

Edison Force Main / Edison Pump Station Upgrade Project Borough of Sayreville and Township of Edison, New Jersey Geotechnical Evaluation and Foundation Study

Prepared for
Middlesex County Utility Authority



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1.0 Introduction and Scope

1.1 Introduction

The Edison Force Main / Edison Pump Station Upgrade Project is part of an overall scheme to provide a redundant means for sewage conveyance from the Edison Pump Station to the Central Wastewater Treatment Plant (Central WWTP). The project consists of two parallel 4,000-foot long pipelines to be constructed with trenchless methods beneath the Raritan River and some shorter connections constructed in open trench excavations on the pump station and treatment plant grounds. Additional structures such as meter chambers, switchgear enclosure, a force main discharge chamber and an aerated grit tank influent channel are also included in the project. A map showing the project site is attached in Appendix A.

This report presents the results of the geotechnical evaluation and foundation study for the proposed construction of the shorter connections constructed in open trench excavations on the pump station and treatment plant grounds as well as meter chambers, the Switchgear Enclosure foundation and Grit Chamber Connection Structure support. The two parallel 4,000-foot long pipelines to be constructed with trenchless methods beneath the Raritan River are addressed in the Geotechnical Data Report (GDR) and Geotechnical Baseline Report (GBR). The overall objective of this study was to characterize the soil, bedrock and groundwater conditions within the project limits and provide geotechnical recommendations for the most cost effective type(s) of foundation system(s) for construction of the subject structures.

1.2 Scope

In completing this study, Hatch Mott MacDonald has performed the following scope of services:

- Reviewed available reconnaissance geologic data for the project site.
- Developed, implemented and supervised a phased subsurface investigation program consisting of eighteen test borings (B-1 through B-18) of which nine borings (B-1, B-5, B-6 and B-13 through B-18) are relevant to the subject structures. Split spoon and undisturbed Shelby tube were recovered and preserved during drilling.
- Installed two monitoring wells to determine the water levels at the Central WWTP and the Edison Pump Station.
- Completed a laboratory testing program to classify the soils and to approximate their engineering properties. French and Parrello Associates, PA performed the laboratory testing in April 2005.
- Analyzed the boring and laboratory data to identify special subsurface conditions that may impact the design and construction of the project.
- Completed a geotechnical design analysis for the support of the subject structures.

2.0 Subsurface Investigation

2.1 Generalized Geology

The project is located in the Coastal Plain Physiographic Province, a region characterized by flat to gently undulating topography underlain by soil zones that gently dip towards the east. The surface expression of the contact between the sediments of the Coastal Plain and the hard bedrock of the Piedmont Physiographic Province is located a few miles west of the alignment. Underground, this contact slowly deepens towards the southeast. The leading edge of the most recent (Wisconsin Age) glaciation is shown on the NJGS maps to terminate within one to two miles north of the site. The Raritan River at the proposed crossing is an estuary and the river level is subject to tidal fluctuations.

According to the New Jersey Geological Survey (USGS) maps of Surficial Geology of the South Amboy Quadrangle, Middlesex and Monmouth Counties, NJ, Map OFM 18 (S. D. Stanford, 1995), the geologic setting in the vicinity of the site consists of the following deposits:

Artificial Fill (af) – “Excavated sand, silt, clay, gravel, and man-made materials (Bricks, cinders, ash, construction debris). Color is variable, but generally light gray to black. In railroad and road embankments, dams, and made land, including areas of dredge spoil along the Raritan River and Raritan Bay. As much as 40 feet thick...”

Estuarine Deposits (Qm) – “Peat and organic-rich clay and silt; brown to dark gray, minor sand and shells. As much as 70 feet thick in the Cheesequake and Raritan Marshes...”

Raritan Terrace Deposit (Qrt) – “Sand, silt, pebble gravel, minor clay and cobble gravel. Fine sediment is gray, brown, and reddish brown. Sand is predominantly quartz; some red shale and feldspar; and minor glauconite and mica. Gravel is predominantly quartz and quartzite; some red and gray mudstone and shale; and minor chert, gneiss, and sandstone. As much as 40 feet thick... It likely includes some glacially-derived sediment from bedrock to the north and east of the Raritan basin in addition to nonglacially- derived sediment from bedrock, Coastal Plain formations, and surficial deposits within the basin.”

Cretaceous Deposits, Undifferentiated (K) – “Sand, silt, and clay of the Raritan (Kr), Magothy, Cheesequake, Merchantville, Woodbury, and Englishtown formations... Abbreviations for Coastal Plain formations are: Krf=Raritan Formation, Farington Sand member, Krw=Raritan Formation, Woodbridge Clay member...”

Weathered Diabase (Kdw) – “Clay, sand, silt, some fragments of diabase. White, red, gray, olive, brown. As much as 20 feet thick...”

Diabase (Kd) – The soils are underlain by the Palisades Formation consisting of Jurassic Age diabase. For specific characteristics of each deposit at the project site, see the descriptions below and the boring logs and laboratory testing data.

2.2 Subsurface Investigation

A subsurface investigation program was performed to identify the soil, rock, and ground water conditions at the site. The subsurface exploration program consisted of eighteen test borings (B-1 through B-18) of which nine borings (B-1, B-5, B-6 and B-13 through B-18) shown in bold text in the following table are in the vicinity of the subject structures. Split spoon and undisturbed Shelby tube were recovered and preserved during drilling. The subsurface investigation program was performed in three intervals (October 2004, March 2005, and May 2005). The investigative program was conducted by Warren George Inc. and supervised by an HMM inspector. A boring location plan is provided (see Appendix B) and inspector’s logs are presented in Appendix C. The following table lists the completion depths and descriptive locations of these borings and test pits:

BORING NO.	LOCATION	ELEV. (ft)	BORING DEPTH (ft)
B-1	Edison Pump Station	+7.64	72.0
<i>B-2</i>	<i>North Channel Raritan River</i>	<i>-25</i>	<i>51.0</i>
<i>B-3</i>	<i>South Channel Raritan River</i>	<i>-2.9</i>	<i>69.0</i>
<i>B-4</i>	<i>South Channel Raritan River</i>	<i>-7.1</i>	<i>72.0</i>
B-5	Central WWTP grounds	+37.07	89.0
B-6	Edison Pump Station	+6.79	84.5

BORING NO.	LOCATION	ELEV. (ft)	BORING DEPTH (ft)
<i>B-7</i>	<i>South Channel Raritan River</i>	<i>-2.7</i>	<i>60.7</i>
<i>B-8</i>	<i>South Channel Raritan River</i>	<i>-3.4</i>	<i>65.5</i>
<i>B-9</i>	<i>Central WWTP grounds</i>	<i>+18.63</i>	<i>69.5</i>
<i>B-10</i>	<i>South Channel Raritan River</i>	<i>-2.5</i>	<i>57.0</i>
<i>B-11</i>	<i>South Channel Raritan River</i>	<i>-3.2</i>	<i>53.5</i>
<i>B-12</i>	<i>North Channel Raritan River</i>	<i>-5.9</i>	<i>60.0</i>
B-13	Edison Pump Station	+7.42	62.0
B-14	Edison Pump Station	+8.04	42.0
B-15	Edison Pump Station	+7.59	52.0
B-16	Edison Pump Station	+7.09	62.0
B-17	Edison Pump Station	+7.15	61.5
B-18	Central WWTP grounds	+35.8	62.0

Table 1-Boring/Testpit List Index

Test boring samples were recovered using a 1-3/8 inch I.D. split spoon sampler driven with a 140lb. hammer falling 30-inches. Samples were taken at intervals of 5-feet, 2.5-feet and continuous as per ASTM Procedure D-1586 and collected by the inspector. The borings were advanced with a truck-mounted Mobile B-61, Mobile B-80, Dietrich D-50, or Failing 1500 drill rig operated by Warren George Inc. of Jersey City, New Jersey. Blows on the sampler were recorded every 6-inches to establish the Standard Penetration Test (SPT) Number or N value for each spoon sample. Recovered samples were retained for further examination and testing. Soil samples from each SPT were described in the field by the HMM on-site inspector using the Unified Soil Classification System (USCS). A pocket penetrometer and Torvane Shear Tester were used in the field to estimate the compressive and shear strength of selected samples and the results recorded on the boring logs. Upon completion of field testing and classification, the recovered samples were placed in glass jars, labeled and retained for further examination and testing. Where directed by the inspector, a sample was collected with a thin-walled (Shelby tube) sampler, hydraulically advanced in general accordance with ASTM D 1587 – 94.

Where rock was encountered before the target depth of the boring was reached, the NX-size diamond bit wireline rock coring equipment was used in general accordance with ASTM D2113. Rock core samples with a nominal diameter of 2-inches were recovered and logged in the field by the field inspector. Upon recovery, the core samples were photographed, the rock and rock quality described, the percent recovery and rock quality designation (RQD) calculated, and the fractures measured and described. The core was then placed in wooden core boxes for storage and transported off site for further examination and testing. With the exception of B-5 and B-6, the borings were backfilled with a cement grout upon completion of the drilling.

An observation well was installed in a 40-foot deep boring located about four feet from Boring B-5 upon completion of the drilling. The well was constructed with 10-feet of 2-inch diameter slotted PVC and 29- feet of solid PVC riser at top. The bottom 12-feet of the well around the PVC was backfilled with #2 sand that was covered with a 1-foot thick bentonite seal and a 26.5-foot thick cement grout seal at the surface. The well is covered with a steel access cover mounted flush with the ground surface. A sketch of the well construction is shown on the log for Boring B-5 provided in Appendix A.

An observation well was installed in Boring B-6 after completion of the drilling when the borehole was grouted to a depth of 45.2-feet below grade. The well was constructed in a similar fashion to the well near Boring B-5. A sketch of the well construction is shown on the boring log. Except for Boring Nos. B-5 and B-6, water levels were measured

during drilling with a weighted tape and are noted on the boring logs. Water levels for Boring Nos. B-5 and B-6 were taken between November 2004 and September 2005. Those water level readings are provided in Section 4.3.

3.0 Laboratory Testing Program

A laboratory-testing program was performed to confirm the field visual classification of the site soils, and to aid in the determination of their engineering properties for design purposes. Testing was performed at French and Parrello Associates' laboratories in Holmdel, New Jersey in two intervals in November 2004 and April 2005. The tests were performed in general accordance with the respective ASTM standards and included:

- | | |
|---|-------------|
| • Natural Moisture Content | ASTM D-2216 |
| • Specific Density | ASTM D-854 |
| • Grain Size and Hydrometer Analysis | ASTM D-422 |
| • Atterberg Limits | ASTM D-4318 |
| • Triaxial Unconfined Unconsolidated (UU) | ASTM D-2850 |
| • Organic Content | ASTM D-2974 |
| • Unit Weight Determination | ASTM D-2937 |
| • AWWA Corrosivity Testing | |

Data sheets for laboratory-testing results are presented in Appendix D. Further discussion of the laboratory test results is presented in Section 5.0 entitled, "Selection of Design Soil Parameters".

4.0 General Subsurface Stratigraphy

4.1 Major Strata Encountered

A thorough review of the boring logs and laboratory test results was conducted to establish the general stratigraphy of the site. The purpose of "stratifying" a site is to group similar soil and rock materials that have the same geologic origin. Stratification not only aids in visualizing the subsurface conditions, but also facilitates computations since the soil or rock material throughout a particular stratum usually exhibits similar engineering characteristics, e.g., strength and compressibility. It should be noted that the strata boundaries shown on the logs have been estimated and inferred using available subsurface data. Actual strata boundaries in the field may differ.

Borings B-1, B-5, B-6 and B-13 through B-18 are relevant to the foundations associated with this report. Based upon our interpretation of the data found in these borings, the soil profile has been divided into the following five general layers:

- Fill
- Estuarine Deposits
- Raritan Terrace Deposits
- Raritan Formation, Woodbridge Clay member
- Raritan Formation, Farington Sand member

The subsurface conditions and the general soil types encountered and identified are as follows:

Fill – Fill was observed in all borings ranging from approximately 9 to 40 feet thickness depending on the location. The fill material varied considerably and generally consisted of moist, very loose to very dense, light brown, brown, black, orange and gray, fine to medium-grained silty sand (USCS designation SM) with localized traces of gravel as well as moist, loose to medium dense, tan, gray, or black, fine-grained silty sand (SM) with trace clay.

Estuarine Deposits (Qm) – Soft to hard clay and silt with organic material was encountered in most borings immediately beneath the fill. The layer generally consists of medium stiff to very soft to soft gray, dark gray, gray, black, and non-plastic organic rich clay and silt (OL and OH) with shells, roots, peat and a trace of fine to coarse sand.

Raritan Terrace Deposit (Qrt) – A two to twenty five foot thick layer of multi-colored (brown, light brown, gray, dark gray, black, and locally red, and white), medium dense to very dense fine to coarse clean to silty gravelly SAND (SP-SW-SM) and sandy GRAVEL (GP-GM) was encountered below the fill and estuarine deposits.

Raritan Formation, Woodbridge Clay member (Krw) - Medium stiff to hard silty CLAY (CL) and clayey SILT (ML) with sand, gravel, shells, organics, and vegetation fibers was encountered on the southeast side of the river below the shallower fill and organics and above the Farington Sand member. This deposit pinches out along the alignment under the Raritan River and thickens toward the southeast riverbank.

Raritan Formation, Farington Sand member (Krf) - Very dense fine to coarse clean SAND (SW-SM) was encountered below the fill, estuarine deposits and Woodbridge Clay member. This deposit pinches out along the alignment under the Raritan River and thickens toward the southeast riverbank.

4.2 Weathered Rock and Bedrock

Weathered Diabase (Kdw) encountered in the borings generally consisted of highly to completely weathered DIABASE having soil-like consistency of very stiff to hard silty CLAY (CL) and clayey SILT (ML) with sand and gravel size remnant rock pieces.

Bedrock was encountered in borings B-1 and B-6. The bedrock exhibited a highly to completely weathered zone ranging in thickness between about one or two feet and about 15 feet. The bedrock consisted of black, dark gray, green and white, fine- to coarse-grained, slightly weathered to unweathered (fresh), extremely strong diabase. RQD values varied but were generally greater than about 70 percent except for Boring Nos. B-1 and B-3.

4.3 Groundwater Conditions

An observation well was installed in a 40-foot deep boring located about four feet from Boring B-5 upon completion of the drilling. The well was constructed with 10 feet of 2-inch diameter slotted PVC and 30 feet of solid PVC riser at top. The bottom 12 feet of the well around the PVC was backfilled with #2 sand that was covered with a 1-foot thick bentonite seal and a 26.5-foot thick cement grout seal at the surface. The well is covered with a steel access cover mounted flush with the ground surface. A sketch of the well construction is shown on the log for Boring B-5 provided in Appendix C.

A second observation well was installed in Boring B-6 at the completion of the drilling after the borehole had been grouted to a depth of approximately 45 feet below grade. The well was constructed in a similar fashion to the well adjacent to Boring B-5. A sketch of the well construction is shown on the log. Water levels were taken at sporadic intervals in November 2004 through July 2005. Groundwater levels of El. -0.6 feet at the Pump Station Site and El 10.2 feet at the Central WWTP Site were used in preparation of this report.

Groundwater was encountered in all borings during the subsurface investigation and in the observation wells. The following table summarizes groundwater level observations from two observation wells at the WWTP and Edison Pump Station sites.

Date	WWTP Well	Edison Pump Station Well
10-27-04	Well constructed	-
11-3-04	El. 10.8'	-

Date	WWTP Well	Edison Pump Station Well
3-25-05	-	Well Developed
4-7-05	El. 11.2'	El. 0.2'
7-7-05	El. 10.2'	El. -0.7'
9-26-05	El. 9.1'	El. -0.5'

5.0 Selection of Design Soil Parameters

The design soil and rock parameters selected for use in the analysis are summarized below. In developing the parameters, reliance was made on both laboratory test results and standard published correlations (a complete list of references is attached in Appendix E). The basis for each parameter is briefly described below.

Unit Weight: The unit weights were based upon sieve analysis results, correlations with textural descriptions, observed field density and SPT results. Sieve analysis results were compared with published tables of Soil Index Properties for the material encountered. The SPT values were also compared to published tables to estimate the relative compactness of the soil. These unit weights are used for computing the present effective overburden pressures, bearing capacity and pile capacity.

Angle of internal friction: The friction angle of the granular strata was estimated using SPT results. N values were first corrected for effective overburden stress and then averaged in the zone of interest. A standard correlation was then utilized to determine the angle of internal friction.

Undrained Shear Strength: The undrained shear strength of the organic clay and silt as well as the underlying hard clay strata were estimated based on the textural description, values obtained from the triaxial testing of the undisturbed samples, grain size analyses and the Atterberg limits. The results of the UU tests were compared with textural descriptions, published strength correlations as well as our experience with similar local deposits to establish strength values.

The basalt bedrock compressive strength was based on compression test results as well as standard published correlations.

