41	minimum gradient	15.08	dry density, pcf	16.39
volume solids, cm^3	33.56	total back pressure, psi	50.00	volume solids, cm^3	45.58
volume voids, cm^3	293.02	maximum effective stress	9.4	volume voids, cm^3	263.41
void ratio	8.73	minimum effective stress	8.4	void ratio	5.78
% saturation	90.15	specific gravity	1.78	% saturation	91.82

$$k = \frac{a L_f}{2 A t} \ln(h_1/h_2)$$

a =	0.94	cm^2	
L_f =	7.67	cm	
A_f =	40.30	cm^2	
t =	240	sec	** Reading #4
h_1/h_2 =	1.01	cm	** Reading #4
k =	4.1E-06	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/29/02	6	53	0	0	0	0.40	49.30	122.13		15.93		
08/29/02	6	57	4	240	240	1.00	48.70	120.86	1.01	15.76	3.9E-06	#1
08/29/02	7	1	8	480	240	1.60	48.10	119.59	1.01	15.60	3.9E-06	#2
08/29/02	7	9	16	960	480	2.80	46.80	116.94	1.02	15.25	4.2E-06	#3
08/29/02	7	13	20	1200	240	3.40	46.20	115.67	1.01	15.08	4.1E-06	** #4
					INFLOW RATE, cm^3/sec	2.50E-03				PERMEABILITY REPORTED AS	4.0E-06	AVG
					OUTFLOW RATE, cm^3/sec	2.58E-03				POROSITY REPORTED AS	0.85	
					INFLOW / OUTFLOW RATIO	0.97						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	NT
023-6128-001	B2-U3 26'-28'	ST	REVIEW	RMW

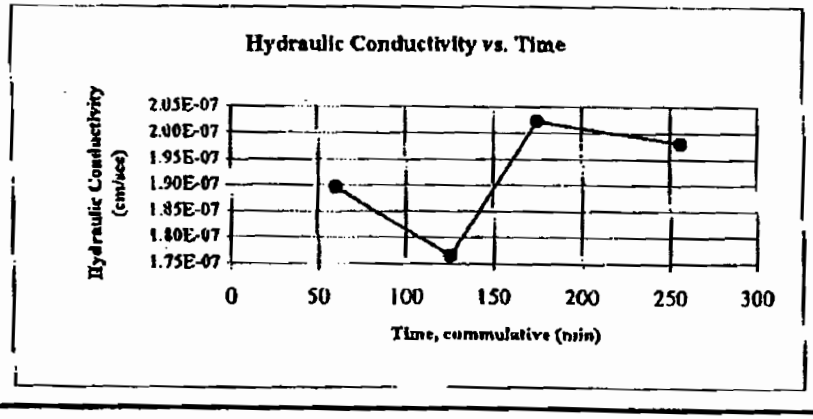
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.127	B-value	0.96	height, cm	7.146
diameter, cm	7.228	cell pressure, psi	56.10	diameter, cm	7.214
area, cm^2	41.03	bottom pressure, psi	50.00	area, cm^2	40.87
volume, cm^3	292.45	top pressure, psi	50.00	volume, cm^3	292.04
weight, g	547.08	head, cm	0	weight, g	513.3
% moisture	25.77	maximum gradient	7.18	% moisture	27.33
dry density, pcf	92.81	minimum gradient	6.93	dry density, pcf	86.14
volume solids, cm^3	164.76	total back pressure, psi	50.00	volume solids, cm^3	152.70
volume voids, cm^3	127.69	maximum effective stress	6.1	volume voids, cm^3	139.34
void ratio	0.77	minimum effective stress	6.1	void ratio	0.91
% saturation	87.80	specific gravity	2.64	% saturation	79.06

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a =	0.94	cm^2	
L_f =	7.15	cm	
A_f =	40.87	cm^2	
t =	4860	sec	** Reading #4
h_1/h_2 =	1.01	cm	** Reading #4
k =	2.0E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/30/02	9	10	0	0	0	0.80	49.20	51.30		7.18		
08/30/02	10	10	60	3600	3600	1.00	49.00	50.88	1.01	7.12	1.9E-07	*#1
08/30/02	11	15	125	7500	3900	1.20	48.80	50.46	1.01	7.06	1.8E-07	#2
08/30/02	12	5	175	10500	3000	1.40	48.65	50.09	1.01	7.01	2.0E-07	#3
08/30/02	13	26	256	15360	4860	1.65	48.35	49.50	1.01	6.93	2.0E-07	** #4
					INFLOW RATE,cm^3/sec	5.53E-05	PERMEABILITY REPORTED AS				1.9E-07	AVG
					OUTFLOW RATE,cm^3/sec	5.53E-05	POROSITY REPORTED AS				0.48	
					INFLOW / OUTFLOW RATIO	1.00						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY 023-6128-001	SAMPLE #: B3-U1 24'-26'	TYPE: ST	TECH REVIEW: NT RMW

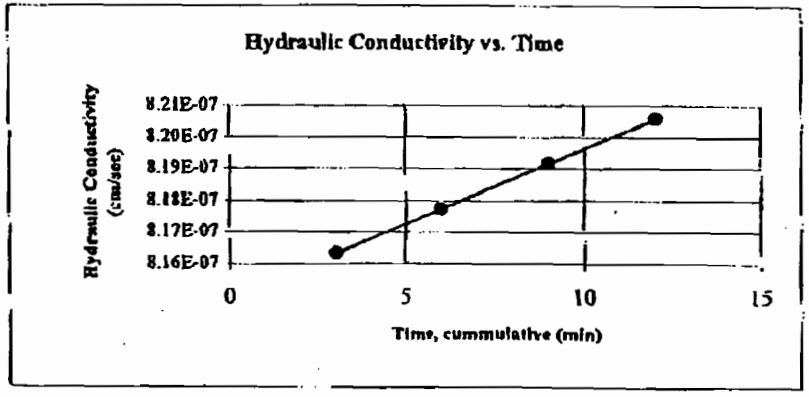
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.379	B-value	0.96	height, cm	7.374
diameter, cm	7.272	cell pressure, psi	72.90	diameter, cm	7.214
area, cm^2	41.53	bottom pressure, psi	51.00	area, cm^2	40.87
volume, cm^3	306.46	top pressure, psi	50.00	volume, cm^3	301.35
weight, g	552.96	head, cm	70.3	weight, g	534.84
% moisture	29.99	maximum gradient	16.61	% moisture	26.76
dry density, pcf	86.61	minimum gradient	16.49	dry density, pcf	87.37
volume solids, cm^3	158.73	total back pressure, psi	50.00	volume solids, cm^3	157.44
volume voids, cm^3	147.74	maximum effective stress	22.9	volume voids, cm^3	143.91
void ratio	0.93	minimum effective stress	21.9	void ratio	0.91
% saturation	86.35	specific gravity	2.68	% saturation	78.45

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a_w =	0.94	cm^2	
L_f =	7.37	cm	
A_f =	40.87	cm^2	
t =	180	sec	** Reading #4
h_1/h_2 =	1.00	cm	** Reading #4
k =	8.2E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/29/02	8	21	0	0	0	0.40	49.60	122.45		16.61		
08/29/02	8	24	3	180	180	0.50	49.50	122.24	1.00	16.58	8.2E-07	#1
08/29/02	8	27	6	360	180	0.60	49.40	122.03	1.00	16.55	8.2E-07	#2
08/29/02	8	30	9	540	180	0.70	49.30	121.82	1.00	16.52	8.2E-07	#3
08/29/02	8	33	12	720	180	0.80	49.20	121.60	1.00	16.49	8.2E-07	** #4
					INFLOW RATE, cm^3/sec	5.56E-04				PERMEABILITY REPORTED AS	8.2E-07	AVG
					OUTFLOW RATE, cm^3/sec	5.56E-04				POROSITY REPORTED AS	0.48	
					INFLOW / OUTFLOW RATIO	1.00						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	
023-6128-001	B12-U2 10'-12'	ST	REVIEW	NT / RMW

SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.432	B-value	0.96	height, cm	7.518
diameter, cm	7.379	cell pressure, psi	57.30	diameter, cm	7.262
area, cm^2	42.76	bottom pressure, psi	50.00	area, cm^2	41.42
volume, cm^3	317.80	top pressure, psi	50.00	volume, cm^3	311.39
weight, g	492.69	head, cm	0	weight, g	509.48
% moisture	20.41	maximum gradient	6.94	% moisture	23.39
dry density, pcf	80.34	minimum gradient	6.82	dry density, pcf	82.74
volume solids, cm^3	191.20	total back pressure, psi	50.00	volume solids, cm^3	192.94
volume voids, cm^3	126.60	maximum effective stress	7.3	volume voids, cm^3	118.46
void ratio	0.66	minimum effective stress	7.3	void ratio	0.61
% saturation	65.97	specific gravity	2.14	% saturation	81.54

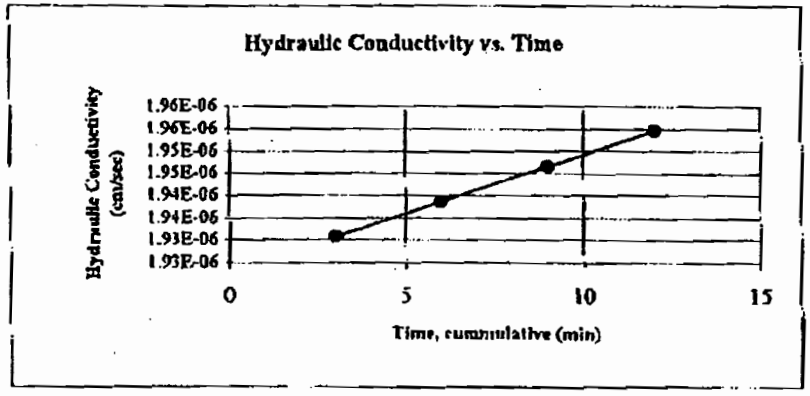
$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a =	0.94	cm^2	
L_f =	7.52	cm	
A_f =	41.42	cm^2	
t =	180	sec	** Reading #4
h_1/h_2 =	1.00	cm	** Reading #4
k =	2.0E-06	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/28/02	8	21	0	0	0	0.40	49.60	52.15		6.94		
08/28/02	8	24	3	180	180	0.50	49.50	51.94	1.00	6.91	1.9E-06	#1
08/28/02	8	27	6	360	180	0.60	49.40	51.73	1.00	6.88	1.9E-06	#2
08/28/02	8	30	9	540	180	0.70	49.30	51.52	1.00	6.85	1.9E-06	#3
08/28/02	8	33	12	720	180	0.80	49.20	51.30	1.00	6.82	2.0E-06	** #4

INFLOW RATE,cm^3/sec	5.56E-04	PERMEABILITY REPORTED AS	1.9E-06 AVG
OUTFLOW RATE,cm^3/sec	5.56E-04	POROSITY REPORTED AS	0.38
INFLOW / OUTFLOW RATIO	1.00		

COMMENTS:



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FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	NT
023-6128-001	B13-U1 10'-12'	ST	REVIEW	RMW

SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.734	B-value	0.96	height, cm	7.544
diameter, cm	7.163	cell pressure, psi	56.10	diameter, cm	7.023
area, cm^2	40.30	bottom pressure, psi	50.00	area, cm^2	38.74
volume, cm^3	311.66	top pressure, psi	50.00	volume, cm^3	292.24
weight, g	541.95	head, cm	0	weight, g	547.1
% moisture	32.14	maximum gradient	6.98	% moisture	28.32
dry density, pcf	82.12	minimum gradient	6.87	dry density, pcf	91.03
volume solids, cm^3	150.23	total back pressure, psi	50.00	volume solids, cm^3	156.17
volume voids, cm^3	161.42	maximum effective stress	6.1	volume voids, cm^3	136.07
void ratio	1.07	minimum effective stress	6.1	void ratio	0.87
% saturation	81.66	specific gravity	2.73	% saturation	88.75

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

$a =$ 0.94 cm^2

$L_f =$ 7.54 cm

$A_f =$ 38.74 cm^2

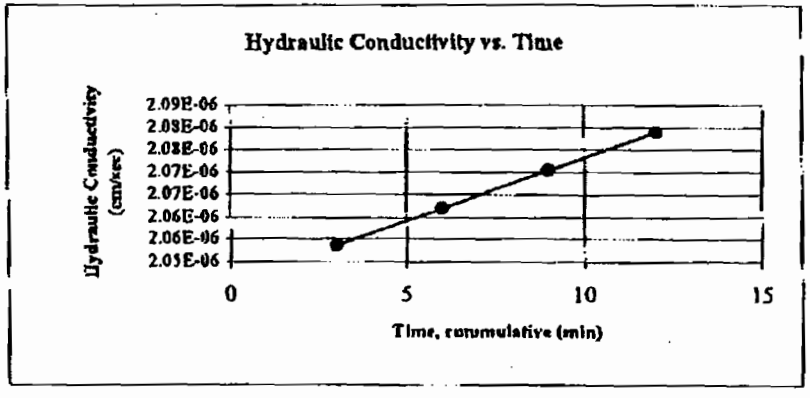
$t =$ 180 sec ** Reading #4

$h_1/h_2 =$ 1.00 cm ** Reading #4

$k =$ 2.1E-06 cm/sec ** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/28/02	8	21	0	0	0	0.40	49.60	52.65		6.98		
08/28/02	8	24	3	180	180	0.50	49.50	52.44	1.00	6.95	2.1E-06	#1
08/28/02	8	27	6	360	180	0.60	49.40	52.22	1.00	6.92	2.1E-06	#2
08/28/02	8	30	9	540	180	0.70	49.30	52.01	1.00	6.89	2.1E-06	#3
08/28/02	8	33	12	720	180	0.80	49.20	51.80	1.00	6.87	2.1E-06	** #4
					INFLOW RATE, cm^3/sec	5.56E-04			PERMEABILITY REPORTED AS		2.1E-06	AVG
					OUTFLOW RATE, cm^3/sec	5.56E-04			POROSITY REPORTED AS		0.47	
					INFLOW / OUTFLOW RATIO	1.00						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	NT
023-6128-001	B20-U2 6'-8'	ST	REVIEW	RMW

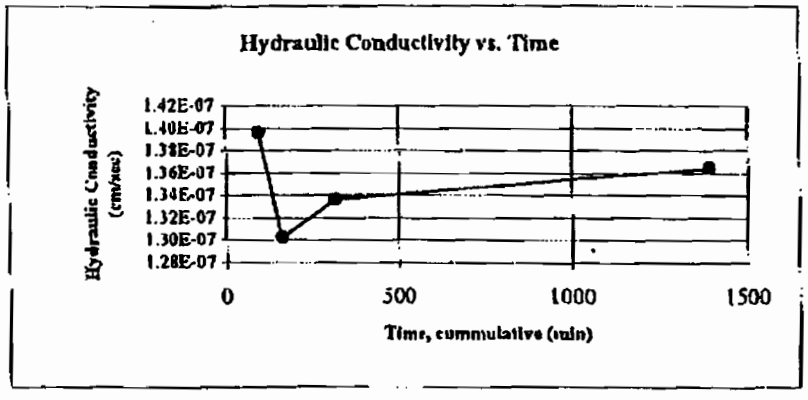
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.366	B-value	0.96	height, cm	7.239
diameter, cm	7.155	cell pressure, psi	55.40	diameter, cm	7.188
area, cm^2	40.21	bottom pressure, psi	50.00	area, cm^2	40.58
volume, cm^3	296.18	top pressure, psi	50.00	volume, cm^3	293.77
weight, g	529.80	head, cm	0	weight, g	522.85
% moisture	39.53	maximum gradient	7.12	% moisture	35.89
dry density, pcf	80.00	minimum gradient	6.22	dry density, pcf	81.72
volume solids, cm^3	144.92	total back pressure, psi	50.00	volume solids, cm^3	146.85
volume voids, cm^3	151.26	maximum effective stress	5.4	volume voids, cm^3	146.92
void ratio	1.04	minimum effective stress	5.4	void ratio	1.00
% saturation	99.23	specific gravity	2.62	% saturation	94.00

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

$a_=$	0.94	cm^2	
$L_f=$	7.24	cm	
$A_f=$	40.58	cm^2	
$t=$	64440	sec	** Reading #4
$h_1/h_2=$	1.11	cm	** Reading #4
$k=$	1.4E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/28/02	7	41	0	0	0	0.45	49.10	51.57		7.12		
08/28/02	9	14	93	5580	5580	0.60	48.80	51.09	1.01	7.06	1.4E-07	#1
08/28/02	10	21	160	9600	4020	0.80	48.70	50.77	1.01	7.01	1.3E-07	#2
08/28/02	12	55	314	18840	9240	1.10	48.30	50.03	1.01	6.91	1.3E-07	#3
08/29/02	6	49	1388	83280	64440	3.50	46.00	45.05	1.11	6.22	1.4E-07	** #4
					INFLOW RATE,cm^3/sec	3.66E-05	PERMEABILITY REPORTED AS				1.3E-07	AVG
					OUTFLOW RATE,cm^3/sec	3.72E-05	POROSITY REPORTED AS				0.50	
					INFLOW / OUTFLOW RATIO	0.98						

COMMENTS:



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METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	B22-U1	TYPE:	ST	TECH	NT
023-6128-001		6'-8'			REVIEW	RMW

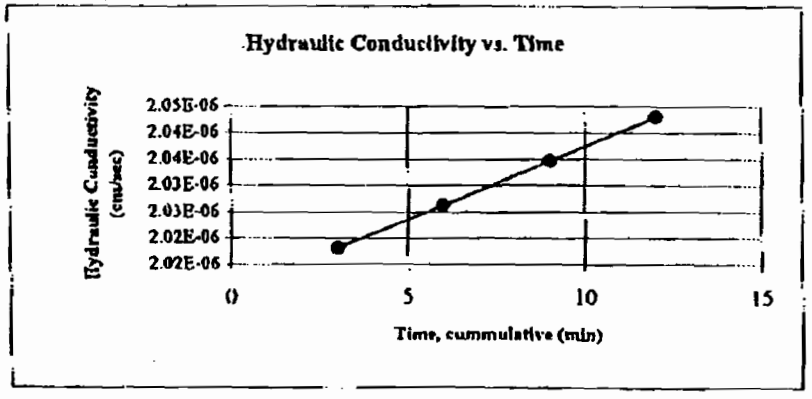
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.760	B-value	0.96	height, cm	7.658
diameter, cm	7.244	cell pressure, psi	54.10	diameter, cm	7.214
area, cm^2	41.22	bottom pressure, psi	50.00	area, cm^2	40.87
volume, cm^3	319.82	top pressure, psi	50.00	volume, cm^3	312.98
weight, g	434.51	head, cm	0	weight, g	416.97
% moisture	58.93	maximum gradient	6.75	% moisture	78.18
dry density, pcf	53.34	minimum gradient	6.64	dry density, pcf	46.66
volume solids, cm^3	106.80	total back pressure, psi	50.00	volume solids, cm^3	91.41
volume voids, cm^3	213.02	maximum effective stress	4.1	volume voids, cm^3	221.57
void ratio	1.99	minimum effective stress	4.1	void ratio	2.42
% saturation	75.63	specific gravity	2.56	% saturation	82.57

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a =	0.96	cm^2	
L_f =	7.66	cm	
A_f =	40.87	cm^2	
t =	180	sec	** Reading #4
h_1/h_2 =	1.00	cm	** Reading #4
k =	2.0E-06	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/29/02	8	21	0	0	0	0.40	49.60	51.66		6.75		
08/29/02	8	24	3	180	180	0.50	49.50	51.46	1.00	6.72	2.0E-06	#1
08/29/02	8	27	6	360	180	0.60	49.40	51.25	1.00	6.69	2.0E-06	#2
08/29/02	8	30	9	540	180	0.70	49.30	51.04	1.00	6.66	2.0E-06	#3
08/29/02	8	33	12	720	180	0.80	49.20	50.83	1.00	6.64	2.0E-06	** #4
					INFLOW RATE,cm^3/sec	5.56E-04				PERMEABILITY REPORTED AS	2.0E-06	AVG
					OUTFLOW RATE,cm^3/sec	5.56E-04				POROSITY REPORTED AS	0.71	
					INFLOW / OUTFLOW RATIO	1.00						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	NT
023-6128-001	B12-U2 26'-28'	ST	REVIEW	RMW

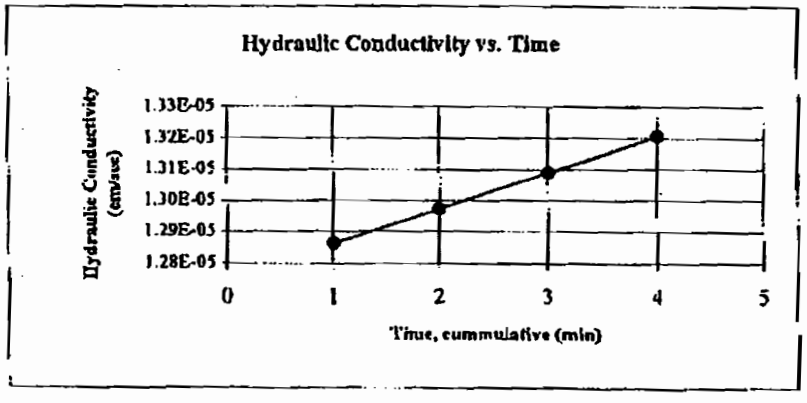
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.468	B-value	0.96	height, cm	7.569
diameter, cm	7.112	cell pressure, psi	59.80	diameter, cm	7.150
area, cm^2	39.73	bottom pressure, psi	51.00	area, cm^2	40.15
volume, cm^3	296.66	top pressure, psi	50.00	volume, cm^3	303.92
weight, g	611.53	head, cm	70.3	weight, g	616.75
% moisture	15.99	maximum gradient	16.15	% moisture	17.19
dry density, pcf	110.90	minimum gradient	15.59	dry density, pcf	108.05
volume solids, cm^3	196.72	total back pressure, psi	50.00	volume solids, cm^3	196.37
volume voids, cm^3	99.94	maximum effective stress	9.8	volume voids, cm^3	107.56
void ratio	0.51	minimum effective stress	8.8	void ratio	0.55
% saturation	84.37	specific gravity	2.68	% saturation	84.13

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a =	0.94	cm^2	
L_f =	7.57	cm	
A_f =	40.15	cm^2	
t =	60	sec	** Reading #4
h_1/h_2 =	1.01	cm	** Reading #4
k =	1.3E-05	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/30/02	8	10	0	0	0	0.50	49.50	122.24		16.15		
08/30/02	8	11	1	60	60	1.00	49.00	121.18	1.01	16.01	1.3E-05	#1
08/30/02	8	12	2	120	60	1.50	48.50	120.12	1.01	15.87	1.3E-05	#2
08/30/02	8	13	3	180	60	2.00	48.00	119.06	1.01	15.73	1.3E-05	#3
08/30/02	8	14	4	240	60	2.50	47.50	118.00	1.01	15.59	1.3E-05	** #4
					INFLOW RATE, cm^3/sec	8.33E-03				PERMEABILITY REPORTED AS	1.3E-05	AVG
					OUTFLOW RATE, cm^3/sec	8.33E-03				POROSITY REPORTED AS	0.35	
					INFLOW / OUTFLOW RATIO	1.00						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	
023-6128-001	B23-U1 5.5'-7.5'	ST	REVIEW	NT RMW

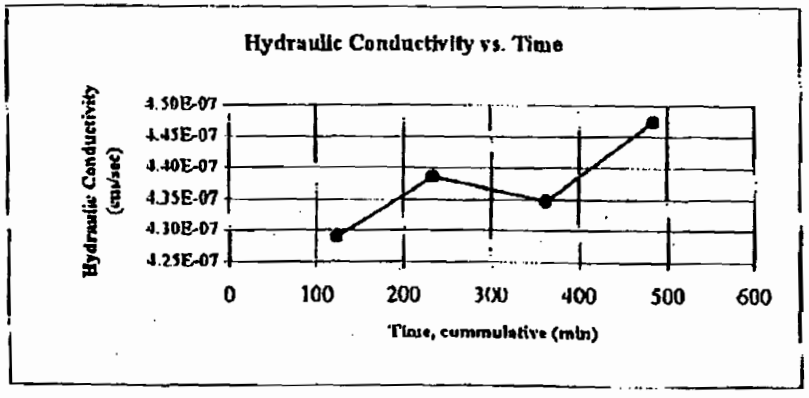
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.722	B-value	0.96	height, cm	7.681
diameter, cm	7.145	cell pressure, psi	53.00	diameter, cm	7.183
area, cm^2	40.10	bottom pressure, psi	51.00	area, cm^2	40.52
volume, cm^3	309.60	top pressure, psi	50.00	volume, cm^3	311.27
weight, g	337.69	head, cm	70.3	weight, g	335.77
% moisture	260.78	maximum gradient	10.30	% moisture	323.26
dry density, pcf	18.86	minimum gradient	8.94	dry density, pcf	15.90
volume solids, cm^3	42.74	total back pressure, psi	50.00	volume solids, cm^3	36.22
volume voids, cm^3	266.86	maximum effective stress	3.0	volume voids, cm^3	275.04
void ratio	6.24	minimum effective stress	2.0	void ratio	7.59
% saturation	91.47	specific gravity	2.19	% saturation	93.24