6.0 Geotechnical Assessment and Recommendations

6.1 Summary of Site Subsurface Conditions

During the geotechnical investigation, three special subsurface conditions were identified which will significantly impact the design and construction of the proposed facilities. They include existing fill, compressible soils and high ground water table.

Artificial Fill – Manmade fills were encountered at both the pump station and treatment facility sites. While borings indicate that it is predominately granular in texture, organic soils, construction debris and refuse materials may also be present. Some excavated fill materials will not be suitable for use as bearing soils or backfill and will have to be disposed of either on or off site as dictated by available area to accommodate such works. A final determination as to the suitability of these soils to serve as either foundation support and/or backfill will not be possible until the site is excavated.

Compressible Soils – The project site is underlain by organic silty clay and loose granular fills extending to depths of approximately 25 feet below surface. In general, these soils have high compressibility and low stability. Special precautions will be required during the design and construction of the project to accommodate these materials. Structures relying on support to these depths will be constructed on deep foundations. Some excavated organic clay

materials will not be suitable for use as bearing materials or backfill and will have to be disposed of either on or off site as dictated by available area to accommodate such works.

High Ground Water Table – Ground water levels observed during the subsurface investigation indicate that a high water table is present at the Pump Station Site. It should therefore be anticipated that dewatering will be required in this area in order to construct the pipes and any below grade foundation elements. Furthermore the loose granular soils below the water table and the granular soils within the pipe horizon are susceptible to loss of bearing due to upward hydraulic gradients imposed by improper dewatering techniques. Special care in design and construction must be taken to prevent “boiling” of the soils beneath the proposed pipe installation.

6.2 Foundation Support

An analysis of the existing subgrade and its potential for foundation support was performed. The study’s main focus was to determine suitable foundation systems for the various structures throughout the project site. Both deep and shallow type foundations are recommended as described below.

PUMP STATION SITE

Switchgear Enclosure – Borings B-1 and B-16 were located close to the proposed switchgear enclosure. The surficial soils encountered consist of loose to very loose granular fills underlain by organic silts and clays extending to a depth of approximately 20 feet. These soils provide insufficient bearing capacity and are compressible rendering them unsuitable for shallow foundation support. Due to the thickness of this weak deposit, soil replacement methods do not represent a practical solution. It is recommended that the foundation be supported on a deep type foundation consisting of driven piles. Pile types considered included steel H-Piles, pipe piles, concrete and timber. Given the on site soil conditions, estimated pile lengths and proposed loading timber piles were selected for support of the structures requiring deep foundations.

A static analysis was performed to estimate the allowable capacity of the aforementioned pile foundation. It was estimated that a 40 foot pile length with a tip at approximately El.-42 will provide an ultimate capacity of approximately 60 tons per pile. The International Building Code New Jersey Edition (IBC) recommends a minimum factor of safety (FOS) of 2 be used for the geotechnical capacity of driven timber piles. Other references suggest using a 3.5 FOS given subsurface investigation, WEAP analysis and static analysis. Based on these sources, a FOS of 3 was utilized for the design. Results of the study suggests that 12"dia butt 8.5"dia tip Southern Yellow Pine timber piles driven to El. -42 will provide an allowable capacity of 20 tons and will provide satisfactory support.

Pipe Installation from Shaft to Pump Station – Borings B-1, B-6 and B-17 were located within the vicinity of this portion of the project. The proposed pipe invert is set at approximately El.-19. Soils encountered at and directly beneath this elevation consisted of medium dense fine to coarse silty sand with varying amounts of gravel. These soils are suitable to support the proposed pipe and bedding without the need for a deep foundation. An allowable bearing load of 2 tons per square foot should be used for the design of this segment of pipe

Pipe Installation from Pump Station to 48” Wet Tap to Bypass Pump Station – Boreholes B-13, B-14 and B-15 were located in the area of this pipe installation. The proposed pipe invert is set at approximately El.-19. Soils encountered at and directly beneath this elevation consisted of medium dense to dense fine to coarse sand with varying amounts of silt and gravel. An allowable bearing load not to exceed 2 tons per square foot should be used for the design of this segment of pipe.

CENTRAL WWTP SITE

60” Meter Chamber - Borings B-5 and B-18 were drilled for the proposed meter chamber. The bottom of slab is planned to be at El. 20.5, approximately 16-feet below existing ground level. The underlying soils encountered consist of stiff to very stiff clayey silts and silty clays with varying amounts of fine sand. These soils are suitable to support

the proposed meter chamber utilizing a spread type foundation. An allowable bearing load of 2 tons per square foot should be used for the design of this foundation

Grit Chamber Connection Structure – Borehole B-18 is located in the vicinity of the planned connection chamber. The bottom of slab is proposed to vary between El. 21.5 to El. 17.5. The underlying soils encountered within the zone of bearing influence consist of stiff to very stiff clayey silts and silty clays with varying amounts of fine sand. These soils are suitable to support the proposed meter chamber utilizing a spread type foundation. An allowable bearing load of 2 tons per square foot should be used for the design of this foundation.

Pipe Installation from Access Shaft to Grit Chamber Connection Structure – Borings B-5 and B-18 were located in the area of this pipe section and structure. The pipe invert is proposed at El. 25.0, approximately 10 feet below existing grade. The soils encountered within the zone of bearing influence consist of stiff to very stiff clayey silts and silty clays with varying amounts of fine sand. An allowable bearing load of 1.5 tons per square foot should be used for the design of this segment of pipe.

Due to the future installation of the 102" line, adjacent to and approximately 5 feet lower than the proposed two 60" pipelines. It is recommended a deep foundation be used at the Grit Chamber Connection Structure to support the proposed 60" pipes in order to prevent undermining during future construction. A static analysis was performed to estimate the allowable capacity of the aforementioned pile foundation. It was estimated that a 25 foot pile length with a tip at approximately El.0 will provide an ultimate capacity of approximately 60 tons per pile. The Results of the study suggests that 12"dia butt 8.5"dia end Southern Yellow Pine timber piles driven to an allowable capacity of 20 tons will provide satisfactory support.

6.3 Seismic Considerations

The IBC recommends that the procedure outlined in Section 9.5.5 of ASCE 7 should be used if soil-structure interaction is considered in the determination of seismic forces and the corresponding structure displacements. Table 9.4.1.2 indicates that Site Class E is the appropriate category when considering soil-structure interaction.

6.4 Earthwork Recommendations

Prior to foundation construction, topsoil, trees, vegetation, asphalt, cinders and any unsuitable materials shall be removed from the bearing area. The granular soils were encountered at both the Pump Station Site and the Central WWTP Site may be suitable for backfill, provided they meet specified gradations and are approved by an engineer licensed in the State of New Jersey, are properly compacted and are within acceptable moisture limits. However, the organic clay encountered is not suitable structural backfill material and should be removed.

Any existing foundations encountered should be removed to a minimum depth of two feet below proposed footings or to competent suitable soil. Existing piles, if encountered, should be cut off two feet below any bottom of final grade or bottom of excavation associated and backfilled with compacted controlled fill. Existing piles that interfere with proposed deep foundations will be removed and any holes created filled with lean mix concrete. Asphalt pavement, concrete slabs and any manmade material encountered should be removed and disposed of in accordance with local and state regulations. Minimal site grading is anticipated for the construction of the proposed facility; however, permanent slopes should be limited to a maximum gradient of 2H on 1V. All areas where structural fill is to be placed should be proof-rolled in the presence of a qualified geotechnical inspector under the direct supervision of an engineer licensed in the State of New Jersey in order to identify soft material.

Both open cut and braced excavations will likely be used during construction. Open cut and braced excavations shall be designed to prevent failures and maintain worker safety in accordance with applicable OSHA and local requirements. If excavations are proposed adjacent to existing structures, special bracing techniques should be

employed. Instrumentation should be installed to monitor and control any settlement and/or horizontal movement of existing foundations with the guidance of qualified engineer licensed in the State of New Jersey.

High groundwater was observed at the Pump Station Site, approximately 7 feet below grade at El.-0.6. It is recommended that a 12-inch thick layer of clean $\frac{3}{4}$ " stone be placed below the proposed pipe bedding and beneath all foundations to protect the subgrade. Within excavated areas groundwater should be maintained a minimum of two feet below the dredge line during construction at all times to prevent piping or boiling of the subgrade during dewatering operations. Deep wells, well points and sump pumps may be required. If the subgrade is compromised during construction by the upward gradient of flowing groundwater, the subgrade should be reassessed by a qualified engineer licensed in the State of New Jersey. Disturbance of proposed load bearing zones could require deep foundation or soil improvement techniques to support proposed structural elements which are not addressed in this report. Excavations and dewatering operations must be designed in consideration of the stability adjacent structures. Steel sheeting and other support methods for excavations and trenches as well as dewatering methods should be designed by a Licensed New Jersey Professional Engineer specializing in dewatered construction.

6.5 Backfill Recommendations

Select structural fill specified under all pipes, foundations and paved areas should be predominantly granular soil aggregates free of organic matter, debris, clay deposits with a maximum particle size not to exceed two inches. Structural fill should be well-graded granular soils with no more than 12% particles finer than the No. 200 sieve. It is expected that some on-site materials will be suitable for reuse as general fill; however, given the nature of the organic clay stratum there will be occurrences of unsuitable materials with high clay and organic contents. Suitability of site materials must be in accordance with the specifications.

Structural fill should be placed in lifts not to exceed twelve inches of loose soil and compacted to a minimum of 95% of the maximum dry density as determined by ASTM D-1557. All fill should be placed within 3% of the optimum moisture content as determined by ASTM D-1557. Areas that will not support structures or pavement can be filled in 12-inch lifts and compacted to 90% of the maximum dry density as determined by ASTM D-1557.

6.6 Inspection

A qualified geotechnical engineer under the direct supervision of an engineer licensed in the State of New Jersey should inspect all aspects of foundation excavation and construction as well as placement of controlled fill. All areas where fill is to be placed should be inspected to verify that loose and or unsuitable material has been removed and that the subgrade is suitable for the placement of fill. Due to the manmade fill soils found at various locations throughout the site, there may be individual areas that may require over excavation and backfill with compacted select structural fill. A qualified geotechnical engineer under the direct supervision of an engineer licensed in the State of New Jersey should make this determination. Materials used for structural fill should be consistent with that tested as per ASTM D-1557. Field compaction should be monitored and tested by a company independent of the Contractor and performed in accordance with the engineer's specifications. All excavations may be subject to inspections by the local building code official.

7.0 Summary and Conclusions

The overall condition of the site is favorable to development of the project as described in this report. Based upon information gathered during the subsurface investigation, the most prevalent geotechnical conditions found at the site that will affect design and construction of the proposed facility is the artificial fill, compressible organic clays and high groundwater table.

It is recommended that both the Switchgear Enclosure foundation and the twin 60" pipe installation adjacent to the Grit Chamber Connection structure be founded on a driven pile foundation as specified above. The remaining foundations and pipe installations should be designed as to not exceed the allowable loads provided.

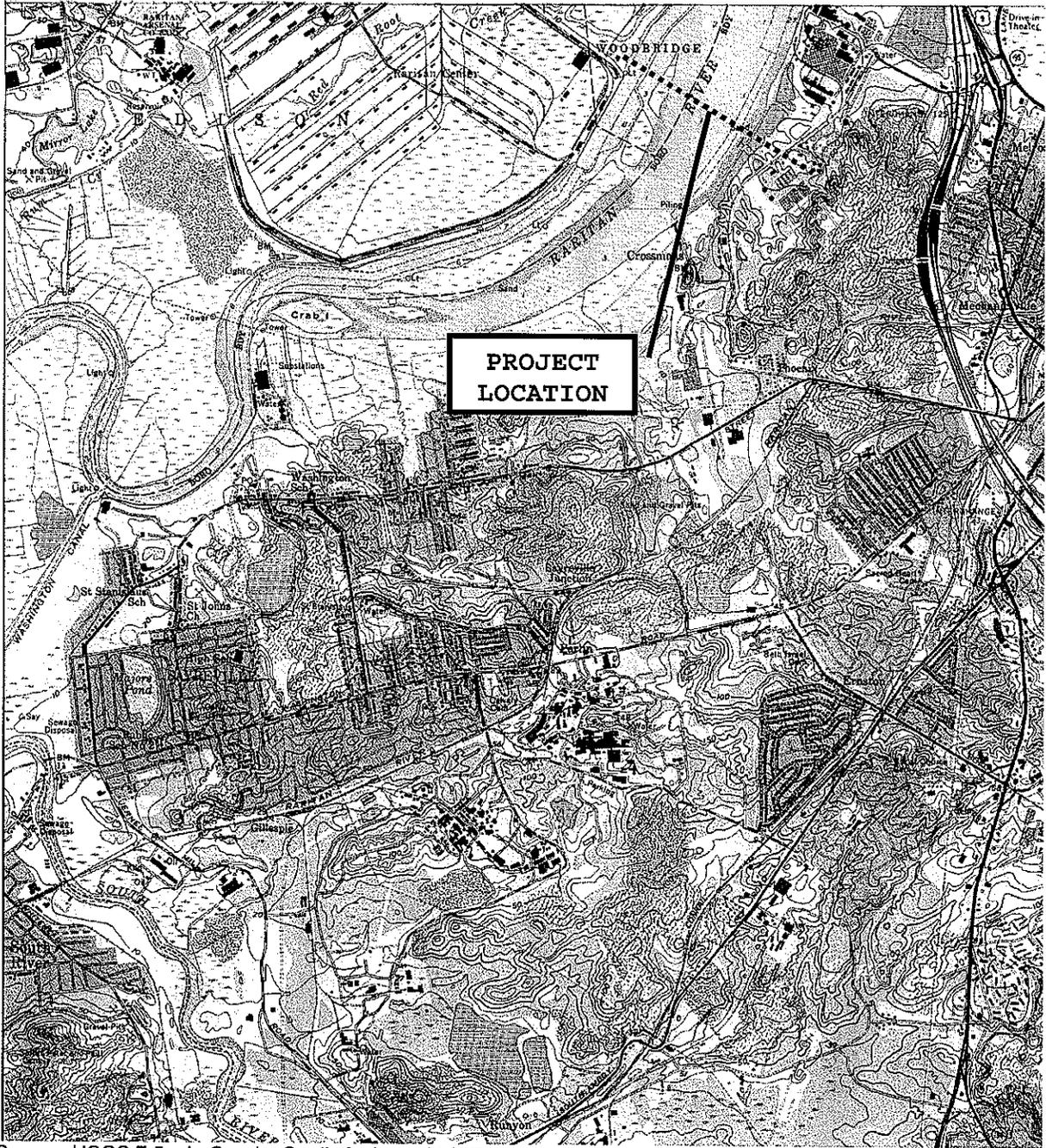
A qualified geotechnical engineer under the direct supervision of an engineer licensed in the State of New Jersey should be retained to verify the geotechnical work, verify subsurface conditions encountered, perform material property and placement testing throughout the construction of the components covered in this report.

Limitations of Report

The conclusions and recommendations contained in this report are based upon the subsurface data obtained during this investigation and on details stated in this report. The validity of the conclusions and recommendations contained in this report are necessarily limited by, among other things, the scope of field investigation and by the number of borings. Therefore, given the nature of this subsurface study, there is a possibility that actual conditions encountered will differ from those discussed in this report. Should conditions arise which differ from those described in this report, Hatch Mott MacDonald (HMM) should be notified immediately and provided with all information when available regarding subsurface conditions.

As part of the geotechnical recommendations presented in this report, HMM makes no warranty as to the absence or presence of any environmental hazard or waste present on any property evaluated hereunder and all reports generated hereto are qualified as being based upon existing data reasonably available to HMM and not subject to independent verification. HMM are not be responsible for any latent defects that could not be reasonably discovered during the performance of its services and makes no legal representations whatsoever concerning any matter, including but not limited to, the ownership of any property or the interpretation of any law. These limitations form a material part of this report and are considered incorporated by reference therein.

[Project Location Map]
Appendix A



Source: USGS 7.5 min Quad – South Amboy, NJ (NTS)

PROJECT LOCATION MAP

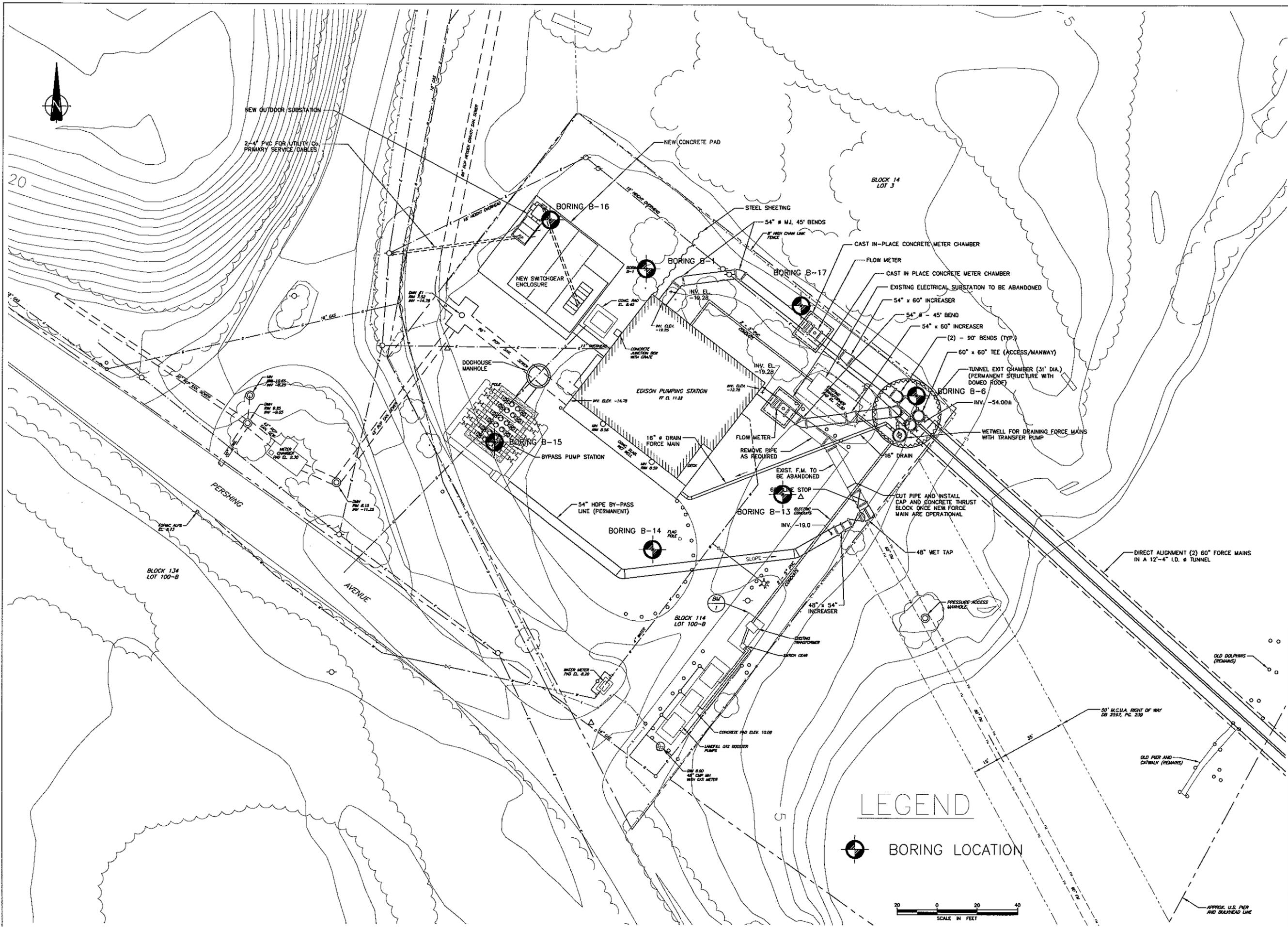
**Middlesex County Utility Authority
EDISON PUMP STATION FORCE
MAIN EXPANSION**

Borough of Sayreville
And Township of Edison
Middlesex County, NJ

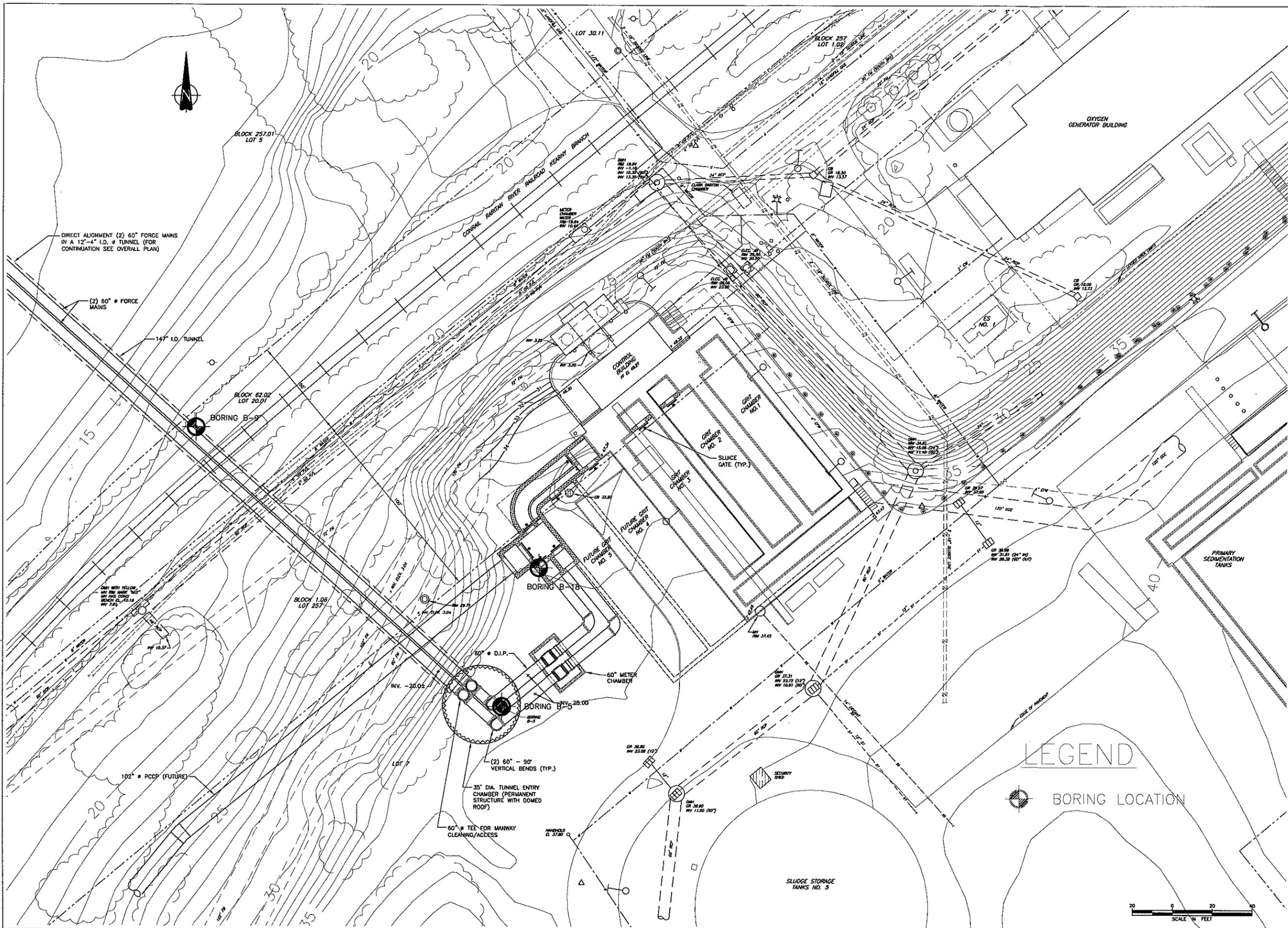


**Hatch Mott
MacDonald**

[Boring Location Map]
Appendix B

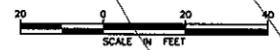


Hatch Mott MacDonald Certificate No. 24CA28075000 100 Willowbrook Road Freehold, New Jersey 07728		Date _____ Approved _____ Checked _____ Drawn _____ Designed _____	Date _____ Revision _____
MIDDLESEX COUNTY UTILITIES AUTHORITY MIDDLESEX COUNTY, NEW JERSEY EDISON FORCE MAINS / EDISON PUMP STATION UPGRADE BORING LOCATION PLAN EDISON PUMP STATION SITE PLAN (20 SCALE)			
Job No. 218967	No. of Sheets 6	Sheet No. 1	Total Sheets 6



LEGEND

BORING LOCATION



Hatch Mott MacDonald Certificate No. 24CA28075000 100 Wilentz Road Freehold, New Jersey 07728	
MIDDLESEX COUNTY UTILITIES AUTHORITY MIDDLESEX COUNTY, NEW JERSEY EDISON FORCE MAINS / EDISON PUMP STATION UPGRADE BORING LOCATION PLAN TREATMENT PLANT SITE PLAN (20 SCALE)	Date: _____ Approved: _____ Checked: _____ Drawn: _____ Design: _____
218967 B/O 8	Total 1



TEST BORING LOG

BORING NO.:

B-1

Page 1 of 3

PROJECT: Edison Force Mains
LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
CLIENT: Middlesex County Utilities Authority
DRILLING CO.: Warren George, Inc.
DRILLER: Mike McCarthy

PROJECT NO.: 219187
PROJECT MGR.: D Servidio
FIELD ENG. STAFF: J. Prada/M. Riegel
DATE/TIME STARTED: 10-21-04 / 10:20am
DATE/TIME FINISHED: 10-25-04 / 1:00pm

Elev.: 7.64 ft. **Datum:** NGVD 29 **Boring Location:** North end of alignment, adjacent to the pump station. **Coord.:** N 606099.80 E 540179.03

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Mobile B-61				Hammer Type	Drilling Fluid	Casing Advance
Type	Flush jt		NX	<input checked="" type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Type Method Depth	
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer		
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None		
Hammer Weight (lb.)		140		<input type="checkbox"/> Skid		<input type="checkbox"/> Cutting Head	Drilling Notes:			
Hammer Fall (in.)		30								

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	P	S-1	0.0 - 2.0			SM	Very loose, brown and black, fine to medium grained Silty SAND (SM), trace Gravel and roots, moist [FILL].					
	U	13										
	S											
	H											
7.5	7	S-2	2.5 - 4.5				Very loose to Dense, light brown, orange, and gray, fine- to medium-grained Silty SAND (SM), moist. [FILL]					
	8	15										
	7											
	8											
5	20	S-3	5.0 - 7.0									
	20	14										
	21											
	24											
7.5	6	S-4	7.5 - 9.5									
	5	9										
	4											
	3											
10	1	S-5	10.0 - 12.0				-Becomes wet					
	1	2										
	2											
	1											
12.5	1	S-6	12.5 - 14.5				-Grades to well-graded Silty SAND					
	2	2										
	1											
	2											
15	2	S-7	15.0 - 17.0				-Trace Gravel from 15-19.5'					15' to 20': "Rig Chatter" during drilling
	2	4										
	3											
	2											
17.5	1	S-8	17.5 - 19.5									
	2	5										
	3											
	2											
20	2	S-9A & B	20.0 - 22.0		20.0	ML	Medium stiff, light brown and gray, interbedded SILT (ML), CLAY (CL) and PEAT (PT), trace Sand, moist.	N	L	M	L	
	3	6			20.3	SM	Loose, light brown, brown, and gray, fine to coarse grained Silty SAND (SM), wet.					
	6											
	8											
22.5	3	S-10	22.5 - 24.5				-Trace Gravel from 22.5-29.5'					w = 20%
	3	7										
	3											
	3											
25	6	S-11	25.0 - 27.0									25' to 30': "Rig Chatter" during drilling
	4	6										
	5											
	6											
27.5	4	S-12	27.5 - 29.5									
	5	5										
	4											
	4											

Water Level Data						Sample Type		Instrum./Well Diagram		NOTES:			
Date	Time	Elapsed Time (hr.)	Depth in feet to:			O	U	T	U	S	G	*UCS _{avg} = Average Uniaxial Compressive Strength	
			Bottom of Casing	Bottom of Hole	Water							*PLT _{avg} = Average Point Load Test Index	
10/25/2004	7:15am	40	-	61'	7.5'							*Averages only include non-structural failures	

BORING NO.: B-1

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks		
								Dilatancy	Toughness	Plasticity	Dry Strength			
30	10	S-13	30.0 - 32.0			SM	Medium dense to Dense, light brown, brown, red, and gray, fine to coarse grained Silty SAND (SM), trace Gravel, wet.							
	13	7												
	15													
	19													
35	14	S-14	32.5 - 34.5				-Grades to fine to medium grained Silty SAND from 32.5 to 39.5'					32' to 37': "Rig Chatter" during drilling		
	12	7												
	14													
	14													
40	12	S-15	35.0 - 37.0									w = 25%		
	9	1												
	9													
	8													
45	5	S-16	37.5 - 39.5											
	7	12												
	6													
	8													
50	6	S-17	40.0 - 42.0											
	6	12												
	6													
	8													
55	19	S-18	42.5 - 44.5									42' to 45': Slight "Rig Chatter" during drilling		
	15	7												
	17													
	14													
60					45.0	SW	Medium dense to Dense, brown, fine to coarse grained SAND (SW) with Gravel, wet.							
	16	S-19	45.0 - 47.0											
	12	11												
	16													
65	27	S-20	47.5 - 49.5									47' to 54': "Rig Chatter" during drilling		
	28	13												
	15													
	24													
70	40	S-21	50.0 - 52.0			SP-SM	Very dense, brown, fine to coarse grained SAND (SP-SM) with Gravel, wet.					w = 11%		
	38	12												
	30													
	28													
75	80	S-22	52.5 - 53.4			SW	Very dense, brown, fine to coarse grained SAND (SW) with Gravel, wet.							
	100/5"	10												
					54.0			SM	Very dense, gray, fine to coarse grained SAND (SM), trace Silt and fine Gravel, wet.					w = 23%
	100/5"	S-23, 5	54.0 - 54.5											
80	100/5"	S-24, 5	55.0 - 55.4			ML	Hard, white, green and grey, SILT (ML), moist.							
					56.1									
	42	S-25	56.0 - 58.0										H	Pocket Penetrometer = 1.5 to 2.0 tsf
	34	8												
85	30													
	38	S-26	58.5 - 60.5											Pocket Penetrometer = 2.0 tsf
	38	24												
	56													
90	100/6"													
	18	S-27	61.0 - 62.7											w = 31%, LL = 35, PL = 27
	26	20												
	61													
95	100/2"						-Grades to Sandy SILT.							
	PUSH	UD-1	63.0 - 63.8											Bottom 3" of tube crimped.
	21	S-28	64.0 - 65.8											w = 30%, G _s =2.77
	28	21												w = 36%
100	36													
	100/3"				67.0									
105		C-1	67.0 - 72.0				DIABASE: dark gray, fine grained, slightly weathered, very hard							
		68												
110												Begin Rock Coring with NX-size diamond bit wireline coring equipment. Water with Revert used as drilling fluid. UCS _{avg} =47119 psi, PLT _{avg} =37320 psi RQD = 68% One mechanical break in sample.		



TEST BORING LOG

BORING NO.:

B-2

Page 1 of 2

PROJECT: Edison Force Mains
 LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
 CLIENT: Middlesex County Utilities Authority
 DRILLING CO.: Warren George, Inc.
 DRILLER: Mike McCarthy

PROJECT NO.: 219187
 PROJECT MGR.: D Servidio
 FIELD ENG. STAFF: J. Prada
 DATE/TIME STARTED: 10-15-04
 DATE/TIME FINISHED: 10-15-04 10:40 am

Elev.: -25 ft. Datum: NGVD 29 Boring Location: Boring taken in the Raritan River from barge toward the northern end of the alignment. Coord.: N 605712.10 E 540652.90

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Mobile B-61				Hammer Type	Drilling Fluid	Casing Advance
Type	Flush jt.		NX	<input type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Type Method Depth	
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer		
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None		
Hammer Weight (lb.)		140		<input checked="" type="checkbox"/> Skid	<input type="checkbox"/>	<input type="checkbox"/> Cutting Head	Drilling Notes:			
Hammer Fall (in.)		30								

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr't/Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	WOR	S-1	0.0 - 2.0			OL	Very soft, dark brown and black, organic Clayey SILT (OL), trace fine grained Sand, trace roots and leaves.	M	L	M	H	
	WOR	24										
	WOR											Pushed casing, wash water is dark gray.
					3.5							
5	5	S-2	5.0 - 7.0			SM	Medium dense, black and dark gray, well-graded, organic, Silty SAND (SM), trace roots, wet.					
	9	8										
	9											
	9											Pushed casing, wash water is dark gray. Slight chatter during wash.
					8.5							
10	8	S-3	10.0 - 12.0			GP	Medium dense, gray, white and red, fine to medium grained, poorly graded GRAVEL (GP), wet.					w = 10%
	8	2										
	10											
	11											
15	8	S-4	15.0 - 17.0									
	9	4										Drove casing with 300# hammer to 20'.
	12											
	11											
					19.0							
20												
												Loss of drilling fluid at 20', drove casing to 21'.
	34	S-5	21.0 - 23.0			GM/SM	Very dense, brown, gray and red, fine to coarse grained poorly graded, Silty SAND (GM/SM) with medium grained Gravel, wet.					
	34	12										
	37											
	38											
					25.0							Drove casing to 27', gravel in wash.
25												
	12	S-6	28.0 - 30.0			SP-SM	Dense to Very dense, light brown and gray, fine to coarse grained poorly graded SAND (SP-SM) with Silt and Gravel, wet.					w = 20%
	18											
	24											
	36											