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a =	0.94	cm^2	
L_f =	7.68	cm	
A_f =	40.52	cm^2	
t =	7260	sec	** Reading #4
h_1/h_2 =	1.04	cm	** Reading #4
k =	4.5E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
09/03/02	7	7	0	0	0	21.90	30.50	79.11		10.30		
09/03/02	9	10	123	7380	7380	23.20	29.20	76.37	1.04	9.94	4.3E-07	#1
09/03/02	11	0	233	13980	6600	24.20	27.90	73.94	1.03	9.63	4.4E-07	#2
09/03/02	13	10	363	21780	7800	25.50	26.60	71.20	1.04	9.27	4.3E-07	#3
09/03/02	15	11	484	29040	7260	26.70	25.40	68.67	1.04	8.94	4.5E-07	** #4
					INFLOW RATE,cm^3/sec	1.65E-04				PERMEABILITY REPORTED AS	4.4E-07	AVG
					OUTFLOW RATE,cm^3/sec	1.76E-04				POROSITY REPORTED AS	0.88	
					INFLOW / OUTFLOW RATIO	0.94						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	NT
023-6128-001	B23-U2 9'-11'	ST	REVIEW	RMW

SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.417	B-value	0.96	height, cm	7.366
diameter, cm	7.201	cell pressure, psi	70.00	diameter, cm	7.188
area, cm^2	40.73	bottom pressure, psi	50.00	area, cm^2	40.58
volume, cm^3	302.05	top pressure, psi	50.00	volume, cm^3	298.92
weight, g	349.49	head, cm	0	weight, g	301.18
% moisture	244.04	maximum gradient	6.99	% moisture	157.11
dry density, pcf	20.99	minimum gradient	6.12	dry density, pcf	24.45
volume solids, cm^3	45.55	total back pressure, psi	50.00	volume solids, cm^3	52.53
volume voids, cm^3	256.50	maximum effective stress	20.0	volume voids, cm^3	246.40
void ratio	5.63	minimum effective stress	20.0	void ratio	4.69
% saturation	96.65	specific gravity	2.23	% saturation	74.69

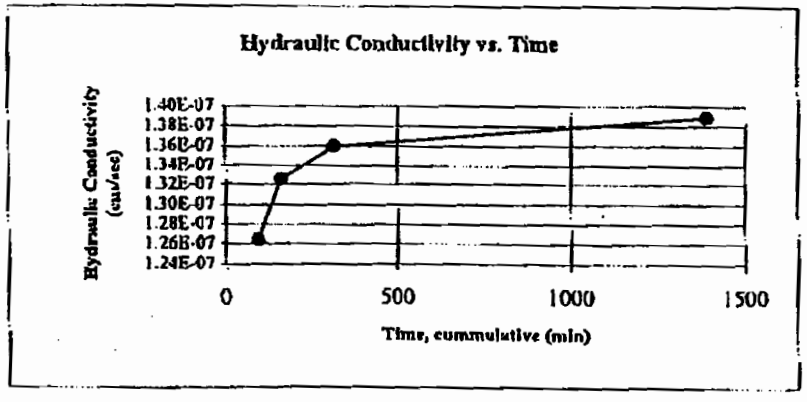
$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a =	0.94	cm^2	
L_f =	7.37	cm	
A_f =	40.58	cm^2	
t =	64440	sec	** Reading #4
h_1/h_2 =	1.11	cm	** Reading #4
k =	1.4E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/28/02	7	41	0	0	0	0.50	49.10	51.52		6.99		
08/28/02	9	14	93	5580	5580	0.60	48.80	51.09	1.01	6.94	1.3E-07	#1
08/28/02	10	21	160	9600	4020	0.70	48.60	50.77	1.01	6.89	1.3E-07	#2
08/28/02	12	55	314	18840	9240	1.10	48.30	50.03	1.01	6.79	1.4E-07	#3
08/29/02	6	49	1388	83280	64440	3.50	46.00	45.05	1.11	6.12	1.4E-07	** #4

INFLOW RATE,cm^3/sec	3.60E-05	PERMEABILITY REPORTED AS	1.3E-07	AVG
OUTFLOW RATE,cm^3/sec	3.72E-05	POROSITY REPORTED AS	0.82	
INFLOW / OUTFLOW RATIO	0.97			

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084) METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	
023-6128-001	B23-U3 26'-28'	ST	TECH REVIEW	NT RMW

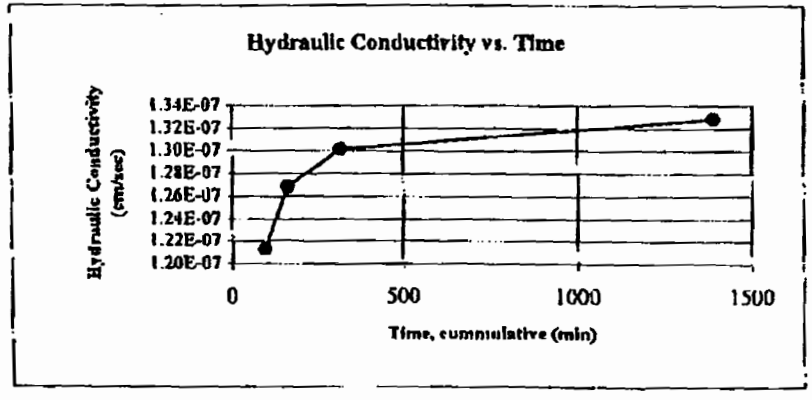
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.209	B-value	0.96	height, cm	7.185
diameter, cm	7.329	cell pressure, psi	70.00	diameter, cm	7.225
area, cm^2	42.18	bottom pressure, psi	50.00	area, cm^2	41.00
volume, cm^3	304.09	top pressure, psi	50.00	volume, cm^3	294.60
weight, g	526.97	head, cm	0	weight, g	508.84
% moisture	40.64	maximum gradient	7.24	% moisture	41.69
dry density, pcf	76.89	minimum gradient	6.33	dry density, pcf	76.07
volume solids, cm^3	139.81	total back pressure, psi	50.00	volume solids, cm^3	134.00
volume voids, cm^3	164.27	maximum effective stress	20.0	volume voids, cm^3	160.60
void ratio	1.17	minimum effective stress	20.0	void ratio	1.20
% saturation	92.69	specific gravity	2.68	% saturation	93.22

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a =	0.94	cm^2	
L_f =	7.18	cm	
A_f =	41.00	cm^2	
t =	64440	sec	** Reading #4
h_1/h_2 =	1.11	cm	** Reading #4
k =	1.3E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
08/28/02	7	41	0	0	0	0.50	49.10	52.01		7.24		
08/28/02	9	14	93	5580	5580	0.60	48.80	51.58	1.01	7.18	1.2E-07	#1
08/28/02	10	21	160	9600	4020	0.75	48.65	51.26	1.01	7.13	1.3E-07	#2
08/28/02	12	55	314	18840	9240	1.10	48.30	50.52	1.01	7.03	1.3E-07	#3
08/29/02	6	49	1388	83280	64440	3.50	46.00	45.51	1.11	6.33	1.3E-07	** #4
					INFLOW RATE, cm^3/sec	3.60E-05				PERMEABILITY REPORTED AS	1.3E-07	AVG
					OUTFLOW RATE, cm^3/sec	3.72E-05				POROSITY REPORTED AS	0.55	
					INFLOW / OUTFLOW RATIO	0.97						

COMMENTS:



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MEASUREMENT OF HYDRAULIC CONDUCTIVITY OF SATURATED POROUS MATERIALS
USING A FLEXIBLE WALL PERMEAMETER (ASTM D 5084)
METHOD C, FALLING HEAD WITH INCREASING TAILWATER LEVEL

FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	B24-U1	TYPE:	ST	TECH	NT
023-6128-001		26'-28'			REVIEW	RMW

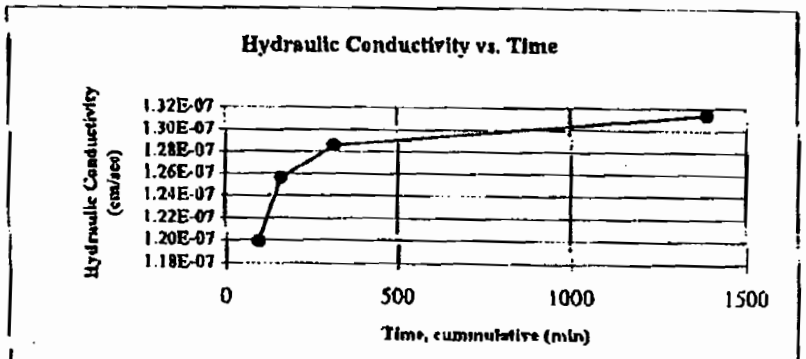
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.150	B-value	0.96	height, cm	7.120
diameter, cm	7.252	cell pressure, psi	64.30	diameter, cm	7.234
area, cm^2	41.30	bottom pressure, psi	50.00	area, cm^2	41.10
volume, cm^3	295.31	top pressure, psi	50.00	volume, cm^3	292.61
weight, g	361.64	head, cm	0	weight, g	340.46
% moisture	135.67	maximum gradient	7.30	% moisture	131.40
dry density, pcf	32.43	minimum gradient	6.39	dry density, pcf	31.38
volume solids, cm^3	61.63	total back pressure, psi	50.00	volume solids, cm^3	59.09
volume voids, cm^3	233.68	maximum effective stress	14.3	volume voids, cm^3	233.52
void ratio	3.79	minimum effective stress	14.3	void ratio	3.95
% saturation	89.09	specific gravity	2.49	% saturation	82.79

$$k = \frac{a L_f}{2 A t} \ln(h_1/h_2)$$

a =	0.94	cm^2	
L_f =	7.12	cm	
A_t =	41.10	cm^2	
t =	64440	sec	** Reading #4
h_1/h_2 =	1.11	cm	** Reading #4
k =	1.3E-07	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (in.)	Gradient	Permeability (cm/sec)	Reading
08/28/02	7	41	0	0	0	0.50	49.10	52.01		7.30		
08/28/02	9	14	93	5580	5580	0.60	48.80	51.58	1.01	7.24	1.2E-07	#1
08/28/02	10	21	160	9600	4020	0.70	48.60	51.26	1.01	7.20	1.3E-07	#2
08/28/02	12	55	314	18840	9240	1.10	48.30	50.52	1.01	7.10	1.3E-07	#3
08/29/02	6	49	1388	83280	64440	3.50	46.00	45.51	1.11	6.39	1.3E-07	** #4
					INFLOW RATE,cm^3/sec	3.60E-05	PERMEABILITY REPORTED AS				1.3E-07	AVG
					OUTFLOW RATE,cm^3/sec	3.72E-05	POROSITY REPORTED AS				0.80	
					INFLOW / OUTFLOW RATIO	0.97						

COMMENTS:



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FWENC/KEYSPAN PROJECT/NY	SAMPLE #:	TYPE:	TECH	
023-6128-001	B24-U2 28'-30'	ST	REVIEW	NT RMW

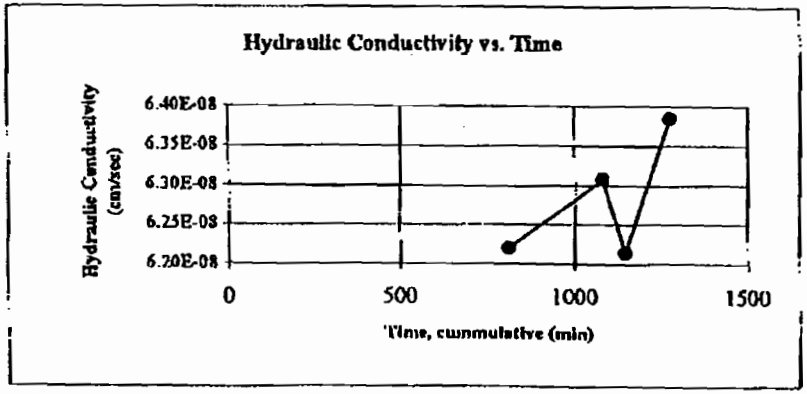
SAMPLE DATA, INITIAL				SAMPLE DATA, FINAL	
height, cm	7.303	B-value	0.96	height, cm	7.252
diameter, cm	6.982	cell pressure, psi	73.40	diameter, cm	6.924
area, cm^2	38.29	bottom pressure, psi	51.00	area, cm^2	37.65
volume, cm^3	279.63	top pressure, psi	50.00	volume, cm^3	273.05
weight, g	521.17	head, cm	70.3	weight, g	484.24
% moisture	30.92	maximum gradient	16.91	% moisture	27.23
dry density, pcf	88.84	minimum gradient	16.04	dry density, pcf	86.98
volume solids, cm^3	153.11	total back pressure, psi	50.00	volume solids, cm^3	146.39
volume voids, cm^3	126.52	maximum effective stress	23.4	volume voids, cm^3	126.67
void ratio	0.83	minimum effective stress	22.4	void ratio	0.87
% saturation	97.29	specific gravity	2.60	% saturation	81.81

$$k = \frac{a\,L_f}{2\,A\,t}\ln(h_1/h_2)$$

a =	0.94	cm^2	
L_f =	7.25	cm	
A_f =	37.65	cm^2	
t =	7740	sec	** Reading #4
h_1/h_2 =	1.01	cm	** Reading #4
k =	6.4E-08	cm/sec	** Reading #4