Water Depth In River						Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Depth in feet to:					
			Bottom of Casing	Bottom of Hole	Water			
10/15/2004	1pm	-	-	-	28'	O	<input type="checkbox"/> Riser Pipe	*River level approximately 44" below deck of barge.
10/18/2004	8am	67	33	35	27'	T	<input type="checkbox"/> Screen	*UCS _{avg} = Average Uniaxial Compressive Strength
10/18/2004	2pm		55	73	31'	U	<input checked="" type="checkbox"/> Filter Sand	*PLT _{avg} = Average Point Load Test Index
10/20/2004	7:35am		55	76.1	27.5'	S	<input checked="" type="checkbox"/> Cuttings	*Averages only include non-structural failures
10/20/2004	11am		0	grout	31'	G	<input type="checkbox"/> Cement Grout	
							<input type="checkbox"/> Concrete	
							<input checked="" type="checkbox"/> Bentonite Seal	
							<input type="checkbox"/> Permeability Test	
							<input checked="" type="checkbox"/> Transducer	

BORING NO.: B-2

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks	
								Dilatancy	Toughness	Plasticity	Dry Strength		
30	18	S-7	30.0 - 32.0			SW-SM	Dense to Very dense, light brown and gray, fine to coarse grained SAND (SW-SM) with Silt, wet.						
	21	8											
	25												
	32												
35	14	S-8	32.0 - 34.0			SM	Dense, light to dark brown, orange, and gray, fine to coarse grained Silty SAND (SM), trace fine Gravel.					w = 13%	
	26	9											
	29												
	32												
40	16	S-9	34.0 - 36.0			ML	Hard, gray and white, Clayey SILT to SILT (ML), little fine to coarse Sand, moist.					Pocket Penetrometer = 1.5 tsf Torvane = 0.3 tsf	
	18	13											
	22				36.0								
	24												
45	PUSH	UD-1	38.0 - 39.0			SM	Dense to Very dense, gray and white, Silty SAND (SM), moist					No Recovery.	
	19	S-11	39.0 - 41.0										Pocket Penetrometer = 3.5 tsf Torvane = 0.4 tsf w = 27%, LL = 35, PL = 24
	23	22											
	25				41.0								
50	18	S-12	41.0 - 43.0			SM	DIABASE: dark gray with white crystals, fine to coarse grained, unweathered, very hard.					Pocket Penetrometer = 4.5 tsf Torvane = 0.4 tsf w = 28%	
	20	24											
	23												
	29												
55	16	S-13	43.0 - 45.0			SM	Very dense, gray and white, Silty SAND (SM), moist.					Pocket Penetrometer = 3.5 tsf Torvane = 0.3 tsf	
	21	10											
	27												
	31												
60	100/0"	S-14	45.0 - 45.0		46.0	SM	No Recovery in S-14.						
	75	S-15	46.0 - 46.8										
	100/4"	2			47.5								No Recovery in S-16.
65	100/0"	S-16	48.0 - 48.0			SM	Begin Rock Coring with NX-size diamond bit wireline coring equipment at 48.0 feet. Water with Revert used as					RQD= 89%	
		C-1	48.0 - 51.0										All breaks are mechanical UCS _{avg} =50393 psi, PLT _{avg} =42576 psi
70							End of Boring at 51 feet.					Boring backfilled with grout injected through a tremie tube.	

NOTES:

PROJECT NO.: 219187

BORING NO.: B-2

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system



TEST BORING LOG

BORING NO.:

B-3

Page 1 of 2

PROJECT: Edison Force Mains
LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
CLIENT: Middlesex County Utilities Authority
DRILLING CO.: Warren George, Inc.
DRILLER: Mike McCarthy

PROJECT NO.: 219187
PROJECT MGR.: D Servidio
FIELD ENG. STAFF: J. Prada
DATE/TIME STARTED: 10-14-04 9:15am
DATE/TIME FINISHED: 10-15-04 11:30am

Elev.: -2.9 ft. **Datum:** NGVD 29 **Boring Location:** Boring taken in the Raritan River from barge toward the center of the alignment. **Coord.:** N 604781.67 E 541766.15

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Mobile B-61				Hammer Type	Drilling Fluid	Casing Advance
Type	Flush It		NX	<input type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Type Method Depth	
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer		
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None		
Hammer Weight (lb.)		140		<input checked="" type="checkbox"/> Skid	<input type="checkbox"/>	<input type="checkbox"/> Cutting Head	Drilling Notes:			
Hammer Fall (in.)		30								

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr't/Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	WOR	S-1	0.0 - 2.0			OL	Very soft to soft, dark gray and black, organic SILT (OL), trace fine Sand, Clay, shells and roots, wet.	N	L	M	N	
	WOR	24										Pushed casing.
	WOR											
	WOR											
5	WOR	S-2	4.0 - 6.0					N	L	M	L	
	WOR	9										Pushed casing.
	WOR											
	WOR											
10	WOR	S-3	9.0 - 11.0					N	L	N	L	
	WOR	2										Pushed casing.
	WOR											
	WOR											
15	2	S-4	14.0 - 16.0									
	1	3										
	2											
	1											Pushed casing, gray wash.
					17.5	OH	Very soft to Medium stiff, gray and dark gray, Organic SILT (OH) with Sand and shell fragments, wet.					
20	2	S-5	19.0 - 21.0									w = 48%
	2	4										Organic Content = 18.7%
	4											
	5											
25	2	S-6	24.0 - 26.0				-Fine Sand pockets below 24'	N	M	M	M	
	1	6										
	1											Pushed casing
	1											
	WOR	S-7	29.0 - 31.0					N	M	M	M	w = 88%
	WOR	20										Boring cleaned out to 31'.

Water Depth in River			Depth in feet to:			Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water			
10/14/2004	9:25am		-	-	6'	O	Open End Rod	River level approximately 36" to 44" below deck of barge.
10/14/2004	2:20pm	5	25'	58'	2'	T	Thin-Wall Tube	
10/15/2004	8am	15	35'	58'	11'	U	Undisturbed Sample	
10/15/2004	11:30am	3	-	69'	9'	S	Split Spoon Sample	
						G	Geoprobe	

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

BORING NO.: B-3

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks		
								Dilatancy	Toughness	Plasticity	Dry Strength			
30	WOR	S-7	29.0 - 31.0			OH	Very soft to soft, gray to dark gray, Organic SILT (OH) with fine Sand pockets, trace shells, wet.					w = 88%		
	WOR	20												
	P	UD-1	31.0 - 33.0											w = 68%, LL = NP, PL = NP
	U	16												S _v = 183 psf, γ _d = 61.4 pcf
	S													Organic Content = 3.3%
	H													G _s = 2.67
35	WOR	S-8	33.0 - 35.0											
	WOR	19												
	WOR													
	WOR													
40	WOR	S-9	39.0 - 41.0											
	WOR	19												
	WOR													
	WOR													
45	2	S-10	44.0 - 46.0									Pocket Penetrometer = 0.25 tsf		
	2	24										Torvane = 0.1 tsf		
	2													
	2													
	P	UD-2	46.0 - 48.0									w = 92%, LL = 105, PL = 47		
	U	16										S _v = 145 psf, γ _d = 52.4 pcf		
50	S											Organic Content = 7.3%		
	H				48.0	SM	Medium dense, brown and black, fine to coarse grained Silty SAND (SM), trace fine to medium Gravel, wet.					G _s = 2.58		
	2	S-11	48.0 - 50.0											
	8	15												
8														
55	6	S-12	50.0 - 52.0									w = 20%		
	7	11												
	7													
	9													
60	10	S-13	52.0 - 54.0			SM/GM	Dense, brown and gray, fine to coarse grained Silty SAND (SM-GM) with fine to medium Gravel, wet.							
	12	4												
	18													
	20													
	18	S-14A & B	54.0 - 56.0			GP	Dense, brown and gray, fine to medium grained poorly graded Sandy GRAVEL (GP), trace Silt, Silt pockets, wet.							
	20	10												
65	16				54.1	ML	Hard, white and green, SILT (ML), with fine to medium grained Sand, moist.	N	H	M	VH	Pocket Penetrometer = 4.5 tsf		
	16												Torvane = 0.4 tsf	
	12	S-15	56.0 - 57.5					N	H	M	VH	w = 22%, LL = 36, PL = 30		
	15	17												
	100/6"													
	18	S-16	58.0 - 60.0						N	H	M	H	w = 42%, LL = 39, PL = 29	
70	21											Rig chattered during washout.		
	21													
	30													
	50	S-17	60.0 - 60.8											
75	100/4"													
	100/1"	S-18	62.0 - 62.1		62.0		S-18 - Black well graded, angular, weathered rock fragments.					Advanced hole to 63'.		
	C-1	18	63.0 - 65.0				DIABASE: gray, black with white minerals, fine to coarse grained, extremely close to very close fractures, fresh, strong to very strong.					Begin Rock Coring with NX-size diamond bit wireline coring equipment. Water with Revert used as drilling fluid. Core Run No. 1: RQD = 0. Silt/clay infill found in one joint. Core Run No. 2: RQD = 0.		
80	C-2	15	65.0 - 67.0									Core Run No. 3: RQD = 29%		
	C-3	20	67.0 - 69.0											
85												End of Boring at 69.		
90												Boring backfilled with grout injected through a tremie tube.		



TEST BORING LOG

BORING NO.:

B-4

Page 1 of 3

PROJECT: Edison Force Mains
 LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
 CLIENT: Middlesex County Utilities Authority
 DRILLING CO.: Warren George, Inc.
 DRILLER: Mike McCarthy

PROJECT NO.: 219187
 PROJECT MGR.: D Servidio
 FIELD ENG. STAFF: J. Prada
 DATE/TIME STARTED: 10-12-04 8:20am
 DATE/TIME FINISHED: 10-13-04 12:00pm

Elev.: -7.1 ft. Datum: NGVD 29 Boring Location: Boring taken in the Raritan River from barge toward the southern end of the alignment. Coord.: N 604185.30 E 542451.46

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Mobile B-61				Hammer Type	Drilling Fluid	Casing Advance
Type	Flush jt.		NX	<input type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Type Method Depth	
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer		
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None		
Hammer Weight (lb.)		140		<input checked="" type="checkbox"/> Skid	<input type="checkbox"/>	<input type="checkbox"/> Cutting Head	Drilling Notes:			
Hammer Fall (in.)		30								

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr't/Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	WOR	S-1	0.0 - 2.0			OL	Very soft, dark gray, organic Clayey SILT (OL), trace fine Sand pockets, wet.					Depth of water 15' to mudline. 20' of casing which penetrated 3.5', first sample will be disturbed.
	WOR	7										
	WOR											
	WOR											
5	WOR	S-2	5.0 - 7.0				-Zone with trace roots and wood pieces from 5 to 7'.					
	WOR	14										Pushed an additional 5' of casing.
	WOR											
	WOR											
10	WOR	S-3	10.0 - 12.0				-Grades to trace shells and Clay from 10 to 12'.					
	WOR	13										
	WOR											
	WOR											
					13.5	OH	Very soft, dark gray, Organic CLAY (OH) with fine Sand pockets and trace shells, moist.					
15	WOR	S-4	15.0 - 17.0									Pocket Penetrometer = 0.25 tsf w = 70%, LL = 77, PL = 32
	WOR	21										
	WOR											
	WOR											
20	WOR	S-5	20.0 - 22.0				-Grades to trace Sand.					Pocket Penetrometer = 0.5 tsf Torvane = 0.2 tsf w = 64%, LL = 77, PL = 30
	WOR	18										
	WOR											
	WOR											
					23.5							
25	2	S-6	25.0 - 27.0			ML	Medium stiff, dark gray SILT (ML) with fine grained Sand pockets, moist.					Pocket Penetrometer = 0.5 tsf
	2	19										w = 40%, LL = 29, PL = 24
	2											
	5											

Water Depth in River			Depth in feet to:			Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water			
10/15/2004	1pm	-	-	-	28'	O	Open End Rod	River level approximately 42" to 48" below deck of barge.
10/18/2004	8am	67	33	35	27'	T	Thin-Wall Tube	
10/18/2004	2pm		55	73	31'	U	Undisturbed Sample	
10/20/2004	7:35am		55	76.1	27.5'	S	Split Spoon Sample	
10/20/2004	11am		0	grout	31'	G	Geoprobe	

BORING NO.: B-4

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description <small>(density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)</small>	Field Tests				Remarks		
								Dilatancy	Toughness	Plasticity	Dry Strength			
30	16	S-7	30.0 - 32.0			ML	Hard, dark gray SILT (ML) with fine Sand pockets, moist.					w = 27%, LL = 45, PL = 27 Wash water is light gray.		
	16	7												
	18													
	20													
					33.5	SW-SM	Very dense, gray and brown, well graded SAND (SW-SM) with trace Silt, wet.							
35	14	S-8	35.0 - 37.0											
	17	15												
	28													
	49													
	18	S-9	37.0 - 39.0						-Zone with trace fine grained Gravel from 37 to 39'.					
	24	10												
40	18	S-10	39.0 - 41.0									w = 14%		
	28	9												
	39													
	60													
45	20	S-11	41.0 - 42.5											
	38	12												
	100/6"													
	42	S-12	43.0 - 43.9						-Zone with silt pockets from 43 to 43.9'.					
50	100/5"	9												
	47	S-13	45.0 - 47.0											
	28	7												
	28													
55	25											w = 14%		
	70	S-14	47.0 - 48.3											
	79	11												
	100/4"													
60	100/6"	S-15	49.0 - 49.5											
		4												
	100/4"	S-16	51.0 - 51.3					SM	-Grades to Silty SAND (SM).					
	2													
100/5"	S-17	53.0 - 53.4												
65														
70														
60	100/4"	S-18	60.0 - 60.3											
		2												
65														
65	16	S-19	65.0 - 67.0			CL	Hard, green and white, Silty CLAY (CL), trace fine Sand, moist.					Pocket Penetrometer = 3-4 tsf Torvane = 0.3 tsf		
	18	20												
	18													
	20													

NOTES:

PROJECT NO.: 219187

BORING NO.: B-4

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system



TEST BORING LOG

BORING NO.:

B-5

Page 1 of 3

PROJECT: Edison Force Mains
 LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
 CLIENT: Middlesex County Utilities Authority
 DRILLING CO.: Warren George, Inc.
 DRILLER: Mike McCarthy

PROJECT NO.: 219187
 PROJECT MGR.: D Servidio
 FIELD ENG. STAFF: M. Riegel
 DATE/TIME STARTED: 10-25-04 2:00pm
 DATE/TIME FINISHED: 10-27-04 2:00pm

Elev.: 37.07 ft. Datum: NGVD 29 Boring Location: South end of alignment, within treatment plant. Coord.: N 603421.23 E 543223.19

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Mobile B-61				Hammer Type	Drilling Fluid	Casing Advance
Type	Flush jt.			<input checked="" type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety	<input type="checkbox"/> Bentonite		
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer	Type Method Depth	
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None		
Hammer Weight (lb.)		140		<input type="checkbox"/> Skid	<input type="checkbox"/>	<input type="checkbox"/> Cutting Head	Drilling Notes:			
Hammer Fall (in.)		30								

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr't/Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	P U S H	S-1 6	0.0 - 2.0			SM	Loose to medium dense, gray, black, and tan, Silty SAND (SM), moist [FILL].	N	N	N		
6	8 8 9	S-2 8	2.5 - 4.5					N	N	N		
5	3 4 5 5	S-3 7	5.0 - 7.0					S	N	L	w = 21%, Gs = 2.67	
10	2 1 1 2	S-4 18	7.5 - 9.5			ML	Very soft to very stiff, gray and tan, Clayey SILT (ML), with fine grained Sand, moist [FILL].	S		M		
10	5 6 6 8	S-5 18	10.0 - 12.0			CL	-Grades to Silty CLAY (CL).	N	M	M	Pocket Penetrometer = 1.5 tsf	
15	4 5 6 7	S-6 14	12.5 - 14.5					N	M	M	Pocket Penetrometer = 1-1.5 tsf	
15	6 6 6 6	S-7 8	15.0 - 17.0			ML	-Grades to SILT with no Sand below 15'.	S	L	L	Pocket Penetrometer = 1.0 tsf w = 31%, LL = 36, PL = 28 γd = 102.8 pcf	
20	6 8 8 12	S-8 20	17.5 - 19.5					S	L	M	Pocket Penetrometer = 1.0 tsf	
20	7 9 9 20	S-9 17	20.0 - 22.0					S	L	L	Pocket Penetrometer = 1.5 - 2 tsf	
25	26 30 34 26	S-10 22	22.5 - 24.5			SM	Medium dense to Very dense, gray and black, Silty SAND, (SM), moist [FILL].					
25	10 11 11 12	S-11 20	25.0 - 27.0				-Pockets of orange silty Clay below 25' to 27'.				Pocket Penetrometer = 2 tsf	
25	7 9 14 20	S-12 22	27.5 - 29.5			CL	Very stiff, orange, Silty CLAY (CL) with pockets of gray, fine grained Sand, moist [FILL]	S	L	M	L	Pocket Penetrometer = 2 tsf