TIME FUNCTION						READINGS						
Date	Hour	Minute	dt,elapsed (min)	dt,elapsed (sec)	dt,reading (sec)	Inflow (cm^3)	Outflow (cm^3)	Head (cm)	(h_1/h_2) (inc.)	Gradient	Permeability (cm/sec)	Reading
09/02/02	17	30	0	0	0	0.10	49.00	122.62		16.91		
09/03/02	7	1	811	48660	48660	2.00	47.10	118.58	1.03	16.35	6.2E-08	#1
09/03/02	11	30	1080	64800	16140	2.65	46.50	117.25	1.01	16.17	6.3E-08	#2
09/03/02	12	36	1146	68760	3960	2.80	46.35	116.93	1.00	16.12	6.2E-08	#3
09/03/02	14	45	1275	76500	7740	3.10	46.05	116.29	1.01	16.04	6.4E-08	** #4
					INFLOW RATE,cm^3/sec	3.92E-05				PERMEABILITY REPORTED AS	6.3E-08	AVG
					OUTFLOW RATE,cm^3/sec	3.86E-05				POROSITY REPORTED AS	0.46	
					INFLOW / OUTFLOW RATIO	1.02						

COMMENTS:



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ATTACHMENT 4

Compatibility Test Results for the Waterloo Barrier® Cut-off Wall

C3 ENVIRONMENTAL LIMITED

AN ASSESSMENT OF SOIL AGGRESSIVITY

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Original Issue Date: November 29, 2002
Revised Issue Date: July 15, 2003

EXECUTIVE SUMMARY

A series of soil tests were performed on a sample provided by Foster Wheeler Environmental Corporation (Foster Wheeler) to determine the aggressivity of soil to be in contact with steel sheet piling. Soil aggressivity or corrosivity is a measure of the potential for corrosion of metals in contact with soil. The main parameters evaluated included: pH, resistivity, chloride concentration, sulphide, and moisture content. The soil exhibited a very low resistivity (435 ohm-cm) indicative of an aggressive soil environment for steel. The high moisture content and high chloride concentrations contribute to the corrosive soil environment. Analysis of the soil characteristics indicates that the potential for corrosion of buried structures is high for this soil environment.

Depending upon the design service life of the sheet pile, corrosion mitigation strategies should be evaluated for the Waterloo Barrier ® installed at the site. Based on the thickness of the sheet pile and available corrosion rates for brakish water, a service life of up to 50 years is possible for the Waterloo Barrier® if no corrosion protection methods are taken. However, the life of the Waterloo Barrier ® can be extended beyond 50 years if corrosion protection is used for the sheet pile. Types of corrosion protection include the application of a coal tar epoxy to the "splash zone" of the sheet pile or the installation of a cathodic protection system.

The report was revised to provide further clarification on the service life of the Waterloo Barrier® with and without corrosion protection.

BACKGROUND

C3 Environmental Limited was provided with soil and water samples by Foster Wheeler for analysis to determine the aggressivity of soil that will be in contact with the Waterloo Barrier® steel sheet piling. Soil aggressivity or corrosivity is a measure of the potential for corrosion of metals in contact with soil.

DESCRIPTION OF SAMPLE

Approximately 5 kg of soil labelled B14 Composite was received on Oct. 21, 2002. The sample appeared to consist primarily of sand saturated with liquid. The sample was dark in colour and contained a visible oily residue; a strong hydrocarbon odour was detected.

RESULTS OF ANALYSIS

The results of analysis for the main parameters required for soil aggressivity testing are presented in Table 1.

Table 1. Analytical Results

Parameter	Results	Method
PH	7.24	ASTM G51-95(2000)
moisture content (%)	26.6	ASTM D2216-80
resistivity (ohm-cm)	435	ASTM G57-95a
NaCl Concentration (mg/kg)	1110	Modified from ASTM C1218/C1218M-99
sulphide concentration[1] (mg/kg)	2.82	APHA 4500S2D

[1]Analysis conducted by Enviro-Test Laboratories Ltd.

DISCUSSION OF RESULTS

According to guidelines published by the American Water Works Association (AWWA) and the Ductile Iron Pipe Research Association (DIPRA), a soil resistively of less than 700 ohm-cm is considered a highly corrosive environment for ferrous metals. The saturated soil conditions and high NaCl levels contribute to the corrosive environment (typical NaCl concentrations for residential soil are in the range of 300 to 400 mg/L). A trace level of sulphide was detected in the soil indicating that the presence of sulphate reducing bacteria (SRB) is a possibility. Metabolic activity by SRB accelerates the corrosion of steel in soil environments (a process referred to as microbiologically induced corrosion).

Based on the AWWA 10-point system for soil evaluation, the soil sample would rank higher than 10. A value of 10 points indicates that corrosion protection is required for buried metal structures.

REVIEW OF ANALYTICAL DATA

A review of analytical data provided by Foster Wheeler indicate that high levels of PAHs and metals are present in the soil and are leaching into the groundwater. Of particular concern, from a corrosivity point of view, are the high concentrations of copper, up to 488 mg/kg, detected in soil samples. Copper will readily deposit onto steel surfaces by a process referred to as 'back-plating'; where copper ions plate onto a steel surface as elemental copper with a corresponding release of iron ions from the steel. This process accelerates the corrosion of steel structures by forming minute galvanic cells. Nickel and lead compounds also have the potential to back-plate onto steel, however, to a lesser extent.

DISCUSSION

The major controlling factor for galvanic corrosion in the intended application is the availability of oxygen. It is expected that the side of the piling exposed to the tidal salt water will be most adversely affected in the tidal zone. It is expected that the interior of the containment cell will not be subjected regular water table variations and the saturated zone will become depleted of oxygen and hence the corrosion rate will be significantly reduced. That portion of the piling buried in the soil will not experience any significant corrosion activity.

Depending on the design service life of the sheet pile, corrosion mitigation should be evaluated for the Waterloo Barrier® installed at this site. Based on the thickness of the sheet pile and available corrosion rates for brackish water, a service life of up to 50 years is possible for the Waterloo Barrier® if no corrosion protection measures are taken. However, the life of the Waterloo Barrier® can be extended beyond 50 years if corrosion protection is used on the sheet pile. The corrosion protection includes a coal tar epoxy coating for the splash zone exposed to the tidal salt water. A typical coating protection system is 16 mils of coal tar epoxy applied to the exposed steel and a few feet of the steel driven into the soil. In this case we estimate the top 50% of the pile should be coated. As an alternative, the sheet pile can be made for the retrofit of an impressed current or sacrificial anode cathodic protection system.

The report was revised to provide further clarification on the service life of the Waterloo Barrier® with and without corrosion protection.

Corrosion Allowance Calculations

1 mil = 0.001"

Section	Thickness mils	Loss per year in mils	Years to Penetration	Years to 70% loss
WZ75	295	0.5	590	413
	295	1	295	207
	295	1.5	197	138
	295	2	148	103
	295	2.5	118	83
	295	3	98	69
WEZ95	375	0.5	750	525
	375	1	375	263
	375	1.5	250	175
	375	2	188	131
	375	2.5	150	105
	375	3	125	88

The first life calculation is based on total consumption of the pile. Assume the useful life is when 70% of the steel is gone then the 70% column is used.

Rule of thumb corrosion allowance for seawall and piers in the Great lakes is taken at 0.1 to 0.3 mils per year. This puts the expected life in the 100's of years range. Special site specific circumstances may exist.

CORROSION PROTECTION

INTRODUCTION

The corrosion of metals and their prevention or repair has created a multi-billion dollar industry providing innovative solutions to the problem.

This publication provides a basic description of the problem and examines commercially available solutions.

WHAT IS CORROSION?

According to the definition in the American Society for Metals (ASM) handbook, corrosion is "the deterioration of a metal by chemical or electrochemical reaction with its environment".

There are certain conditions which must be met before corrosion can occur.

(1) There must be an anode and a cathode.

(2) There must be an electrical potential between the anode and cathode.

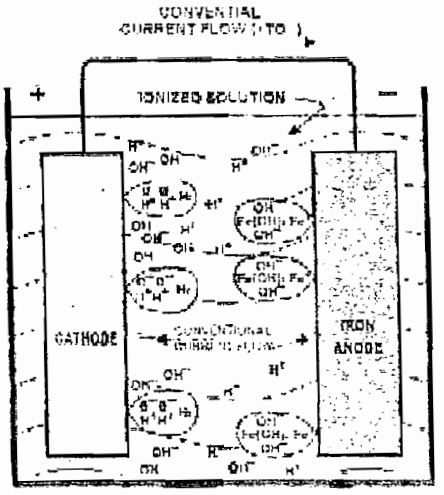
(3) There must be a metallic path electrically connecting the anode and cathode.

(4) The anode and cathode must be immersed in an electrically conductive electrolyte which is ionized (H^+ hydrogen ions and OH^- hydroxyl ions).

Once these conditions are met, an electric current will flow and metals will be consumed at the anode.

The corrosion problems in this document are limited to carbon/alloy steel applications and therefore the sacrificial anode in the corrosion process is assumed to be iron (Fe).

In the corrosion process as shown in the diagram below, the potential difference between the anode and cathode causes a migration of electrons from the anode to the cathode along the metallic connection between the anode and cathode.



At the anode, with the loss of electrons, positively charged iron atoms remain which combine with negatively charged (OH^-) ions to form a ferrous hydroxide ($Fe[OH]_2$) which then may react further to form Ferric Hydroxide ($Fe_2[OH]_3$) better known as rust.

At the cathode, a surplus of electrons combine with positively charged hydrogen ions to form Hydrogen (H_2). When hydrogen ions are converted to hydrogen atoms and hydrogen gas a surplus of hydroxyl ions (OH^-) is created which acts to increase the alkalinity of the electrolyte in the vicinity of the cathode.

In any corrosion cell it is important to remember that the amount of metal that will be removed is directly proportional to the amount of current flow. Therefore to fight corrosion, ways must be found to increase the resistance to current flow.

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TYPES OF CORROSIVE ENVIRONMENTS

ATMOSPHERIC CORROSION

All unprotected carbon and low alloy steels corrode to some extent when exposed to the atmosphere. A corrosion cell is formed when moisture in the air forms an electrolyte where a potential difference exists. Studies have shown that rates of corrosion vary significantly from location to location. There are a number of factors affecting the rates including temperature, humidity, annual rainfall, airborne industrial chemicals, acid rain, sea air, etc.

SOIL CORROSION

Soil corrosion encompasses all corrosion occurring on buried steel structures. Rate affecting factors include pH levels, electrical resistivity, oxygen, groundwater, soil bacteria, reactive chemicals and soil classification.

Soil type or classification is of major importance. Granular soils that have good drainage tend to have a fairly high resistance to current flow and thus slower corrosion rates. Clay and silty soils provide poor drainage and tend to have unfavourable pH levels and lower electrical resistivity resulting in higher corrosion rates. Some of the worst soils are those containing large concentrations of soluble salts which act to cause high levels of electrical conductivity.

As a rule, corrosion rates decline with a reduction in oxygen levels within the soil. An exception is bacterial action where anaerobic sulfate-reducing bacteria act as depolarizers at the cathode and allow corrosion to proceed in an oxygen free soil environment.

In normal anaerobic soil conditions, where bacterial action is absent, rates of corrosion on unprotected plain carbon steel are less than one half mil per side per year.

CORROSION IN FRESH WATER

This includes all nonsaline natural waters typified by streams, rivers, ponds and lakes. Steel is frequently used for various structures that are completely or partially submerged. In virtually all of these applications, the corrosion rate is influenced not only by the prevailing oxygen content of the natural water, but also by the presence of minerals or industrial pollutants. In general, the rates tend to be higher at the water/air interface where the greater presence of oxygen accelerates the process.

There is little difference in the corrosion rate in natural waters where pH levels are between 4.5 and 9.5. Here, rates remain low and seldom exceed two mils per year. However, as pH levels drop below 4, corrosion rates accelerate rapidly. pH rates at the high end of the scale tend not to be a problem unless they are very high.

CORROSION IN SEAWATER

Seawater is a relatively uniform saline solution consisting predominantly of sodium and magnesium chlorides dissolved in water. In addition to the dissolved chlorides, other factors affecting corrosion in seawater are oxygen concentration, water temperature, water velocity and biofouling.

Generally an increase in the presence of oxygen increases the rate of corrosion in seawater. The various natural forms of inhibition that prevent access of oxygen to a metal surface reduce the rate considerably. The worst corrosion rates at any given location generally occur at or just above the water/air interface (splash zone). Here, the increased presence of oxygen is a major factor.

Temperature is an important factor. The higher temperatures of seawater in tropical climates cause an increase in the rate of corrosion as compared to similar conditions in temperate climates.

The corrosion rate for plain carbon steel immersed in seawater near the surface averages about 5 mils per year for the first 5 to 10 years and then decreases to a slower rate due to the rust build-up reducing oxygen availability for further corrosion. Rates in the splash zone typically exceed these averages.