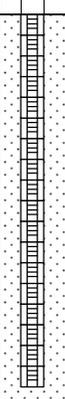
Water Level Data						Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Depth in feet to:					
			Bottom of Casing	Bottom of Hole	Water			

BORING NO.: B-5

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks			
								Dilatancy	Toughness	Plasticity	Dry Strength				
30	8	S-13	30.0 - 32.0			ML	Very stiff to hard, orange and gray, Sandy, Clayey SILT (ML), moist, [FILL].								
	11	18													
	14														
	21														
35	12	S-14A & B	32.5 - 34.5				CL	Hard, gray, Silty CLAY (CL), moist [FILL].	N	M	H		Pocket Penetrometer = 1.5 tsf		
	18	20								S	L	L			
	21														
	30														
40	16	S-15	35.0 - 37.0			40.0	ML	Hard, orange and gray, Clayey SILT (ML), trace fine Sand, moist [FILL].	S	L	N		w = 33%, LL = NP, PL = NP γ _d = 96.8 pcf Organic Content = 4.8%		
	23	24													
	38														
	40														
45	12	S-16	37.5 - 39.5			CL	Hard, gray, Silty CLAY (CL), moist, slightly organic.	N	L	M		Pocket Penetrometer = 3.5 tsf			
	15	24													
	30														
	42														
50	16	S-17	40.0 - 42.0			CL	Hard, gray, Silty CLAY (CL), moist, slightly organic.	N	L	H		Pocket Penetrometer = 2.0 tsf			
	18	24													
	24														
	30														
55	17	S-18	42.5 - 44.5			ML	-Zone with trace organics from 35 to 37'.	N	L	M		Pocket Penetrometer = 2.0 tsf			
	19	24													
	21														
	24														
60	12	S-19	45.0 - 47.0			ML	-Varved zone from 45 to 50'.	N	M	H		Pocket Penetrometer = 1.5 tsf			
	18	24													
	24														
	34														
65	14	S-20	47.5 - 49.5			CL	Hard, black gray, Silty CLAY (CL), moist, slightly organic.	N	M	H		w = 27%, LL = 39, PL = 28 γ _d = 97.1 pcf Organic Content = 3.4%			
	21	20													
	27														
	30														
70	28	S-21	50.0 - 52.0			ML	-Zone with trace fine grained Sand from 50 to 57.5'.	S	L	L		Pocket Penetrometer = 1.5 tsf			
	44	24													
	68														
	79														
75	24	S-22	52.5 - 54.5			CL	Hard, black gray, Silty CLAY (CL), moist, slightly organic.	S	L	L		Pocket Penetrometer = 3.0 - 3.5 tsf			
	46	24													
	72														
	100/3"														
80	28	S-23	55.0 - 57.0			ML	-Zone with trace shells from 60 to 62'.	R	L	N		Pocket Penetrometer = 3 - 4 tsf			
	31	24													
	33														
	37														
85	25	S-24	57.5 - 59.5			CL	Hard, black gray, Silty CLAY (CL), moist, slightly organic.	N	M	M		w = 27%, LL = 39, PL = 28 γ _d = 97.1 pcf Organic Content = 3.4%			
	37	24													
	42														
	50														
90	26	S-25	60.0 - 62.0			ML	-Zone with trace shells from 60 to 62'.	N	M	H		Pocket Penetrometer = 3.0 - 3.5 tsf			
	31	24													
	47														
	70														
95	32	S-26	62.5 - 64.0			ML	-Zone with trace shells from 60 to 62'.	N	M	H		Pocket Penetrometer = 3.0 - 3.5 tsf			
	48	17													
	100/5"														
100	21	S-27	65.0 - 66.4			ML	-Dry zone with trace fibers from 65' to 70'.	N	L	L		Pocket Penetrometer = 3.0 - 3.5 tsf			
	58	18													
	100/6"														
105	42	S-28	67.5 - 69.0			ML	-Dry zone with trace fibers from 65' to 70'.	N	L	L		Pocket Penetrometer = 3 - 4 tsf			
	63	18													
	100/6"														

NOTES:

PROJECT NO.: 219187

BORING NO.: B-5

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size

NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description <small>(density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)</small>	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
70	45	S-29	70.0 - 71.4			CL	Hard, gray, Sandy lean CLAY (CL), trace fibers, dry, slightly organic.	N	L	M	Pocket Penetrometer = 3 tsf w = 20%, LL = 28, PL = 20 Organic Content = 3.2%	
	68	17										
	100/5"											
75	51	S-30	72.5 - 73.8			ML	Hard, gray, Clayey SILT (ML), trace fibers, dry, slightly organic.	S	L	L	Pocket Penetrometer = 5+ tsf	
	72	16										
	100/4"											
80	37	S-31	75.0 - 76.5			CL	Hard, gray, Sandy lean CLAY (CL), trace fibers, dry, slightly organic.	N	L	M		
	53	18										
	100/6"											
85	25	S-32	77.5 - 79.5			CL	Hard, gray and black, Sandy lean CLAY (CL), trace fine Gravel and fibers, dry, slightly organic.	N	M	M	Pocket Penetrometer = 2.5 tsf w = 27%, LL = 48, PL = 27 Organic Content = 1.7%	
	41	24										
	53											
90	17	S-33	80.0 - 82.0				-Grades to occasional wood inclusions below 80'.	N	M	M	Pocket Penetrometer = 3.5 tsf	
	37	20										
	54											
95	25	S-34	82.5 - 84.5					N	M	M	Pocket Penetrometer = 4 tsf	
	48	24										
	66											
100	22	S-35	88.0 - 89.0				-Grades to lean CLAY with fine grained Sand, organics and fibers, dry.	N	M	M		
	100/6"	20										
110							End of Boring at 89 feet.				Boring B-5 backfilled with grout injected through a tremie tube.	
											Observation well installed in a 40-foot deep borehole located about four feet from Boring B-5. Well construction details shown on pages 1 and 2 of this log.	



TEST BORING LOG

BORING NO.:

B-6

Page 1 of 3

PROJECT: Edison Force Mains
LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
CLIENT: Middlesex County Utilities Authority
DRILLING CO.: Warren George, Inc.
DRILLER: D. Williams, M. Kelly

PROJECT NO.: 219187
PROJECT MGR.: D Servidio
FIELD ENG. STAFF: R. Ball
DATE/TIME STARTED: 3/16/05 / 10:15 am
DATE/TIME FINISHED: 3/18/05 / 12:00 pm

Elev.: 6.79 ft. **Datum:** NGVD29 **Boring Location:** North end of alignment, proposed shaft site, adjacent to the pump station. **Coord.:** N 606037.04 E 540314.32

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Mobile B-80			Hammer Type	Drilling Fluid	Casing Advance
Type	Flush jt		NX	<input checked="" type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Type Method Depth
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer	
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None *	
Hammer Weight (lb.)		140		<input type="checkbox"/> Skid		<input type="checkbox"/> Cutting Head	Drilling Notes: * Revert		
Hammer Fall (in.)		30							

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	2	S-1	0.0 - 2.0			SM	Loose to medium dense, black, fine to medium grained, Organic Silty SAND (SM), trace roots, moist [FILL].					Sand catcher used in SPT.
	2	7										
	2											
	4											
	8	S-2	2.5 - 4.5				-Grades to fine to medium grained, Silty SAND, trace fine grained Gravel.					w=16%
	11	11										
	13											
	17											Added casing, pushed with 600 lb force
5	7	S-3	5.0 - 7.0				-Grades to Silty SAND with angular gravel, wet.					Rig chatter, changed to less worn SPT cone
	9	11										
	9											
	8											
	6	S-4	7.5 - 9.5									Broken sandtrap
	5	0										No recovery in Sample S-4
	6											
	6											
10	2	S-5	10.0 - 12.0									w=27%
	3	12										
	2											
	3											
	2	S-6	12.5 - 14.5									
	3	12										
	4											
	5											
15	3	S-7A	15.0 - 17.0		15.7	OH	Soft to Medium stiff, brown and black, Organic SILT (OH), some fine grained Sand, plant material, moist.	N	L	M	L	Pocket Penetrometer = 0.5 tsf Torvane = 0.05 tsf
	4	S-7B										
	2	22										
	2											
	WOR	S-8A	17.5 - 19.5									
	1	S-8B										Added casing, 400 lb force
	3	24										w=78%,LL=125,PL=50
	3											Organic Content=7.4%
20	2	S-9A	20.0 - 22.0		20.6	SM	Medium dense, dark brown, gray, and black, fine to coarse grained SAND (SM), little Silt, trace fine to medium Gravel, wet.	N		M		
	5	S-9B										
	9	17										
	11											
	10	S-10	22.5 - 24.5				-Coarse Gravel in sample from 22.5-24.5'					Rig chatter. w=18%
	7	14										
	11											Possible Cobble
	12											
25	9	S-11A	25.0 - 27.0				-Grades to Gravelly SAND with Silt from 25 to 27'.					Rig chatter.
	14	S-11B										Gravel layer in top 4" (likely wash)
	14	14										
	12											
	10	S-12	27.5 - 29.5									Rig chatter.
	11	17										
	12											
	18											

Water Level Data				Sample Type		Instrum./Well Diagram		NOTES:												
Date	Time	Elapsed Time (hr.)	Depth in feet to:			O	T	U	S	G	Riser Pipe	Screen	Filter Sand	Cuttings	Cement Grout	Concrete	Bentonite Seal	Permeability Test	Transducer	*UCS _{avg} = Average Uniaxial Compressive Strength *PLT _{avg} = Average Point Load Test Index *Averages only include non-structural failures
			Bottom of Casing	Bottom of Hole	Water															

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
NOTE: Soil identifications based on visual-manual methods of the USCS system

BORING NO.: B-6

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30	21	S-13A	30.0 - 32.0			SM	Medium dense to Dense, red brown, gray, and brown, fine to coarse grained SAND (SM), wet.					Gravel lens
	26	S-13B					-Pocket of fine to medium grained Gravel (3" thick).					Changed drilling fluid.
	20	24										
	19											
35	14	S-14	32.5 - 34.5									
	14	12										
	12											
	12											
40	13	S-15	35.0 - 37.0									New drilling staff (Mike Kelly) Driller indicates borehole (at 25' bgs) likely caved in overnight and needs to be cleaned.
	18	11										
	15											
	15											
45	4	S-16	37.5 - 39.5									
	5	10										
	9											
	8											
50	8	S-17	40.0 - 42.0			SW-SM	Medium dense to Very dense, red brown, brown and gray, well-graded SAND (SW-SM) with Silt, trace fine grained, rounded, Gravel, wet.					w=23%
	8	14										
	10											
	14											
55	28	S-18A & B	42.5 - 44.5									
	30											
	21	17										
	9											
60	51	S-19	45.0 - 47.0									Hard drilling, possible cobble.
	15	6										
	13											
	21											
65	9	S-20A	47.5 - 49.5									Rig chatter.
	10	S-20B					-Zone with pockets of red, medium grained SAND from 49 to 49.5'.					
	13	13										
	15											
70	19	S-21A	50.0 - 52.0									No fluid return. Top 7" fine to coarse Gravel (wash)
	11	S-21B										
	10	14										
	11											
75	9	S-22	52.5 - 54.5									Top 5" - Gravel (Wash)
	12	12										
	13											
	11											
80	27	S-23	55.0 - 57.0				-Zone of red Silty SAND (SM) from 55 to 56'.					Rig chatter, bottom 6" hard drilling. Tapped SPT in 4".
	12	17										
	13											
	30											
85	23	S-24A	57.5 - 59.5				-Grades to well-graded SAND (SW).					Heavy rig chatter.
	32	S-24B										
	21	12										
	24											
90	7	S-25A	60.0 - 62.0		60.5	ML	Hard, white with black specks, Clayey SILT (ML), trace fine grained Sand, moist.	N	L	M	M	Pocket Penetrometer = 2.5 tsf Tovane = 0.8 tsf w=36%, LL=43, PL=29 Added 3" casing to 61'. Inside 4" casing at 20'. Change drilling bit. No recovery in sample S-26
	12	S-25B										
	15	22										
	19											
95	37	S-26	62.5 - 64.5									
	14	0										
	16											
	27											
100	18	S-27A	65.0 - 67.0									
	20	S-27B										
	22	17										
	24											
105	14	S-28A	67.5 - 69.5				-Grades to fine to medium grained, Sandy, Clayey SILT from 67.5 to 69.5'.	N	L	H	H	Pocket Penetrometer = 3.25 tsf Tovane = 0.8 tsf Last 2" of SPT very hard. Last 3 runs difficult to pull-back Casing now at full depth to rock.
	14	S-28B										
	20	24										
	100/5											
70							Started coring at 69.5 feet.					

NOTES:

PROJECT NO.: 219187

BORING NO.: B-6

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description <small>(density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)</small>	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
70		C-1	69.5 - 74.5				DIABASE: dark gray, fine grained, slightly weathered to fresh, very hard					Begin rock coring with NX size diamond bit sireline coring equipment. Water with revert used as drilling fluid. RQD = 95.8% Rec = 95.8% UCS _{avg} =51809 psi
75		C-2	74.5 - 79.5									RQD = 85.8% Rec = 95% UCS _{avg} =43638 psi, PLT _{avg} =38400 psi
80		C-3	79.5 - 84.5									RQD = 98.8% Rec = 98.8%
85							End of Boring at 84.5 feet.					Boring backfilled with grout injected through a tremie tube to 45'.
90												
95												
100												
105												
110												



TEST BORING LOG

BORING NO.:

B-7

Page 1 of 2

PROJECT: Edison Force Mains
 LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
 CLIENT: Middlesex County Utilities Authority
 DRILLING CO.: Warren George, Inc.
 DRILLER: Mike McCarthy

PROJECT NO.: 219187
 PROJECT MGR.: D Servidio
 FIELD ENG. STAFF: M. Riegel/R. Ball
 DATE/TIME STARTED: 3/9/05 / 10:00 am
 DATE/TIME FINISHED: 3/10/05 / 12:00 pm

Elev.: -2.7 ft. Datum: NGVD 29 Boring Location: South Channel of the Raritan River. Coord.: N 605221.40 E 541362.60

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Failing 1500		Hammer Type	Drilling Fluid	State Plane	
Type	Flush jt		NX	<input checked="" type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input checked="" type="checkbox"/> Bentonite	Casing Advance	
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input type="checkbox"/> Polymer	Type Method Depth	
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> None		
Hammer Weight (lb.)		140		<input type="checkbox"/> Skid	<input checked="" type="checkbox"/> Barge	<input type="checkbox"/> Cutting Head	Drilling Notes:		
Hammer Fall (in.)		30							

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests			Remarks
								Dilatancy	Toughness	Plasticity	
0	WOR	S-1	0.0 - 2.0			OH	Very soft, brown, black and dark gray, Organic SILT (OH), trace fine grained Sand and roots, wet.				Pushed 10' of casing.
	WOR	24									
	WOR										
	WOR										
5	WOR	S-2	2.5 - 4.5								
	WOR	7									
	WOR										
	WOR										
10	WOR	S-3	5.0 - 7.0								
	WOR	15									
	WOR										
	WOR										
15	WOR	S-4	7.5 - 9.5								w=58%, Organic Content=3.3%
	WOR	15									
	WOR										
	WOR										
20	WOR	S-5	10.0 - 12.0								
	WOR	24									
	WOR										
	WOR										
25	WOR	S-6	12.5 - 14.5								
	WOR	20									
	WOR										
	WOR										
30	WOR	S-7	15.0 - 17.0				-Zone with trace fine grained Gravel from 15 to 17'.				
	WOR	15									
	WOR										
	WOR										
35	WOR	S-8	17.5 - 19.5				-Zone with trace shells from 17.5 to 24.5'.				Driller removed casing, placed shoe and pushed to 15' below grade. w=58%, Organic Content=3.2%
	WOR	13									
	WOR										
	WOR										
40	WOR	S-9	20.0 - 22.0								
	WOR	19									
	WOR										
	WOR										
45	WOR	S-10	22.5 - 24.5								
	WOR	20									
	WOR										
	WOR										
50	WOR	S-11	25.0 - 27.0								
	WOR	24									
	WOR										
	WOR										
55	WOR	S-12	27.5 - 29.5								
	WOR	24									
	WOR										
	WOR										

Water Level Data				Sample Type			Instrum./Well Diagram		NOTES:			
Date	Time	Elapsed Time (hr.)	Depth in feet to:			O	T	U	S	G	<input type="checkbox"/> Riser Pipe <input type="checkbox"/> Screen <input type="checkbox"/> Filter Sand <input type="checkbox"/> Cuttings <input type="checkbox"/> Cement Grout <input type="checkbox"/> Concrete <input type="checkbox"/> Bentonite Seal <input type="checkbox"/> Permeability Test <input type="checkbox"/> Transducer	3/10/05 at 7:00am, water depth = 6.0', 6.5' from deck to water surface, water at elevation 3.3, NGVD29. *UCS _{avg} = Average Uniaxial Compressive Strength *PLT _{avg} = Average Point Load Test Index *Averages only include non-structural failures
			Bottom of Casing	Bottom of Hole	Water							