METHODS OF PROTECTION / CONTROL

HOT DIP GALVANIZING

Hot dip galvanizing is a three step process which results in a protective zinc coating being applied to a given shape of carbon steel

The first step in the process is the surface preparation of the material. This is accomplished by dipping it into a pickling tank of sulfuric or hydrochloric acid followed by water rinsing.

Next, the material undergoes a flux application which is accomplished by floating a flux layer on the top of the molten zinc. The actual application occurs as the workpiece passes through the flux layer just before entering the zinc bath.

The galvanizing occurs in the zinc bath. Here the material is immersed for a given time in a tank of near pure molten zinc at 850°F. The result is a progression of zinc-iron alloy layers metallurgically bonded to the base metal. The outermost layer is almost pure zinc.

A hot dipped galvanized coating protects in two ways. It is first a barrier protection providing a tough metallurgically bonded coating which completely covers the steel surface and seals it from the corrosive action of its environment. Second, it offers cathodic protection to the underlying steel. When zinc and steel are connected in the presence of an electrolyte, the zinc will be consumed instead of the steel. This is especially true where the steel becomes exposed through damage and the zinc then is sacrificed to protect the exposed area.

COAL TAR EXPOXY COATING

Coal tar epoxy is a corrosion inhibiting coating applied to the sandblasted surface of a carbon steel section.

The first step is the surface preparation. The entire surface to be coated is sandblasted to clean grey metal with the removal of all oils, greases and other organic matter. All surfaces must be dry prior to coating. Next, the coal tar epoxy liquid is prepared by mixing a coal tar pitch with an epoxy resin just prior to application. Then,the material is applied using airless spray equipment. Normally, a minimum of 16 mils is applied over the entire coating area. Finally, the material is allowed to be cured for a predetermined time prior to further handling.

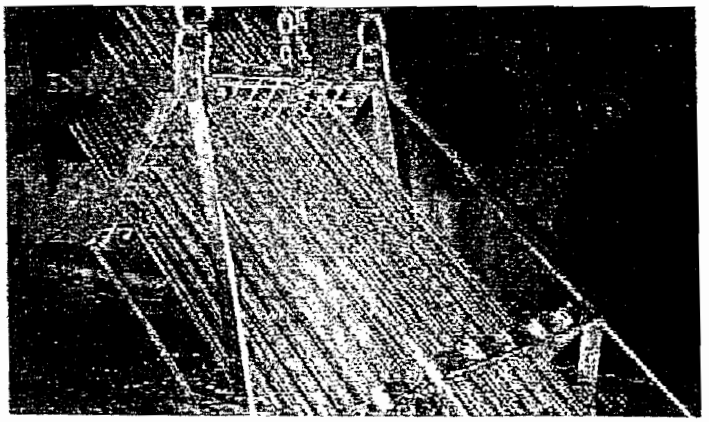
Coal tar epoxy provides an excellent barrier protection against corrosion.

FUSION BONDED EPOXY COATING

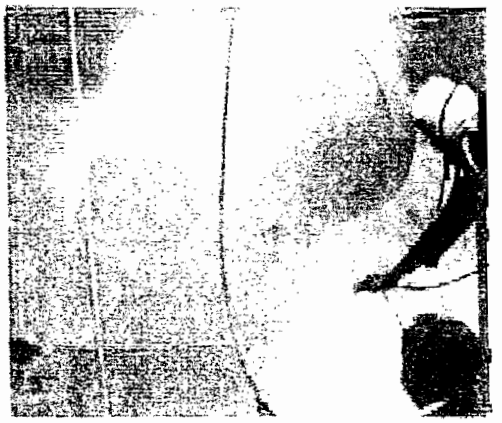
Fusion bonding is a process in which a thermosetting epoxy coating is applied to a heated workpiece which has received a sandblasted surface preparation.

Step one is the mechanical blasting of the surface to an organically clean near-white metal finish. The workpiece is then heated to a temperature of 350-450°F prior to epoxy application. A special epoxy powder is then electrostatically sprayed onto all surfaces where it fuses into a continuous encapsulating film, and then cures. Finally, after the appropriate curing time, the material is ready for further handling. Application can also be accomplished using either the flocking or the fluidized bed method

The resultant coating is irreversibly set and additional heat or pressure will not cause damage. This type of coating is quite expensive but is excellent in harsh environments.



Hot dipped galvanized sections being removed from dip tank.



Fusion bonded epoxy being applied

CATHODIC PROTECTION

Cathodic protection is a corrosion control system utilizing induced electric current to reverse the corrosion process by changing the steel structure from anodic to cathodic thus creating a flow of current to the steel instead of away from it

Two basic cathodic protection systems are generally used. For low current applications a sacrificial anode is placed close to the steel structure and an electrical flow is established from the anode (usually zinc or magnesium) to the steel cathode. Where higher currents are required, an impressed current system is employed. This system utilizes an external power source to overpower the current sources flowing from the steel structure thus transforming the steel from an anode into a cathode. The major components in a typical impressed current system are a rectifier (power source) and a current discharging structure (ground bed).

Cathodic protection is used widely, especially for buried steel structures such as pipelines.

Typical Rectifier

MILL APPLIED COATINGS

Mill applied coatings are corrosion protection systems applied to carbon steel coil products at the mill prior to shipment to the fabricator for conversion into parts or components.

There are two main classifications of mill applied coatings. The oldest and most widely used are galvanic and are essentially zinc, aluminum or zinc/aluminum combinations. These are applied in a line where the plain carbon steel coil is fed continuously through a molten bath and receives a coating which drys and hardens in a looping tower prior to re-coiling.

The second type are paint coatings. The coils first receive a light coating of zinc which is mechanically wiped to create a dull bonding finish. The coils then are un-coiled and fed continuously through a paint line which applies a coating to the required thickness and colour.

Most mill applied coatings are for use on relatively thin coils of steel. Paint coatings are seldom applied to steel heavier than 18 gauge and galvanized coatings to a maximum of 8 gauge.

WEATHERING STEELS

These steels display an atmospheric corrosion resistance of approximately four times that of plain carbon steels. The initial appearance of unpainted weathering steel exposed to the atmosphere is virtually identical to that of carbon steel. However, after a number of exposures to wet and dry cycles, an oxide film will form on the exposed weathering steel surface. The oxide film is very dense and adherent once weathering is essentially complete. Further corrosive attack is slowed to a negligible amount because air and moisture cannot penetrate the weathering steel oxide film.

Weathering steels should not be used in a marine environment (especially saltwater) where a continuous contact with water and/or soluble chlorides prevents the formation of an oxide layer.

LOW-ALLOY CORROSION RESISTANT STEELS

Those steels are somewhat similar to weathering steels because of the addition of noble elements such as copper to increase corrosion resistance. They differ in that the low-alloy corrosion resistant steels can be effectively used in virtually all corrosive environments while the use of weathering steel is limited to the atmosphere. Weathering steels typically have a more consistent, architecturally superior surface oxide finish than low alloy steels.

It should be noted that many high strength low allow steels may not have increased corrosion resistance as only strengthening elements may have been added.

STAINLESS STEELS

The alloy elements combined with plain carbon steel to form stainless steel are chromium and nickel. These steels are very effective because an oxide surface film forms on the anode (passivation) which isolates it from the electrolyte in the corrosion cell, and thus increases the resistance to current flow.

OTHER METHODS

- *STRUCTURAL PAINTING*

The material to be painted should first receive a complete grit blasting and be free of all organic matter. A rust resistant paint should be applied according to manufacturers recommendations. Paints normally have a limited service life and re-application will be necessary during the life of the structure.

- *INCREASED STEEL THICKNESS*

This method does not provide for a corrosion protection system. Steel is provided in a greater thickness than is initially structurally required. The steel is allowed to rust and the service life is determined by the time taken to corrode down to the minimum design thickness.

- *TAPE COATINGS*

Tape coatings are used primarily to protect long circular structural shapes and fasteners. They are available in hot or cold applied rolls of various sizes and widths. Most coatings of this type are manufactured from polyethylene.

SPECIFICATIONS

- *HOT DIP GALVANIZING*

  ASTM A123, standard specification for hot dip zinc coatings on iron and steel products.

  CSA G164, hot dip galvanizing of irregularly shaped articles

- *COAL TAR EPOXY COATINGS*

  Steel Structures Painting Council (SSPC) paint specification N° 16. Coal tar epoxy-polyamide black (or dark red) paint.

  SSPC-SP10, near-white blast cleaning.

- *FUSION BONDED EPOXY COATING*

  ASTM A950, standard specification for fusion bonded epoxy-coated structural steel 'H' piles and sheet piling

- *CATHODIC PROTECTION*

  National Association of Corrosion Engineers (NACE) specification RP-05, recommended practice, design, installation, operation and maintenance of impressed current deep ground beds.

- *MILL APPLIED COATINGS*

  ASTM A525, standard specification for steel sheet, zinc coated (galvanized) by the hot dip process, general requirements.

  ASTM A446, standard specification for steel sheet, zinc coated (galvanized) by the hot dip process, physical (structural) quality.

  Mill applied paint coatings. See manufacturers specifications.

- *WEATHERING STEELS*

  ASTM A606, standard specification for steel, sheet and strip, high-strength, low-alloy, hot-rolled and cold-rolled, with improved atmospheric corrosion resistance.

- *LOW-ALLOY CORROSION RESISTANT STEELS*

  ASTM A588, standard specification for high-strength low-alloy structural steel 50 KSI (345 MP_a) minimum yield point to 4 in. (100 mm) thick.

  ASTM A690, standard specification for high-strength low-alloy steel H-piles and sheet piling for use in marine environments.

- *STAINLESS STEELS*

  ASTM A167, standard specification for stainless and heat resisting chromium-nickel steel plate, sheet and strip.

  ASTM A176, standard specification for stainless and heat-resisting chromium steel plate, sheet and strip.

  ASTM A480, standard specification for general requirements for flat-rolled stainless and heat-resisting steel plate, sheet and strip.

- *STRUCTURAL PAINTING*

  SSPC - SP10, near-white blast cleaning.

  SSPC - PA1, shop, field and maintenance painting.

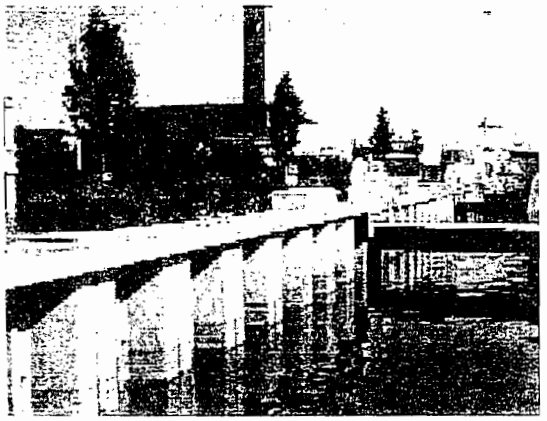
- *TAPE COATINGS*

  NACE specification RP-02 recommended practice. Application of organic coatings to the external surface of steel pipe for underground service.

CORROSION PROTECTION-CMRM
HEAVY CONSTRUCTION PRODUCTS

- *HOT DIP GALVANIZING*

  Used extensively for the protection of highway guiderail products. Also used on steel sheet piling in fresh water. Not recommended for salt water applications.



- *COAL TAR EPOXY*

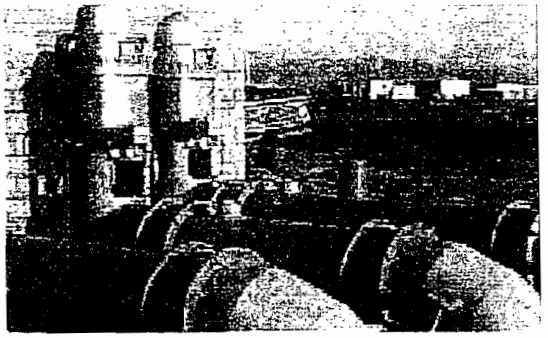
  An excellent barrier coating for saltwater applications. Provides long term protection to steel piling in any marine environment. Also a good solution where anaerobic soil conditions are encountered. Used extensively in water pollution control plants. Expensive but still good economy for the right application.

- *FUSION BONDED EPOXY*

  Quite an expensive coating. Used mostly in very aggressive conditions where the cost can be justified. Excellent for piling in even the worst of marine applications.

- *CATHODIC PROTECTION*

  Used extensively in underground pipeline systems. Can be used to protect piling structures in various atmospheric, soil or marine environments. These systems require periodic maintenance.



- *MILL APPLIED COATINGS*

  Can be used for guiderail or lightweight sheet piling if proper galvanized coating thickness is provided. Also used as protective coating for stay-in-place bridge deck forms. Mill applied paint coatings have been employed extensively on roadside noise attenuation systems.

- *WEATHERING STEELS*

  Mainly for architectural applications. Could be used for civil applications where site conditions permit.

- *LOW-ALLOY CORROSION RESISTANT STEELS*

  Used for marine structures in saltwater where extra cost of steel can be justified. Projects require more lead time due to product availability. Sometimes used in combination with coal tar or fusion bonded epoxy coating

- *STAINLESS STEELS*

  Very high corrosion resistance but also very expensive. Used in highly corrosive applications such as water pollution control, mining smelters and pulp mills. Some recent use in bridge deck reinforcing steel. Future potential for bridge or other civil applications where life cycle costing can justify the increase in cost of materials.

- *INCREASED STEEL THICKNESS*

  This method can be used effectively in the design of steel sheet piling structures. It may, in some cases, be more cost-effective than providing a protective coating.

- *TAPE COATINGS*

  Well known for pipeline protection. Can be used effectively to coat DYWIDAG tie rods and various fasteners which may be exposed to high corrosion rates.

- *STRUCTURAL PAINTING*

  Somewhat less expensive than epoxy, but not as permanent or corrosion resistant. One of the major applications of structural painting is to re habilitate old structures, especially bridges. Steel sheet piles or highway guiderails are occasionally painted to enhance appearance and offer corrosion protection.

TECHNICAL ASSISTANCE

The preceding is offered as a reference in the selection of corrosion protection systems.

For further information and assistance, please contact your nearest CMRM representative

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ATTACHMENT 5

Operation, Maintenance, and Monitoring (OM&M) Plan

Operation, Maintenance, and Monitoring (OM&M) Plan

For

OU-1 Remedial Activities
At the Former Brooklyn Borough Gas Works Site

July 2003

Prepared For:

KeySpan Corporation
OneMetroTech Center
Brooklyn, NY 11201

Prepared by:

Foster Wheeler Environmental Corporation
1000 The American Road
Morris Plains, New Jersey 07950

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OPERATION, MONITORING AND MAINTENANCE (OM&M) PLAN

1.0 REGULATORY

The operation, maintenance, and monitoring tasks for OU-1 shall be performed until the final elements of the remedial action are performed under OU-3. The following maintenance and monitoring requirements shall be implemented for OU-1:

1. Monitor the soil erosion sediment control measures until they are removed.
2. Monitor the water level inside and outside the vertical barrier cut-off wall by collecting data from the piezometers.
3. Maintain the design (or as-built) conditions.

The monitoring and maintenance will be performed by KeySpan personnel or personnel contracted by KeySpan. Personnel familiar with the OU-1 remediation activities will perform the inspections.

2.0 MONITORING, INSPECTION, AND MAINTENANCE

2.1 Soil Erosion and Sediment Control (SESC) Measures

The soil erosion and sediment control measures will be inspected weekly as long as they are in use. This will consist of a visual inspection to check for erosion, and to ensure that the measures have remained intact.

The SESC measures may require maintenance due to erosion resulting from rain, snow, wind, and other natural factors. Eroded areas will be repaired by replacement with appropriate material.

2.2 Piezometers

A set of piezometers (one inside and one outside) will be installed every 400 feet along the vertical barrier slurry cut-off walls. Drawing C-3 shows the locations of the Site piezometers. One (1) piezometer will be installed inside of the wall and another will be installed outside of the wall. The piezometers will be installed for the purpose of monitoring the depth of the groundwater. Along the Coney Island Creek, only inside piezometers will be installed. No piezometers will be installed in the Creek.

The water levels in each piezometer will be measured after construction of the vertical barrier cut-off wall around the site is completed. The initial measurements will establish a baseline for the Site. Thereafter, the water levels will be measured on a monthly basis. If, for a period of three consecutive months, the water levels in the piezometers are within 0.5 feet of the previous measurements (accounting for tidal impacts), the water level in the site will be considered to have attained equilibrium. At this point, the piezometers will be monitored on a quarterly basis.

Results on the piezometer depth measurements will be noted in a logbook and maintained by the individual performing the inspection.

3.0 RECORDKEEPING

The monitoring, maintenance, and repair records will be kept by KeySpan. An inspection report or maintenance/repair report will be completed depending on the activity. Examples of these reports are provided in Table OM&M-1 and Table OM&M-2, respectively. The individual performing these activities will complete and sign the report. Copies of the reports will be distributed as required.

4.0 REPORTING TO THE REGULATORY AGENCIES

The Recordkeeping section discusses the recordkeeping requirements for the operation, maintenance, and monitoring following OU-1 remediation. Since the remedial activities in OU-1 represent an intermediate measure to prevent contamination from migrating offsite, these requirements will be carried out until completion of remedial activities associated with OU-3. At that time the Operation, Maintenance and Monitoring Plan developed for the entire site will be operative. These records are available for review by the NYSDEC upon request.

TABLES

TABLE 2-1
FORMER BROOKLYN BOROUGH GAS WORKS SITE
COORDINATES FROM THE SURVEY OF BORINGS B-1 THROUGH B-24 AND SPOT ELEVATIONS

Boring No.	Northing	Easting	Elevation
B-1	151547.3899	989882.4114	6.68
B-2	151529.1574	989980.0884	6.69
B-3	151510.9234	990055.2167	6.84
B-4	151474.2760	990419.6256	11.81
B-5	151471.2805	990518.2710	12.65
B-6	151477.4309	990831.9616	11.34
B-7	151507.5270	990992.4347	10.54
B-8	151398.0975	990920.6584	11.15
B-9	151304.2463	990824.6404	11.86
B-10	151133.8142	990654.3948	11.65
B-11	151256.3954	990656.6199	12
B-12	150994.0628	990513.5062	10.41
B-13	150867.8961	990342.1966	7.49
B-14	150771.1817	989949.8041	6.21
B-15	150786.7298	989902.5359	5.78
B-16	150800.1477	989854.3028	5.42
B-17	150811.5185	989798.2734	5.17
B-18	150873.8585	989759.6664	5.81
B-19	150933.6517	989720.1076	5.51
B-20	151021.3284	989679.7514	5.59
B-21	151104.9315	989617.2470	5.66
B-22	151251.4910	989620.5405	6.37
B-23	151376.6951	989680.2578	6.36
B-24	151517.2134	989754.7120	8.21
Spot Elevation	151190.7245	989726.6783	7.56
Spot Elevation	151197.9568	989738.3801	7.13
Spot Elevation	151083.4193	989730.5001	7.54
Spot Elevation	151167.1772	989850.1720	5.2
Spot Elevation	151026.9343	989796.7651	5.79
Spot Elevation	150958.7233	989800.0605	5.72
Spot Elevation	150911.2393	990026.7364	8.59
Spot Elevation	150936.1328	990042.0289	8.78
Spot Elevation	150937.5529	990073.6464	8.65
Spot Elevation	150839.0630	990040.5879	8.07
Spot Elevation	150849.9775	989990.5772	7.42
Spot Elevation	150810.8928	989798.1716	5.09
Spot Elevation	151444.4475	990545.9974	12.63
Spot Elevation	151435.15	990523.9531	13.08
Spot Elevation	151427.5246	990506.0897	12.91
Spot Elevation	151295.4011	990526.9022	12.97
Spot Elevation	151283.5423	990537.3686	14.27
Spot Elevation	151271.2168	990542.9520	12.83
Spot Elevation	151296.1385	990698.4218	12.29
Spot Elevation	151278.6269	990681.5364	12.22

TABLE 2-2
FORMER BROOKLYN BOROUGH GAS WORKS SITE
SOIL BORINGS AND FINAL DEPTH

Soil Boring Location	Final Depth of Soil Boring (Feet bgs)
B-1	31
B-2	28
B-3	26
B-4	46
B-5	46
B-6	19
B-7	26
B-8	46
B-9	44
B-10	26
B-11	26
B-12	26
B-13	44
B-14	44
B-15	26
B-16	91
B-17	18
B-18	44
B-19	24
B-20	44
B-21	44
B-22	28
B-23	28
B-24	30

TABLE 2-3
FORMER BROOKLYN BOROUGH GAS WORKS SITE
LOCATIONS FOR SOIL SAMPLES TESTED FOR SIEVE ANALYSIS AND ATTERBERG LIMITS

Soil Boring Location	Sample Depth (Feet bgs)	Sieve Analysis (ASTM D-422)	Atterberg Limits (ASTM D-4318)
B-2	26 – 28	X	X
B-2	14 – 16	X	--
B-4	19 – 21	X	X
B-8	10 – 12	X	X
B-9	10 – 12	X	X
B-11	8 – 10	X	X
B-13	10 – 12	X	X
B-15	4 – 6	X	X
B-16	16 – 18	X	--
B-16	30 – 34	X	X
B-18	2 – 4	X	X
B-20	38 – 40	X	--
B-23	26 – 28	X	X
B-23	19 – 21	X	--

Notes:
-- Not sampled

TABLE 2-4
FORMER BROOKLYN BOROUGH GAS WORKS SITE
LOCATIONS FOR SOIL SAMPLES TESTED FOR PERMEABILITY

Soil Boring Location	Sample Depth (Feet bgs)
B-1	21 – 23
B-1	29 – 31
B-2	6 – 8
B-2	21 – 23
B-2	26 – 28
B-7	21 – 23
B-9	12 – 14
B-12	9 – 11
B-12	10 – 12
B-13	10 – 12
B-18	6 – 8
B-20	4 – 6
B-20	6 – 8
B-20	38 – 40
B-22	6 – 8
B-22	26 – 28
B-23	5.5 – 7.5
B-23	9 – 11
B-23	26 – 28
B-24	26 – 28
B-24	28 – 30

TABLE 2-5
FORMER BROOKLYN BOROUGH GAS WORKS SITE
GEOTECHNICAL TESTING RESULTS FOR
NORTH SIDE OF SITE (Borings B-1 through B-7)

Permeability Results

No.	Boring Number	Sample ID	Depth feet (BGS)	Permeability (cm/sec) ASTM D-5084
1	B - 1	B1-U1-21-23	21 - 23	8.10E-07
2	B - 1	B1-U2-29-31	29 – 31	8.60E-07
3	B - 2	B2-U1-6-8	6 – 8	8.20E-07
4	B - 2	B2-U2-21-23	21 – 23	4.00E-06
5	B - 2	B2-U3-26-28	26 – 28	1.90E-07
6	B - 3	B3-U1-24-26	24 - 26	8.20E-07
7	B - 7	B7-U1-21-23	21 – 23	Poor recovery

Sieve Analysis, and Atterberg Limit Results

No.	Soil Boring	Sample Depth (Feet bgs)	Sieve Analysis (ASTM D-422)	Atterberg Limits (ASTM D-4318)		
				LL	PL	PI
1	B-2	14 – 16	SP	--	--	--
2	B-4	19 – 21	MH	106	44	62

Notes:
LL = Liquid limit
PL = Plastic limit
PI = Plasticity Index
NP = non-plastic
SP = Poorly graded soil
MH = Sandy elastic silt
-- = Not sampled

TABLE 2-6
FORMER BROOKLYN BOROUGH GAS WORKS SITE
GEOTECHNICAL TESTING RESULTS FOR THE AREA ALONG THE CREEK (Borings B-8 through B-21)

Permeability Results

No.	Boring Number	Sample ID	Depth feet (BGS)	Permeability(cm/sec) ASTM D-5084
1	B - 9	B9-U2-12-14	12-14	Poor recovery
2	B - 12	B12-U2-10-12	10-12	1.90E-06
3	B - 12	B12-U1-9-11	9 – 11	Poor recovery
4	B - 13	B13-U1-10-12	10 – 12	2.10E-06
5	B - 18	B18-U1-6-8	6-8	Poor recovery
6	B - 20	B20-U1-4-6	4 – 6	Poor recovery
7	B - 20	B20-U2-6-8	6 – 8	1.40E-07

Sieve Analysis, and Atterberg Limit Results

No.	Soil Boring Location	Sample Depth (Feet bgs)	Sieve Analysis (ASTM D-422)	Atterberg Limits (ASTM D-4318)		
				LL	PL	PI
1	B-8	10 – 12	SW - SM	NP	NP	NP
2	B-9	10 – 12	SM	86	67	19
3	B-11	8 – 10	MH	65	54	11
4	B-13	10 – 12	SM	29	25	4
5	B-15	4 – 6	SM	17	17	NP
6	B-16	16 – 18	SP	--	--	--
7	B-16	30 – 34	SP - SM	NP	NP	NP
8	B-18	2 – 4	SC-SM	26	20	6
9	B-20	38 – 40	SP - SM	--	--	--

Notes:
LL = Liquid limit
PL = Plastic limit
PI = Plasticity Index
NP = non-plastic
SP = Poorly graded soil
MH = Sandy elastic silt
SM = Silty sand
SW-SM = Well graded sand with silt and gravel
SP-SM = Poorly graded sand with silt
SC-SM = Silty, clayey sand
-- = Not sampled

TABLE 2-7
FORMER BROOKLYN BOROUGH GAS WORKS SITE
GEOTECHNICAL TESTING RESULTS FOR WEST SIDE OF SITE (Borings B-22 through B-24)