BORING NO.: B-7

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks			
								Dilatancy	Toughness	Plasticity	Dry Strength				
30	WOR	S-13	30.0 - 32.0			OH	Very soft, gray Organic SILT (OH), trace fine grained Sand, wet.								
	WOR	24													
	WOR														
	WOR														
	WOR	S-14	32.5 - 34.5												
	WOR	24													
	WOR														
	WOR														
35	WOR	S-15	35.0 - 37.0									Driller pushed casing to 25'. w=84%,LL=100,PL=45 Organic Content=6.1%			
	WOR	24													
	WOR														
	WOR														
	WOR	S-16	37.5 - 39.5												
	WOR	15													
	WOR														
	WOR														
40	P	UD-1	40.0 - 42.0				-Grades to with shell fragments.					w=64%,LL=82,PL=37,Gs=2.64 Organic Content=6.2% S _v = 323 psf, γ _d = 58.0 pcf			
	U	22													
	S														
	H														
	WOR	S-17	42.5 - 44.5												
	WOR	15													
	WOR														
	WOR														
45	WOR	S-18A	45.0 - 47.0		45.0	SM	-Zone of fine grained Silty SAND (SM) from 45 to 47.5'								
	WOR	S-18B													
	WOR	8													
	WOR														
	WOR	S-19	47.5 - 49.5		47.5			OH	-Grades to fine to medium grained Sandy, Organic SILT, trace fine grained gravel.			L	L	w=59%	
	WOR	8													
	WOR														
	WOR														
50	18	S-20	50.0 - 52.0		50.0	SM	Medium dense, dark brown, fine grained SAND (SM), wet. -Pockets of white, grey and green Clay and Silt.								
	12	12													
	12														
	12														
	15	S-21	52.5 - 54.5		52.2			ML	Hard, white, gray, and green, fine to medium grained, Sandy, Clayey SILT (ML), trace fine grained Gravel, moist.			M	M	w=22%,LL=33,PL=25	
	25	13													
	30														
	50/5														
55	100/2	S-22	54.5 - 54.7		55.5		DIABASE: dark gray, white and green crystals, fine to coarse grained, fresh, very hard.					Pocket Penetrometer = 1 tsf Begin rock coring with NX size diamond bit sireline coring equipment. Water with revert used as drilling fluid. Rec = 93.3% RQD = 78.3% UCS _{avg} = 29914 psi			
		2													
		C-1	55.7-60.7												
		56													
60							End of boring at 60.7 feet below channel bottom.					Boring backfilled with grout injected through a tremie tube.			
65															
70															



TEST BORING LOG

BORING NO.:

B-8

Page 1 of 2

PROJECT: Edison Force Mains
LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
CLIENT: Middlesex County Utilities Authority
DRILLING CO.: Warren George, Inc.
DRILLER: Mike McCarthy

PROJECT NO.: 219187
PROJECT MGR.: D Servidio
FIELD ENG. STAFF: R. Ball/B. Starcher
DATE/TIME STARTED: 3/14/05 / 11:45 am
DATE/TIME FINISHED: 3/15/05 / 2:30 pm

Elev.: -3.4 ft. **Datum:** NGVD 29 **Boring Location:** South Channel of the Raritan River. **Coord.:** N 604427.80 E 542055.00

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Failing 1500				Hammer Type	Drilling Fluid	State Plane	
Type	Flush jt		NX	<input checked="" type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Casing Advance		
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer	Type Method Depth		
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None			
Hammer Weight (lb.)		140		<input type="checkbox"/> Skid		<input type="checkbox"/> Cutting Head	Drilling Notes:				
Hammer Fall (in.)		30									

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests			Remarks
								Dilatancy	Toughness	Plasticity	
0	WOR	S-1	0.0 - 2.0			OH	Very soft, gray dark gray and black, Organic SILT (OH) with Clay, moist.				
	WOR	24									Pushed casing.
	WOR										
	WOR										
5	WOR	S-2	2.5 - 4.5				-Soil profile becomes wet.				
	WOR	24									
	WOR										
	WOR										
10	WOR	S-3	5.0 - 7.0				-Zone of Organic SILT with shells from 5 to 12'.				
	WOR	24									Pushed casing. w=63%, Organic Content=4.9%
	WOR										
	WOR										
15	WOR	S-4	7.5 - 9.5								
	WOR	8									
	WOR										
	WOR										
20	WOR	S-5	10.0 - 12.0								
	WOR	3									
	WOR										
	WOR										
25	0	S-6	12.5 - 14.5				-Shells grade to coarse from 12.5 to 14.5'.				
	1	6									
	2										
	0										
15	WOR	S-7	15.0 - 17.0				-Pockets of shell fragments from 15 to 20'.	L		N	
	WOR	18									
	WOR										
	WOR										
20	WOR	S-8	17.5 - 19.5					L		N	H
	WOR	24									
	WOR										
	WOR										
25	WOR	S-9	20.0 - 22.0								
	WOR	10									
	WOR										
	WOR										
25	WOR	S-10	22.5 - 24.5				-Grades to Clayey, Organic SILT, trace shells.				
	WOR	24									
	WOR										
	WOR										
25	WOR	S-11	25.0 - 27.0					L		N	Pushed casing.
	WOR	13									
	WOR										
	WOR										
25	WOR	S-12	27.5 - 29.5				-Zone of trace well-graded Sand and fine gravel Gravel from 27.5 to 29.5'				w=87%
	WOR	11									
	WOR										
	WOR										

Water Level Data			Depth in feet to:			Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water			
						O Open End Rod	Riser Pipe	3/14/05 at 11:00 am, water depth = 6.0'
						T Thin-Wall Tube	Screen	6.3' from deck to water surface, water at elevation 2.6', NGVD 29
						U Undisturbed Sample	Filter Sand	*UCS _{avg} = Average Uniaxial Compressive Strength
						S Split Spoon Sample	Cuttings	*PLT _{avg} = Average Point Load Test Index
						G Geoprobe	Cement Grout	*Averages only include non-structural failures
							Concrete	
							Bentonite Seal	
							Permeability Test	
							Transducer	

BORING NO.: B-8

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
NOTE: Soil identifications based on visual-manual methods of the USCS system

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30	WOR	S-13	30.0 - 32.0			OH	Very soft over stiff, gray, Clayey, Organic SILT (OH), trace shells, moist.	L		M		
	WOR	24										
	WOR											
	WOR											
	WOR	S-14	32.5 - 34.5									
	WOR	20										
35	WOR	S-15	35.0 - 37.0									
	WOR	17										
	WOR											
	WOR											
	WOR	S-16	37.5 - 39.5									
	WOR	7										
40	WOR	S-17	40.0 - 42.0				-Grades to Organic CLAY.				w=71%,LL=112,PL=44, γ_d =53.1pcf Organic Content=5.0%	
	WOR	7										
	WOR											
	WOR											
	WOR	S-18	42.5 - 44.5									
	WOR	3										
45	4	S-19	45.0 - 47.0								Rig chatter at 47'.	
	4	24										
	5											
	7											
	12	S-20	47.5 - 49.5	48.0								
	14	10										
50	14	S-21	50.0 - 52.0								w=13%	
	14	8										
	9											
	13											
	11	S-22	52.5 - 54.5									
	18	6										
55	86	S-23	55.0 - 57.0		55.5	CH	Hard, gray, white, and black, Silty CLAY (CH), some fine to coarse Sand, little fine Gravel.				Pocket Penetrometer = 4 tsf	
	37											
	100/5											
	20	S-24	57.5 - 59.5									
	54											
	32											
60					60.5		DIABASE: Dark green to gray, white and green grains, medium grained, fresh, hard.				No recovery in S-24 - WASH Heavy chatter at 59.75'. Cleaned drilling fluid. Advanced casing to 60.5'.	
		C-1	60.5-65.5									
		56										
65							End of boring at 65.5 feet below channel.				Boring backfilled with grout injected through a tremie tube.	
70												

NOTES:

PROJECT NO.: 219187

BORING NO.: B-8

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system



TEST BORING LOG

BORING NO.:

B-9

Page 1 of 2

PROJECT: Edison Force Mains
 LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
 CLIENT: Middlesex County Utilities Authority
 DRILLING CO.: Warren George, Inc.
 DRILLER: Mike Kelly

PROJECT NO.: 219187
 PROJECT MGR.: D Servidio
 FIELD ENG. STAFF: S. Taranto
 DATE/TIME STARTED: 3/30/05 / 12:30 pm
 DATE/TIME FINISHED: 3/31/2005 / 2:30 pm

Elev.: 18.63 ft. Datum: NGVD 29 Boring Location: Just south of RR at the southern shore of the Raritan River Coord.: N 603560.08 E 543070.35

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Mobile B-61				Hammer Type	Drilling Fluid	Casing Advance
Type	Flush jt		NX	<input checked="" type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Type Method Depth	
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer		
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None		
Hammer Weight (lb.)		140		<input type="checkbox"/> Skid		<input type="checkbox"/> Cutting Head	Drilling Notes:			
Hammer Fall (in.)		30								

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	10	S-1	0.0 - 2.0			SP-SM	Medium dense, orange brown, fine grained SAND (SP-SM) with Silt and fine grained Gravel, moist [FILL].					
	14	17			2.5	SM	Medium dense to dense, orange brown, fine grained Silty SAND (SM), trace Clay, moist [FILL]. -Pockets of Clay.					
5	2	S-3	5.0 - 7.0		5.0	ML	Medium stiff, tan and gray, Clayey SILT (ML), trace fine grained Sand, moist [FILL]					w=22%, G _c =2.03 Pushed casing.
	3	17										
	2											
	3											
	1	S-4	7.5 - 9.5				-Zone with trace organics from 7.5 to 8.5'. -Grades to Sandy SILT (ML) with Clay, trace fine grained Gravel.					
	2	21										
	6											
	9											
10	3	S-5	10.0 - 12.0		10.1	ML	Stiff to hard, gray, Clayey SILT (ML), trace fine Sand, moist. -Thin layers of orange brown, Silty Sand [FILL].					
	6	21										
	11											
	14											
	7	S-6	12.5 - 14.5				-Grades to SILT with Sand.					w=26%, LL=32, PL=23
	11	19										
	19											
	14											
15	5	S-7A	15.0 - 17.0									
	6	S-7B										
	13	24										
	13						-Zone of Clayey SILT, trace fine grained Sand from 15 to 17.					
	10	S-8	17.5 - 19.5									
	9	24										
	12											
	10											
20	7	S-9	20.0 - 22.0									
	9	23										
	13											
	13											
	7	S-10A	22.5 - 24.5		23.0	CL	Very stiff to Hard, gray and dark gray, Silty CLAY (CL), trace fine grained Sand, moist.					
	15	S-10B										
	30	17										
	24											
25	9	S-11	25.0 - 27.0									w=24%, Organic Content=4.9%
	12	24										
	17											
	24											
	10	S-12A	27.5 - 29.5									
	17	S-12B										
	26	23										
	25											

Water Level Data			Depth in feet to:			Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water			
						O Open End Rod	<input type="checkbox"/> Riser Pipe	BORING NO.: B-9
						T Thin-Wall Tube	<input type="checkbox"/> Screen	
						U Undisturbed Sample	<input type="checkbox"/> Filter Sand	
						S Split Spoon Sample	<input type="checkbox"/> Cuttings	
						G Geoprobe	<input type="checkbox"/> Cement Grout	
							<input type="checkbox"/> Concrete	
							<input type="checkbox"/> Bentonite Seal	
							<input type="checkbox"/> Permeability Test	
							<input type="checkbox"/> Transducer	

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks	
								Dilatancy	Toughness	Plasticity	Dry Strength		
30	11	S-13A	30.0 - 32.0			CL	Very stiff, gray, Silty CLAY (CL), moist.						
	11	S-13B											
	22	24			31.0	ML	Hard, gray, Sandy SILT (ML) with Clay, moist.						
	23												
	25	S-14A	32.5 - 34.5				SM	Very dense, gray, fine to medium grained Silty SAND (SM), wet.					
	50	S-14B				33.5							
40	S-14C												
34	21												
35	15	S-15	35.0 - 37.0										
	28	21											
	28												
	34												
	20	S-16	37.5 - 39.5				SM	-Thin pockets of Clayey SAND, trace organics from 37.5 to 39.5'.					
	27	22											
24													
27													
40	10	S-17A	40.0 - 42.0			ML	-Grades to poorly graded SAND (SP), trace Silt, wet. Hard, gray, Clayey SILT (ML), trace fine Sand, moist.						
	20	S-17B											
	27	24											
	30												
	7	S-18	42.5 - 44.5										
	20	24										w=29%,LL=45,PL=29	
21													
37													
45	16	S-19	45.0 - 47.0			CL	Hard, dark gray, Silty CLAY (CL), trace fine grained Sand, moist.						
	22	24											
	36												
	49												
	35	S-20	47.5 - 49.5										
	37	24											
43													
50													
50		UD-1	50.0 - 52.0				-Grades to trace well-graded Sand.					Shelby Tube w=17%,LL=35,PL=22, γ _d =117.3 pcf, Organic Content=5.6%,S _u =3929psf Gs = 2.77	
55	20	S-21A	55.0 - 57.0										
	32	S-21B											
	40	24											
	45												
	37	S-22A	57.5 - 59.5				SM	-Zone of Clayey SILT (ML) with fine grained Sand from 56 to 57'.					
	42	S-22B											
43	21												
53													
60	29	S-23	60.0 - 62.0										
	43	24											
	50												
	69												
	30	S-24	62.5 - 64.5									w=26%,Organic Content=4.6%	
	30	24											
44													
44													
65	20	S-25	65.0 - 67.0			OH	Hard, dark brown gray, Organic CLAY (OH), moist.						
	29	24											
	33												
	51												
	33	S-26	67.5 - 69.5										
	43	24											
50													
87													
70							End of boring at 69.5 feet.					Boring backfilled with grout injected through a tremie tube.	

NOTES:
PROJECT NO.: 219187

BORING NO.: B-9

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system



TEST BORING LOG

BORING NO.:

B-10

Page 1 of 2

PROJECT: Edison Force Mains
 LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
 CLIENT: Middlesex County Utilities Authority
 DRILLING CO.: Warren George, Inc.
 DRILLER: Robert Ware

PROJECT NO.: 219187
 PROJECT MGR.: D Servidio
 FIELD ENG. STAFF: M. Riegel
 DATE/TIME STARTED: 5/2/05 / 8:00 am
 DATE/TIME FINISHED: 5/2/05 / 2:00 pm

Elev.: -2.5 ft. Datum: NGVD 29 Boring Location: South Channel of the Raritan River Coord.: N 605122.97 E 541273.41

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Dietrich D-50				Hammer Type	Drilling Fluid	State Plane
Type	Flush jt		NX	<input type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input checked="" type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Casing Advance	
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer		Type Method Depth
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None		
Hammer Weight (lb.)		140		<input checked="" type="checkbox"/> Skid	<input checked="" type="checkbox"/> Barge	<input type="checkbox"/> Cutting Head	Drilling Notes:			
Hammer Fall (in.)		30								

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0												No sampling, drove casing to bedrock.
5												
10												
15												
20												
25												

Water Level Data			Depth in feet to:			Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water			
						O Open End Rod T Thin-Wall Tube U Undisturbed Sample S Split Spoon Sample G Geoprobe	<input type="checkbox"/> Riser Pipe <input type="checkbox"/> Screen <input checked="" type="checkbox"/> Filter Sand <input checked="" type="checkbox"/> Cuttings <input type="checkbox"/> Cement Grout <input type="checkbox"/> Concrete <input type="checkbox"/> Bentonite Seal <input type="checkbox"/> Permeability Test <input checked="" type="checkbox"/> Transducer	*UCS _{avg} = Average Uniaxial Compressive Strength *PLT _{avg} = Average Point Load Test Index *Averages only include non-structural failures

BORING NO.: B-10

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description <small>(density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)</small>	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30												No sampling, drove casing to bedrock.
35												
40												
45												
50					52.0							
55		C-1 45	52.0-57.0				DIABASE: dark gray, white and green crystals, fine to coarse grained, fresh, very hard.					Begin rock coring with NX size diamond bit sireline coring equipment. Water with revert used as drilling fluid. Rec = 75% ROD = 75% UCS _{avg} = 45930 psi, PLT _{avg} = 27144 psi
60							End of boring at 57.0 feet.					Boring backfilled with grout injected through a tremie tube.
65												
70												

NOTES:
PROJECT NO.: 219187

BORING NO.: B-10

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
NOTE: Soil identifications based on visual-manual methods of the USCS system



TEST BORING LOG

BORING NO.:

B-11

Page 1 of 2

PROJECT: Edison Force Mains
 LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
 CLIENT: Middlesex County Utilities Authority
 DRILLING CO.: Warren George, Inc.
 DRILLER: Robert Ware