Permeability Results

No.	Boring Number	Sample ID	Depth feet (BGS)	Permeability (cm/sec) ASTM D-5084
1	B - 22	B22-U1-6-8	6 – 8	2.00E-06
2	B - 22	B22-U2-26-28	26 – 28	1.30E-05
3	B - 23	B23-U1-5.5-7.5	5.5 – 7.5	4.90E-07
4	B - 23	B23-U2-9-11	9 – 11	1.40E-07
5	B - 23	B23-U3-26-28	26 – 28	1.30E-07
6	B - 24	B24-U1-26-28	26 – 28	1.30E-07
7	B - 24	B24-U2-28-30	28 – 30	5.40E-07

Sieve Analysis, and Atterberg Limit Results

No.	Soil Boring Location	Sample Depth (Feet bgs)	Sieve Analysis (ASTM D-422)	Atterberg Limits (ASTM D-4318)		
				LL	PL	PI
1	B-23	26 – 28	CH	59	30	29
2	B-23	19 – 21	SP	--	--	--

Notes:
LL = Liquid limit
PL = Plastic limit
PI = Plasticity Index
SP = Poorly graded soil
-- = Not sampled
CH = Fat Clay

TABLE OM&M-1

INSPECTION REPORT
KEYSPAN CORPORATION
FORMER BROOKLYN BOROUGH GAS WORKS SITE

AREA INSPECTED: _____

INPSECTION DATE: _____

NAME OF INSPECTOR/COMPANY: _____

DESCRIBE CONDITION OF AREA BEING INSPECTED: _____

_____

_____

_____

DESCRIBE LOCATION/TYPE OF PROBLEM: _____

_____

_____

_____

DESCRIBE ACTIONS TO BE TAKEN: _____

_____

_____

_____

_____

(PRINT/SIGN)
INSPECTOR NAME

TABLE OM&M-2

MAINTENANCE/REPAIR REPORT
KEYSPAN CORPORATION
FORMER BROOKLYN BOROUGH GAS WORKS SITE

AREA MAINTAINED/REPAIRED: _____

MAINTENANCE/REPAIR DATE: _____

NAME OF RESPONSIBLE PARTY/COMPANY: _____

GENERAL DESCRIPTION OF MAINTENANCE/REPAIR ACTIVITIES:

_____

_____

_____

LOCATION/TYPE/MATERIALS USED FOR MAINTENANCE/REPAIR:

_____

_____

_____

DESCRIBE FOLLOW-UP, IF ANY, TO VERIFY THE MAINTENANCE/REPAIR ACTIVITY: _____

_____

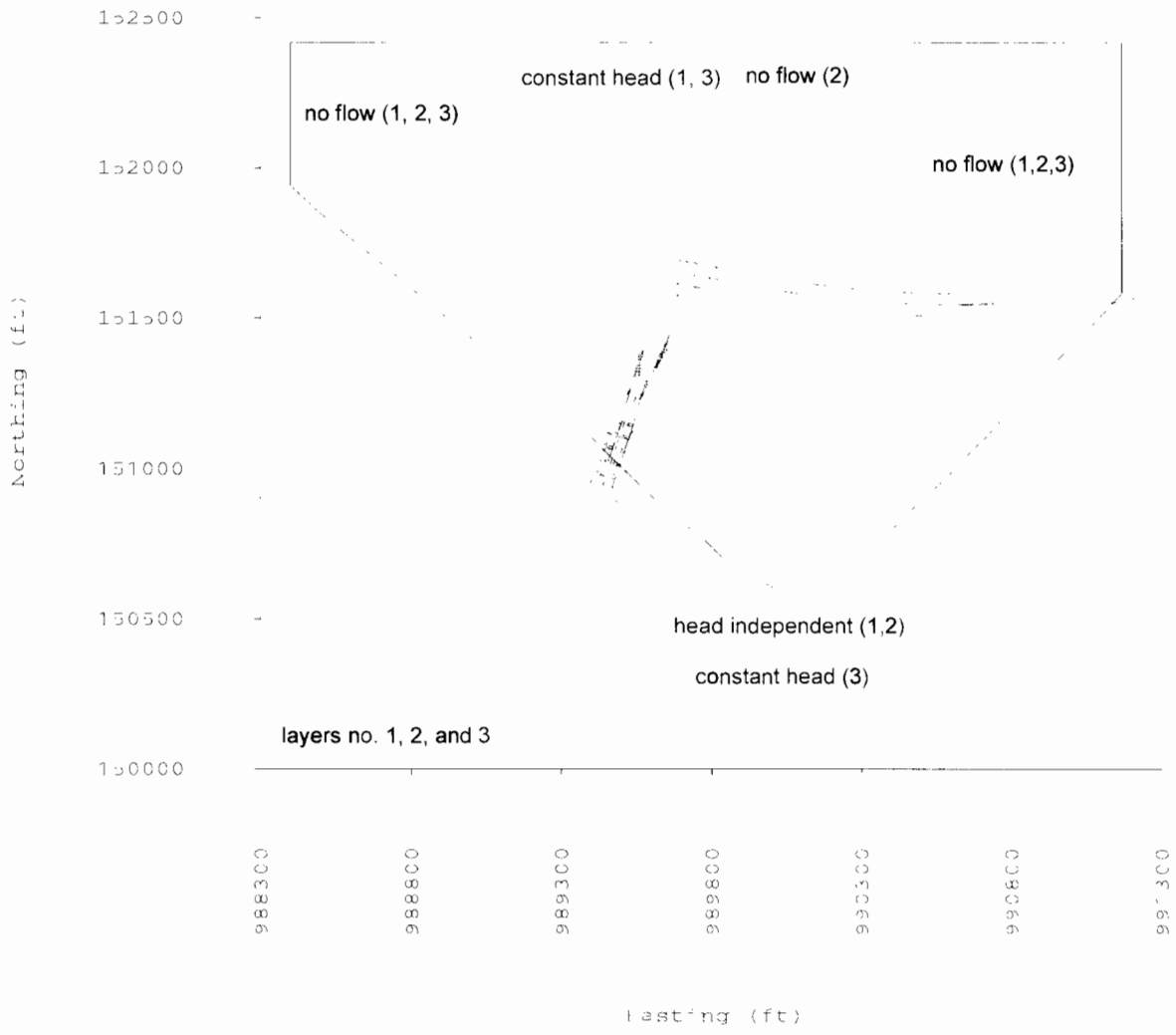
_____

_____

_____

(PRINT/SIGN)
INDIVIDUAL PERFORMING
MAINTENANCE/REPAIR

FIGURES



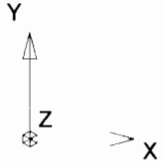


Figure 1 - Model Boundary Conditions

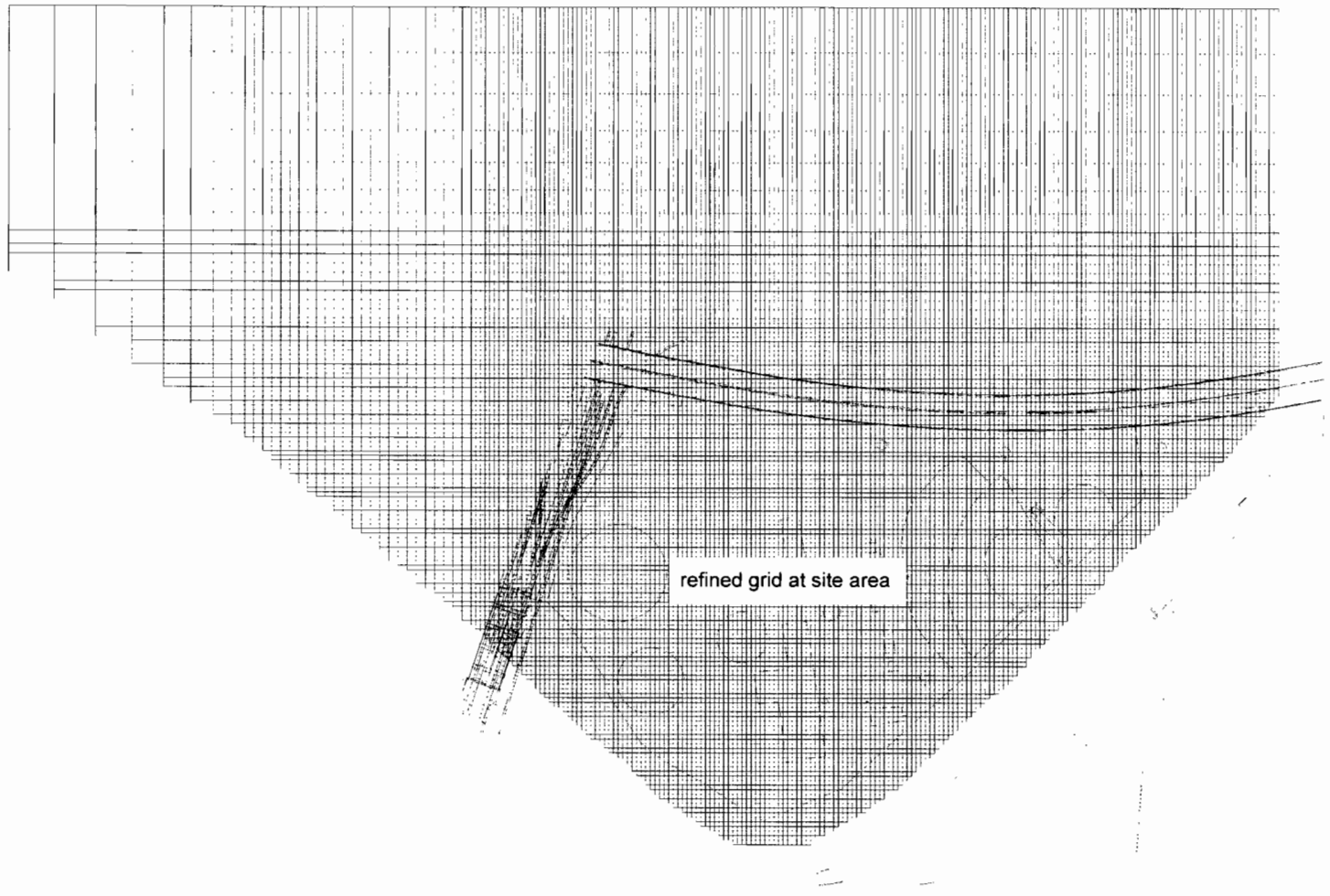


Figure 2 - 2D Finite Difference Model Grid

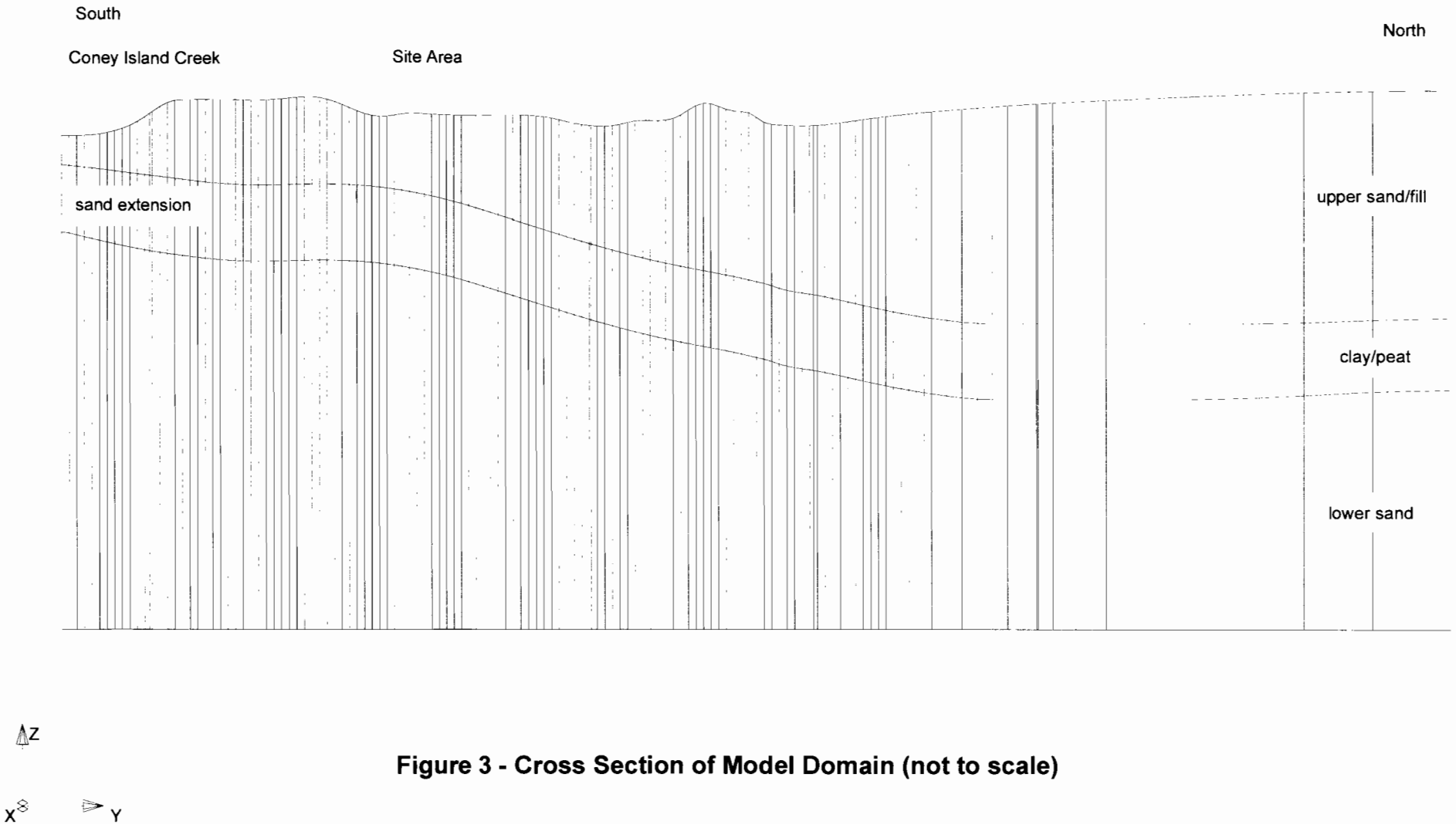


Figure 3 - Cross Section of Model Domain (not to scale)