PROJECT NO.: 219187
 PROJECT MGR.: D Servidio
 FIELD ENG. STAFF: M. Riegel
 DATE/TIME STARTED: 5/4/05 / 9:00 am
 DATE/TIME FINISHED: 5/2/05 / 2:00 pm

Elev.: -3.2 ft. Datum: NGVD 29 Boring Location: South Channel of the Raritan River Coord.: N 604980.16 E 541422.17

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Dietrich D-50		Hammer Type	Drilling Fluid	State Plane	
Type	Flush jt		NX	<input type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input checked="" type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Casing Advance
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer	Type Method Depth
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None	
Hammer Weight (lb.)		140		<input checked="" type="checkbox"/> Skid	<input checked="" type="checkbox"/> Barge	<input type="checkbox"/> Cutting Head	Drilling Notes:		
Hammer Fall (in.)		30							

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests			Remarks	
								Dilatancy	Toughness	Dry Strength		
0											No sampling, drove casing to 27.5'	
5												
10												
15												
20												
25												
	WOR	S-1	27.5 - 29.5			OH	Very soft, dark gray, Organic SILT (OH), trace fine grained Sand and shells, wet.					Began drilling and sampling at 27.5' below mudline. γ _a =53.9 pcf, w=74%
	WOR	18										
	WOR											
	WOR											

Water Level Data			Depth in feet to:			Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Bottom of Casing	Bottom of Hole	Water			
						O Open End Rod	Riser Pipe	*UCS _{avg} = Average Uniaxial Compressive Strength
						T Thin-Wall Tube	Screen	*PLT _{avg} = Average Point Load Test Index
						U Undisturbed Sample	Filter Sand	*Averages only include non-structural failures
						S Split Spoon Sample	Cuttings	
						G Geoprobe	Cement Grout	
							Concrete	
							Bentonite Seal	
							Permeability Test	
							Transducer	

BORING NO.: B-11

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr't/Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks			
								Dilatancy	Toughness	Plasticity	Dry Strength				
30	WOR	S-2	30.0 - 32.0			OH	Very soft, dark gray, Organic SILT (OH), trace fine grained Sand and shells, wet.								
	WOR	24													
	WOR														
	WOR														
	WOR														
	WOR														
35	WOR	S-3	32.5 - 34.5												
	WOR	24													
	WOR														
	WOR														
	WOR														
	WOR														
40	WOR	S-4	35.0 - 37.0												
	WOR	24													
	WOR														
	WOR														
	WOR														
	WOR														
45	P	UD-1	39.0 - 41.0									w=74%, LL=100, PL=43 γ _s =54.5 pcf, S _u =187 psf Pocket Penetrometer= 0.25 tsf			
	U	22													
	S														
	H														
	WOR	S-6	41.0 - 43.0						-Zone with no shells from 41 to 43'.						
	WOR	20													
50	WOR	S-7	43.0 - 45.0												
	WOR														
	WOR														
	WOR														
	WOR														
	WOR														
55	2	S-8	45.0 - 47.0				-Grades to Sandy, Organic SILT (OH), trace Peat and Gravel, wet.					w=139%, LL=196, PL=83 Organic Content=41.8%			
	2	20						47.0							
	4														
	3														
	1	S-9	47.0 - 48.5					SM	Very loose, gray, fine grained Silty SAND (SM), wet.						w=32%
	1	12							48.5						Driller pushed casing to 48.5.
60		C-1	48.5 - 53.5				DIABASE: dark gray, white and green crystals, fine to coarse grained, fresh, very hard.					Begin rock coring with NX size diamond bit sireline coring equipment. Water with revert used as drilling fluid. Rec = 87% ROD = 87% PLT=28344 psi			
		52													
65							End of boring at 53.5 feet.					Boring backfilled with grout injected through a tremie tube.			
70															



TEST BORING LOG

BORING NO.:

B-12

Page 1 of 2

PROJECT: Edison Force Mains
 LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
 CLIENT: Middlesex County Utilities Authority
 DRILLING CO.: Warren George, Inc.
 DRILLER: Robert Ware

PROJECT NO.: 219187
 PROJECT MGR.: D Servidio
 FIELD ENG. STAFF: M. Riegel
 DATE/TIME STARTED: 5/5/05 / 10:00 am
 DATE/TIME FINISHED: 5/6/05 / 11:00 am

Elev.: -5.9 ft. Datum: NGVD 29 Boring Location: North Channel of the Raritan River Coord.: N 605387.42 E 540979.71

Item	Casing	Sampler	Core Barrel	Rig Make & Model: Dietrich D-50		Hammer Type	Drilling Fluid	Casing Advance
Type	Flush jt		NX	<input type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Bentonite	Type Method Depth
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Polymer	
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> None	
Hammer Weight (lb.)		140		<input checked="" type="checkbox"/> Skid	<input checked="" type="checkbox"/> Barge	<input type="checkbox"/> Cutting Head	Drilling Notes:	
Hammer Fall (in.)		30						

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks								
								Dilatancy	Toughness	Plasticity	Dry Strength									
0																			No sampling, drove casing to 25' below	
5																				
10																				
15																				
20																				
25	WOR	S-1	25.0 - 27.0			OH	Very soft, dark grey, Organic Silty CLAY (OH), trace shells, wet.													Began drilling and sampling 25' below mudline.
	WOR	17																		
	WOR																			
	WOR																			
	WOR	S-2	27.0 - 29.0																	
	WOR	18																		
	WOR																			
	WOR																			

Water Level Data				Sample Type			Instrum./Well Diagram		NOTES:					
Date	Time	Elapsed Time (hr.)	Depth in feet to:			O	T	U	S	G	<input type="checkbox"/> Riser Pipe <input type="checkbox"/> Screen <input checked="" type="checkbox"/> Filter Sand <input checked="" type="checkbox"/> Cuttings <input type="checkbox"/> Cement Grout <input checked="" type="checkbox"/> Concrete <input checked="" type="checkbox"/> Bentonite Seal <input checked="" type="checkbox"/> Permeability Test <input checked="" type="checkbox"/> Transducer	*UCS _{avg} = Average Uniaxial Compressive Strength *PLT _{avg} = Average Point Load Test Index *Averages only include non-structural failures		
			Bottom of Casing	Bottom of Hole	Water									
												BORING NO.: B-12		

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30	P	UD-1	30.0 - 32.0			OH	Very soft to Soft, dark grey Organic Silty CLAY (OH), trace shells, wet.					w=73%,LL=84,PL=31
	U	24						$\gamma_d=55.2$ pcf, $S_u=137$ psf				
	S							Pocket Penetrometer= 0.28 tsf				
	H											
	WOR	S-3	32.0 - 34.0									
	WOR	20										
	WOR											
	WOR											
	WOR	S-4	34.0 - 36.0					-Zone with trace Peat from 34 to 36'.				
	WOR	14										
35	WOR											
	WOR											
	WOR	S-5	36.0 - 38.0									
	WOR	24										
	1											
	2											
40	2	S-6A & B	38.0 - 40.0				Dark brown, little Peat and shells, from 38-40'					w=333%,LL=435,PL=258 Organic Content=43.5%
	2	20										
	2											
	2											
45	P	UD-2	40.0 - 41.5				-Grades to fine to medium grained, Sandy, Organic SILT.					w=52%, $\gamma_d=73.4$ pcf
	U	12										Bottom of tube contains fine to medium alluvial gravel.
	SH											
	10	S-7	42.0 - 43.5		41.5	SM	Very dense grey fine to coarse grained Silty SAND (SM), some fine to medium Gravel, wet.					w=12%
	72*	14										*Higher blowcounts due to gravel
	100/6											
50	5	S-8	43.5 - 45.5				Very stiff to Hard, gray, Silty CLAY (CL), trace fine Sand and Gravel, moist.					
	9	18										
	14											
	22						-Grades to fine grained, Sandy, Silty CLAY					
	14	S-9	45.5 - 47.5									w=20%,LL=33,PL=17
	15	20										
	36											
	31											
10	S-10	47.5 - 49.5										w=24%, $\gamma_d=108.6$ pcf $G_s=2.92$
39	14											
32												
37												
55					55.0							
		C-1	55.0 - 60.0				DIABASE: dark gray, white and green crystals, fine to coarse grained, fresh, very hard.					Begin rock coring with NX size diamond bit sireline coring equipment. Water with revert used as drilling fluid. Rec = 93% RQD = 73% $UCS_{avg}=42461$ psi, $PLT_{avg}=31200$ psi
60						End of boring at 60.0 feet.					Boring backfilled with grout injected through a tremie tube.	
65												
70												

PROJECT:	Edison Pump Station Force Main Expansion	PROJECT NO.:	218967
LOCATION:	Borough of Sayreville And Township of Edison, Middlesex County, NJ	PROJECT MGR.:	P. Kocsik
CLIENT:	Middlesex County Utility Authority	FIELD ENG. STAFF:	S. Taranto
DRILLING CO.:	Warren George, Inc.	DATE/TIME STARTED:	3/25/05 / 10:20 am
DRILLER:	Mike Kelly	DATE/TIME FINISHED:	3/28/05 / 7:20 am

Elev.:	7.42 ft.	Datum:	NGVD 29	Boring Location:	Pump station.	Coord.:	N 605986.43 E 540274.56	
Item	Casing	Sampler	Core Barrel	Rig Make & Model:	B-80	Hammer Type	Drilling Fluid	Casing Advance
Type	Flush jt		NX					
Length (ft)		2		<input checked="" type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Bentonite	Type Method Depth
Inside Diameter (in.)	4.25			<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Polymer	
Hammer Weight (lb.)		140		<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> None	
Hammer Fall (in.)		30		<input type="checkbox"/> Skid	<input type="checkbox"/>	<input type="checkbox"/> Cutting Head		

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr./Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	16	S-1	0.0 - 2.0			SP	Medium dens brown, fine to medium grained SAND (SP), trace clayey Silt, trace fine Gravel.					
	17	19										
	12											
	15	S-2	2.0 - 4.0				Dense orange brown, medium grained SAND (SP), trace clayey Silt, moist.					
	14	11										
	20											
	12											
	7	S-3	4.0 - 6.0				Medium dense orange brown, medium grained SAND (SP), trace Silt.					Two samples (A & B) taken.
5	11	11										
	17											
	18											
	30	S-4A	6.0 - 8.0				Top 9" - Same, dense.					
	24	S-4B					Bottom 9" - Dense orange, coarse grained SAND (SP), trace Silt, moist.					
	23	18										
	24											
	8	S-5	8.0 - 10.0				Top 5" - Medium dense, Same, wet.					
	10	10					Medium dense tan, fine grained SAND (SP), trace Silt, wet.					
	8											
	5											
10	3	S-6	10.0 - 12.0			SW-SM	Loose tan fine to medium grained SAND (SW-SM), trace Silt, wet, coarse Gravel stuck on tip.					w = 12%
	3	9										
	7											
	8											
	4	S-7	12.0 - 14.0									
	1	8										
	2											
	3											
	4	S-8	14.0 - 16.0									
15	5	6										
	6											
	4											
	4	S-9	16.0 - 18.0		16.4		Top 5" - Very loose tan, fine grained SAND, trace Silt, wet.					
	1	21				OL	Very soft dark gray brown, Silty CLAY (OL), trace fine Sand, [Organic].					organic odor present w = 88%, LL = 66, PL = 36 Organic Content = 10.4%
	1											
	3											
	4	S-10A	18.0 - 20.0				-Grades to loose					
	3	S-10B										
	2	24										
	5				20.0							
20	2	S-11	20.0 - 22.0			SW-SM	Medium dense dark gray, fine to medium grained SAND (SW-SM) trace Silt, trace fine Gravel, wet.					
	5	16										
	8											
	8											
25	10	S-12	25.0 - 27.0			SW	Brown, fine to medium SAND (SW), trace Silt, trace fine Gravel, wet.					w = 19%
	16											
	15											
	14											

Water Level Data					Sample Type		Instrum./Well Diagram		NOTES:						
Date	Time	Elapsed Time (hr.)	Depth in feet to:			O	T	U		S	G				
			Bottom of Casing	Bottom of Hole	Water	O	Open End Rod	T	Thin-Wall Tube	U	Undisturbed Sample	S	Split Spoon Sample	G	Geoprobe

Field Test Legend:	Dilatancy: N - None S - Slow R - Rapid	Plasticity: NP - Non-Plastic L - Low M - Medium H - High
	Toughness: L - Low M - Medium H - High	Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system

BORING NO.: B-13

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30	20	S-13	30.0 - 32.0			SP-SM	Dense olive brown, fine to medium grained SAND (SP-SM), trace fine to coarse grained Gravel, trace Silt, wet. Thin gravelly Sand layers throughout.					w = 17%
	26	12										
	16											
	16											
35	11	S-14	35.0 - 37.0				-Grades to medium dense, some medium Gravel, with gravelly Sand layers, wet.					
	11	18										
	12											
	11											
40	11	S-15	40.0 - 42.0									w = 22%
	10	14										
	14											
	15											
45	20	S-16	45.0 - 47.0				-Grades to very dense.					Drill chattering Lost drill bit in hole.
	26	16										
	30											
	12											
50	21	S-17	50.0 - 52.0			SW	Dense olive brown, medium to coarse grained SAND (SW), some fine to medium grained Gravel, trace Silt, wet.					Drill chattering
	19	14										
	13											
	13											
55	50	S-18	55.0 - 57.0				-Grades to very dense.					
	62	17										
	43											
	35											
60	32	S-19	60.0 - 62.0			SP	Top 6" - Medium dense brown, fine grained SAND (SP), little coarse grained gray Gravel, wet.					End of boring at 62.0 feet.
	14	18		CL	Bottom 12" - Very stiff light gray with dark gray speckling, Silty CLAY (CL), little fine grained Sand, moist.							
	16											
	18											
65												
70												

NOTES:

PROJECT NO.: 218967

BORING NO.: B-13

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system



TEST BORING LOG

BORING NO.:

B-14

Page 1 of 2

PROJECT: Edison Pump Station Force Main Expansion	PROJECT NO.: 218967
LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ	PROJECT MGR.: P. Kocsik
CLIENT: Middlesex County Utility Authority	FIELD ENG. STAFF: S. Taranto
DRILLING CO.: Warren George, Inc.	DATE/TIME STARTED: 3/24/05 / 11:30 am
DRILLER: Mike Kelly	DATE/TIME FINISHED: 3/25/05 / 8:00 am

Elev.: 8.04 ft	Datum: NGVD 29	Boring Location: Pump station.	Coord.: N 605960.29 E 540182.40
Item	Casing	Sampler	Core Barrel
Type	Flush jt		NX
Length (ft)		2	
Inside Diameter (in.)	4.25		
Hammer Weight (lb.)		140	
Hammer Fall (in.)		30	

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instrmt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks	
								Dilatancy	Toughness	Plasticity	Dry Strength		
0	2	S-1	0.0 - 2.0			SP	Topsoil						
	20	24					Dense orange brown, fine grained SAND (SP), little fine grained Gravel.						
	17												
	13												
	1	S-2	2.0 - 4.0				-Grades to medium dense, trace Silty Clay, moist.						
	4	17											
	9												
	13												
	4	S-3	4.0 - 6.0				Medium dense orange brown, fine grained SAND (SP), little fine to medium grained Gravel, trace Silty Clay, moist.						Pushed 6' of casing.
5	5	16											
	6												
	5												
	4	S-4	6.0 - 8.0			SM	Medium dense light tan with orange and light gray mottling, fine grained Silty SAND (SM), trace fine Gravel, moist.						w = 19%
	7	12											
	4												
	5												
	2	S-5	8.0 - 10.0		8.5		-Grades to loose, wet.						
	4	11				CL	Medium stiff light gray, Silty CLAY (CL), little fine Sand, trace fine Gravel, moist.						w = 24%, LL = 34, PL = 20
	6												
	6						Top 5" - Loose light tan with orange mottling, fine grained SAND, (SP) trace Silt, wet.						
10	1	S-6	10.0 - 12.0			SP	Light gray, Silty CLAY (CL), trace fine grained Sand.						
	2	10				CL	Bottom 5" - Stiff light gray, Silty CLAY (CL), trace fine grained Sand.						
	8						Top 13" - Stiff light brown to light gray Silty CLAY (CL), little fine grained Sand, wet.						
	6						Bottom 4" - Loose, light brown, medium to coarse grained SAND, trace Silt, moist.						
	4	S-7A	12.0 - 14.0		13.2								
	7	S-7B				SP							
	4	17											
	5												
	8	S-8	14.0 - 16.0				-Grades to medium dense.						
15	11	17											
	11												
	12												
	14	S-9	16.0 - 18.0			SW-SM	-Grades to trace fine grained Gravel (SW-SM).						w = 13%
	12	19											
	16												
	14												
	3	S-10	18.0 - 20.0				-Grades to loose.						
	3	17											
	4												
	7												
20	5	S-11A	20.0 - 22.0				Top 3" - Loose, light orange and brown, medium to coarse grained SAND (SP), trace Silt, wet.						
	5	S-11B					Bottom 8" - Loose gray fine grained Silty SAND (SP), trace fine grained Gravel, wet.						
	3	11											
	3												
25	10	S-12	25.0 - 27.0			SM	Medium dense gray, medium to coarse grained SAND (SM), little fine grained Gravel, trace Silt, wet.						w = 18%
	8	13											
	7												
	8												