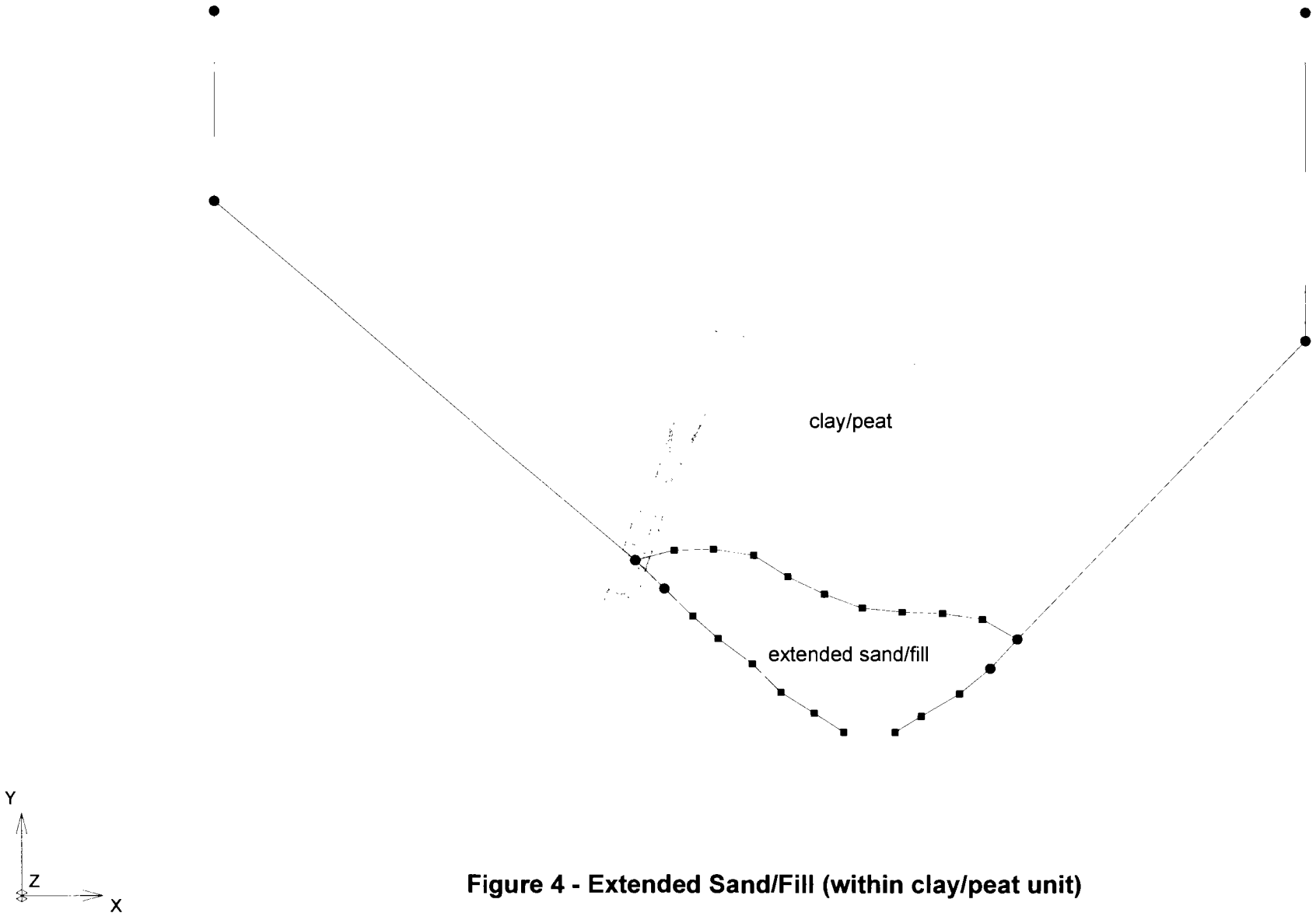


Figure 4 - Extended Sand/Fill (within clay/peat unit)

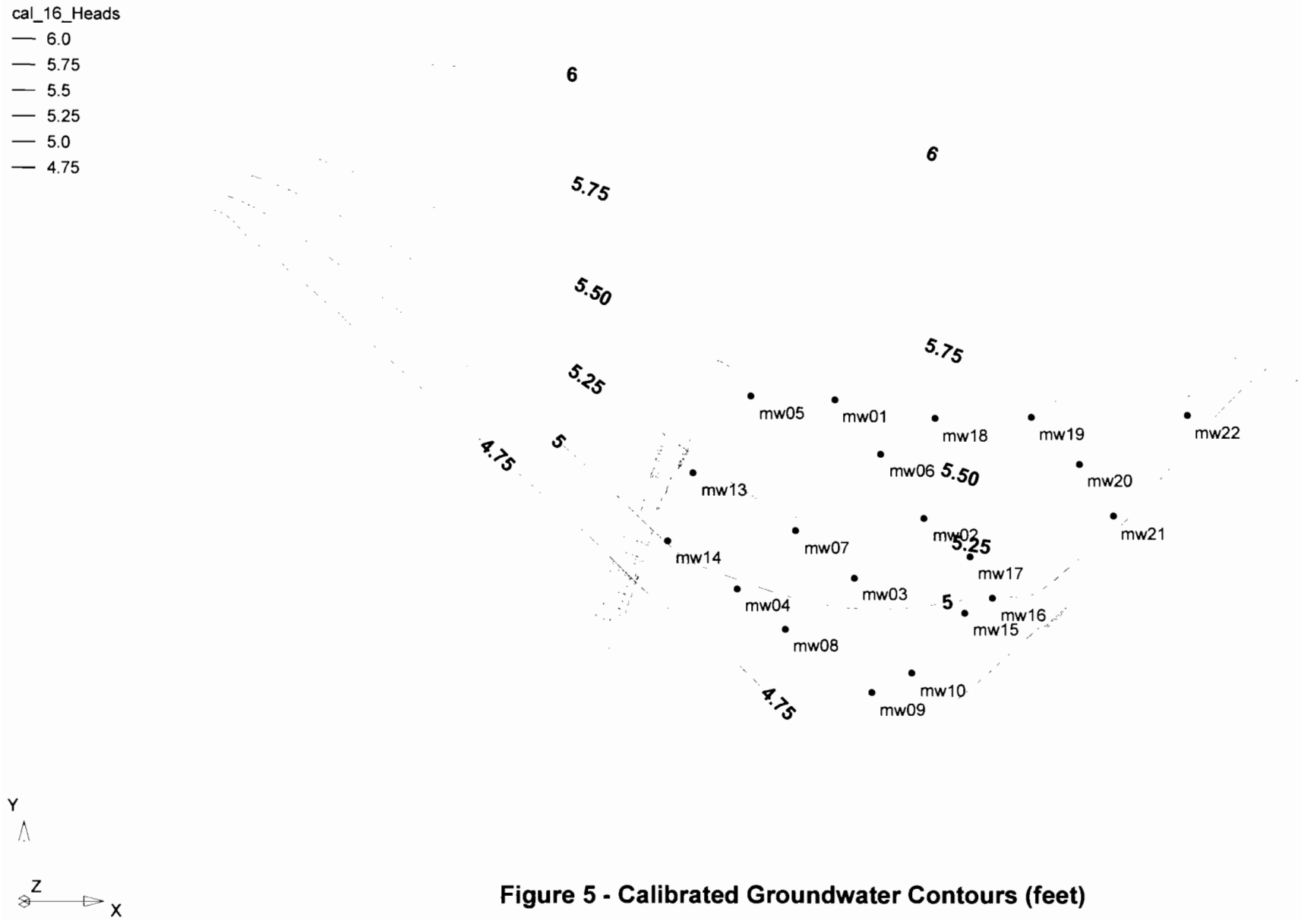


Figure 5 - Calibrated Groundwater Contours (feet)

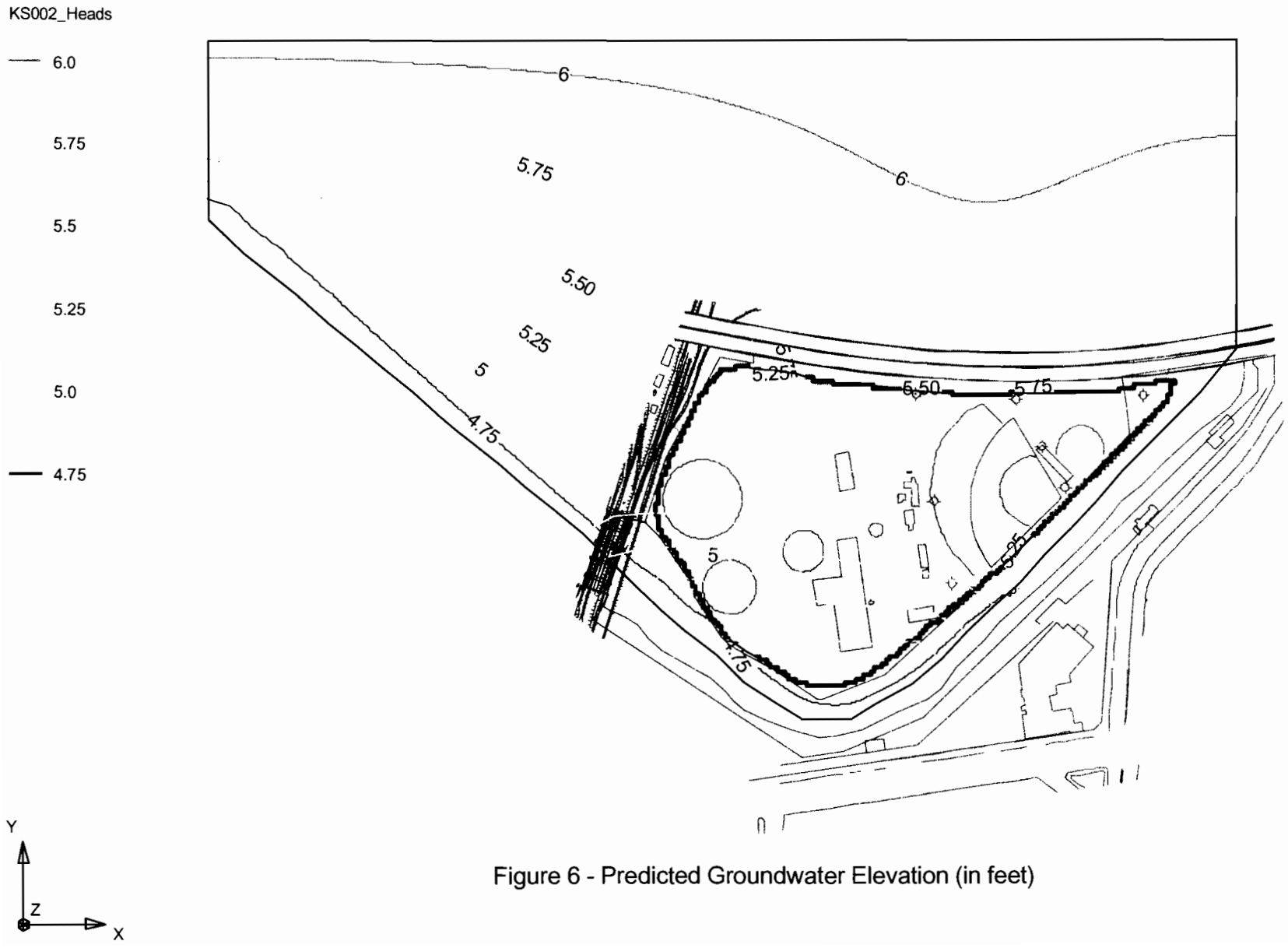


Figure 6 - Predicted Groundwater Elevation (in feet)