Water Level Data					Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Depth in feet to:				
			Bottom of Casing	Bottom of Hole	Water		

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
NOTE: Soil identifications based on visual-manual methods of the USCS system

BORING NO.: B-14

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30	14	S-13	30.0 - 32.0			SW	Very dense light orange and brown, fine to coarse grained SAND (SW), little fine Gravel, trace Silt, wet.					
	24	14										
	27											
	20											
35	14	S-14	35.0 - 37.0			SW-SM	Dense olive brown, course to fine grained SAND (SW-SM), some medium to fine grained Gravel, trace Silt, wet, with alternating 1/2" layer of gravelly Sand throughout.					w = 18%
	17	15										
	15											
	16											
40	12	S-15	40.0 - 42.0			SP	Dense olive brown, medium grained SAND (SP), trace Silt, trace fine grained Gravel, wet.					
	16	13										
	16											
	14											
							End of boring at 42.0 feet.					
45												
50												
55												
60												
65												
70												

NOTES:

PROJECT NO.: 218967

BORING NO.: B-14

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system

PROJECT:	Edison Pump Station Force Main Expansion	PROJECT NO.:	218967
LOCATION:	Borough of Sayreville And Township of Edison, Middlesex County, NJ	PROJECT MGR.:	P. Kocsik
CLIENT:	Middlesex County Utility Authority	FIELD ENG. STAFF:	S. Taranto
DRILLING CO.:	Warren George, Inc.	DATE/TIME STARTED:	3/23/05 / 12:20 pm
DRILLER:	Mike Kelly	DATE/TIME FINISHED:	

Elev.:	7.59 ft.	Datum:	NGVD 29	Boring Location:	Pump station.	Coord.:	N 606013.51 E 540103.23		
Item	Casing	Sampler	Core Barrel	Rig Make & Model:	B-80	Hammer Type	Drilling Fluid	Datum:	State Plane
Type	Flush jt		NX	<input checked="" type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Safety	<input type="checkbox"/> Bentonite	Casing Advance	
Length (ft)		2		<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer	Type Method Depth	
Inside Diameter (in.)	4.25			<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input type="checkbox"/> Automatic	<input type="checkbox"/> None		
Hammer Weight (lb.)		140		<input type="checkbox"/> Skid	<input type="checkbox"/> Cutting Head	Drilling Notes:			
Hammer Fall (in.)		30							

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr./m/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	10	S-1	0.0 - 2.0			SM	Top 6" - Topsoil Bottom 4" - Medium dense orange, fine to medium grained SAND (SM), some clayey Silt, moist.					
	8	10										
	7											
	6											
	6	S-2	2.0 - 4.0									
	7	13										
	8											
	5											
	8	S-3	4.0 - 6.0			SM	Loose orange, fine to medium grained SAND (SM), little clayey Silt, moist.					
	3	10										
5	3											
	4											
	8	S-4	6.0 - 8.0				-Grades to light brown.					w = 15%
	4	5										
	4											
	5											
	1	S-5	8.0 - 10.0			SP	Very loose light brown, fine grained SAND (SP), trace Silt, wet.					Started drilling with mud.
	1	1										
	1											
10	W.O.H.	S-6	10.0 - 12.0			SW	Medium dense gray with light tan bands, fine grained SAND (SW), trace Silt, wet.					
	3	12										
	8											
	12											
	11	S-7A	12.0 - 14.0				Dark gray, fine SAND (SW), trace fine grained Gravel, trace Silt, wet.					
	27	S-7B										
	38	17										
	44											
	17	S-8A	14.0 - 16.0				Top 6" - Very dense orange, fine to medium grained SAND (SW), trace Silt, trace fine grained Gravel, moist.					
	27	S-8B					Bottom 8" - Very dense light gray with dark orange mottling, fine grained SAND (SW), little clayey Silt, moist.					
15	28	14										
	33											
	3	S-9	16.0 - 18.0				-Grades to medium dense.					
	9	9										
	5											
	6											
	W.O.H.	S-10A	18.0 - 20.0		18.8		Top 10" - grades to wet.					
	3	S-10B			19.3	OL	Bottom 8" - Stiff bark brown, Organic Silty CLAY (OL), trace fine Sand.					w = 107%, LL = 70, PL = 43 Organic Content = 12.2%
	8	16										
	6											
20	W.O.H.	S-11A	20.0 - 22.0		21.1	SC	Top 11" - Grades to soft. Bottom 13" - Very loose dark gray medium grained Organic SAND, some clayey Silt, moist.					
	1	S-11B										
	2	24										
	2											
25	5	S-12	25.0 - 27.0			SW-SM	Medium dense gray, fine to coarse grained SAND (SW-SM), trace Silt, trace fine grained Gravel, wet.					w = 18%
	9	13										
	10											
	8											

Water Level Data					Sample Type		Instrum./Well Diagram		NOTES:			
Date	Time	Elapsed Time (hr.)	Depth in feet to:			O	T	U	S	G	<input type="checkbox"/> Riser Pipe <input type="checkbox"/> Screen <input type="checkbox"/> Filter Sand <input type="checkbox"/> Cuttings <input type="checkbox"/> Cement Grout <input type="checkbox"/> Concrete <input type="checkbox"/> Bentonite Seal <input type="checkbox"/> Permeability Test Transducer	BORING NO.: B-15
			Bottom of Casing	Bottom of Hole	Water							

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30	19 18 12 12	S-13 14	30.0 - 32.0			SP	Medium dense light brown, medium to coarse grained SAND (SP-SM), little Gravel, trace Silt, wet.					
35	9 11 11 10	S-14 16	35.0 - 37.0				-Grades to olive gray.					
40	6 6 9 10	S-15 11	40.0 - 42.0								w = 21%	
45	20 19 29 33	S-16 13	45.0 - 47.0			SW	Dense light brown, fine to coarse grained SAND (SW), little fine grained Gravel, trace Silt, wet.					
50	26 42 29 27	S-17 15	50.0 - 52.0				Very dense light brown, medium to coarse grained SAND (SW), little fine grained Gravel, trace Silt, wet.					
							End of Boring at 52.0 feet.					
55												
60												
65												
70												

NOTES:

PROJECT NO.: 218967

BORING NO.: B-15

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system

PROJECT: Edison Pump Station Force Main Expansion	PROJECT NO.: 218967
LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ	PROJECT MGR.: P. Kocsik
CLIENT: Middlesex County Utility Authority	FIELD ENG. STAFF: S. Taranto
DRILLING CO.: Warren George, Inc.	DATE/TIME STARTED: 3/22/05 / 10:30 am
DRILLER: Mike Kelly	DATE/TIME FINISHED: 3/23/05 / 8:50 am

Elev.: 7.09 ft. Datum: NGVD 29	Boring Location: Pump station.	Coord.: N 606124.30 E 540131.06		
Item	Casing	Sampler	Core Barrel	Datum: State Plane
Type	Flush jt		NX	
Length (ft)		2		
Inside Diameter (in.)	4.25			
Hammer Weight (lb.)		140		
Hammer Fall (in.)		30		

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr./Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	4	S-1	0.0 - 2.0			SW	Topsoil - Grass and black, fine SAND, little Silt.					
	6	7					Medium dense orange, fine to medium grained Silty SAND (SW), little fine Gravel.					
	8											
	9											
	4	S-2A	2.0 - 4.0				Medium dense brown, fine to medium grained SAND (SW), little fine Gravel, trace Silt, moist.					
	7	S-2B					Medium dense pale orange, fine grained Silty SAND (SW).					
	9	13										
	11											
	7	S-3	4.0 - 6.0				-Grades to loose, mottling, moist.					
5	5	14										
	5											
	3											
	4	S-4	6.0 - 8.0				-Grades to medium dense.					
	4	15										
	9											
	8											
	3	S-5	8.0 - 10.0				-Grades to loose.					Started drilling with mud.
	3	15										w = 32%
	3											
	2											
10	2	S-6	10.0 - 12.0				Loose grey, red brown medium to fine grained SAND (SM), some Clayey Silt, trace fine grained Gravel.					
	3	15										
	4											
	4											
	1	S-7	12.0 - 14.0				-Grades to very loose, wet.					
	1	17										
	2											
	2											
	3	S-8A	14.0 - 16.0		14.9							
15	3	S-8B			15.5	CL	Medium stiff, pale orange, Silty CLAY (CL), trace fine grained Sand.					
	3	S-8C				SW	Loose, light gray with orange mottling, fine Grained Silty SAND (SW).					
	4	23										
	10	S-9A	16.0 - 18.0		16.9		Medium dense, light brown, fine grained Silty SAND (SW).					
	8	S-9B				OH	Very stiff, brown, Organic Silty CLAY (OH).					
	8	18										
	7											
	2	S-10	18.0 - 20.0				Very soft, dark brown, Organic Silty CLAY (OH), some fine grained Sand.					
	1	21										
	1											
	4				20.0							
20	4	S-11	20.0 - 22.0			SW	Medium dense, dark gray, fine to coarse grained Silty SAND (SW), with fine grained Gravel (subrounded).					
	7	13										
	8											
	9											
25	5	S-12	25.0 - 27.0			SM	Brown, fine to coarse grained SAND (SM), trace clayey Silt, trace fine Gravel (subrounded).					w = 14%
	10	8										
	11											
	12											

Water Level Data					Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Depth in feet to:				
			Bottom of Casing	Bottom of Hole	Water		

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

BORING NO.: B-16

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30	8	S-13	30.0 - 32.0			SP	Medium dense, olive, fine grained SAND (SP), trace Silt, wet.					Drill chattering
	9	14										
	9											
	9											
35	30	S-14	35.0 - 37.0			SW	Very dense olive brown, medium to coarse grained SAND (SW), some fine to medium Gravel (subrounded), trace Silt.					
	37	16										
	29											
	27											
40			40.0 - 42.0				Discrepancy regarding depths. Driller says spoons after 22' are 5' too shallow.					Drill chattering, 1000 psi downforce.
45	17	S-15	45.0 - 47.0			GW-GM	Dense olive brown, medium to coarse grained Gravel (GW-GM), with fine to coarse grained Silty Sand (subrounded).				w = 11%	Drill chattering
	26	12										
	20											
	12											
50	27	S-16A	50.0 - 52.0			SW	-Grade to very dense. Very dense, orange brown, fine to medium grained SAND (SW), little fine Gravel trace Silt.					
	43	S-16B										
	36	17										
	19											
55	6	S-17	55.0 - 57.0				Medium dense, orange brown, fine to medium grained SAND (SW), little fine Gravel, trace Silt, wet.					Driller reports Clay at 59'.
	10	8										
	15											
	21											
60	20	S-18	60.0 - 62.0		60.0	CL	Hard, light gray with white and black speckled, Silty CLAY (CL), trace fine Sand, moist.					End of Boring at 62.0 feet.
	20	22										
	28											
	28											
65												
70												

NOTES:

PROJECT NO.: 218967

BORING NO.: B-16

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system



TEST BORING LOG

BORING NO.:

B-17

Page 1 of 2

PROJECT: Edison Pump Station Force Main Expansion
LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
CLIENT: Middlesex County Utility Authority
DRILLING CO.: Warren George, Inc.
DRILLER: Mike Kelly

PROJECT NO.: 218967
PROJECT MGR.: P. Kocsik
FIELD ENG. STAFF: M. Riegel
DATE/TIME STARTED: 3/21/05 / 10:30 am
DATE/TIME FINISHED:

Elev.:	7.15 ft.	Datum:	NGVD 29	Boring Location:	Pump station.	Coord.:	N 606081.82	E 540256.89	
Item	Casing	Sampler	Core Barrel	Rig Make & Model:			Datum: State Plane		
Type	Flush jt		NX	<input checked="" type="checkbox"/> Truck <input type="checkbox"/> Tripod <input type="checkbox"/> ATV <input type="checkbox"/> Geoprobe <input type="checkbox"/> Track <input type="checkbox"/> Air Track <input type="checkbox"/> Skid <input type="checkbox"/>			Hammer Type	Drilling Fluid	Casing Advance
Length (ft)		2		<input checked="" type="checkbox"/> Cat-Head <input type="checkbox"/> Winch <input checked="" type="checkbox"/> Roller Bit <input type="checkbox"/> Cutting Head			<input type="checkbox"/> Safety <input checked="" type="checkbox"/> Doughnut <input type="checkbox"/> Automatic	<input type="checkbox"/> Bentonite <input checked="" type="checkbox"/> Polymer <input type="checkbox"/> None	Type Method Depth
Inside Diameter (in.)	4.25								
Hammer Weight (lb.)		140							
Hammer Fall (in.)		30							

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks	
								Dilatancy	Toughness	Plasticity	Dry Strength		
0	4	S-1A	0.0 - 2.0			SM	Topsoil - brown, fine SAND, little Silt, trace roots.						
	16	S-1B					Medium dense, tan orange, fine grained Silty SAND (SM).						Pushed 6' casing.
	10	20											
	7												
	7	S-2	2.5 - 4.5				Loose, tan orange, fine to medium grained Silty SAND (SM), moist.						
	3	20											
	4												
	3												
5	5	S-3A	4.5 - 6.5				Loose, gray tan, fine to medium grained Silty SAND (SM),						
	3	S-3B					little fine Gravel.						
	3	20											
	4												
	4	S-4A	7.0 - 9.0				Medium dense, dark gray, fine to medium grained Silty SAND (SM), coarse gravel in tip of spoon.						
	7	S-4B											
	10	11											
	15												
	9	S-5A	9.0 - 11.0				Medium dense, tan orange, fine to coarse grained Silty SAND (SM), alternating with						
	6	S-5B					dark gray, fine to medium grained Sand, little clayey Silt.						
10	6	12											
	4												
	3	S-6	11.0 - 13.0				Very loose, gray, fine to coarse grained Silty SAND (SM), trace.						w = 20%
	2	7					medium to fine grained Gravel.						
	2												
	3				13.0								
	2	S-7A	13.0 - 15.0		13.25	OH	Medium stiff, Organic Clayey SILT (OH), little fine grained Sand.						
	3	S-7B				SM	Loose, orange, fine to coarse grained Silty SAND (SM).						
	3	17											
	4												
15	2	S-8	15.0 - 17.0				Loose, orange light tan, fine to medium grained Silty SAND (SM), trace Sandstone fragments.						
	2	18											
	3												
	3												
					20.0								
20	WOH	S-9A	20.0 - 22.0			OH	Soft, dark gray Organic Silty CLAY, little fine grained Sand, moist to wet.						
	3	S-9B			21.0	SM	Loose, dark gray, fine to medium grained Organic SAND (SM), some clayey Silt,						w = 23%
	3	24					trace fine to medium grained Gravel, wet.						Organic Content = 1.3%
	5												
					25.0								
25	9	S-10	25.0 - 27.0			GW	Medium dense, dark gray, fine to coarse grained SAND (GW), some fine to medium						
	10	12					Gravel, trace Silt, some mottling, wet.						
	11												
	8												

Water Level Data						Sample Type	Instrum./Well Diagram	NOTES:				
Date	Time	Elapsed Time (hr.)	Depth in feet to:			O	T	U	S	G	<input type="checkbox"/> Riser Pipe <input type="checkbox"/> Screen <input type="checkbox"/> Filter Sand <input type="checkbox"/> Cuttings <input type="checkbox"/> Cement Grout <input type="checkbox"/> Concrete <input type="checkbox"/> Bentonite Seal <input type="checkbox"/> Permeability Test <input type="checkbox"/> Transducer	BORING NO.: B-17
			Bottom of Casing	Bottom of Hole	Water							

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30	11 11 10 14	S-11 14	30.0 - 32.0			SW-SM	Medium dense, olive brown, fine to coarse grained SAND (SW-SM), some fine to medium Gravel (subrounded), trace Silt.					w = 18%
35	10 11 14 11	S-12 11	35.0 - 37.0			SW	Medium dense, olive brown, medium to fine grained SAND (SW), trace Silt, wet.					
40	11 11 16 20	S-13 12	40.0 - 42.0			SP-SM	Medium dense, olive brown, fine to coarse grained SAND (SP-SM), little fine grained Gravel (subrounded), trace Silt, wet.					w = 19%
45	17 15 23 21	S-14A S-14B 16	45.0 - 47.0				Dense, brown, fine grained Silty SAND (SW), some fine to medium Gravel (rounded), wet. Dark olive band, 3.5" thick, of Clayey SILT and fine SAND at 45.8'.					Drill chattering 46 - 50'
50	13 13 17 19	S-15 14	50.0 - 52.0				Medium dense, olive brown, fine to coarse grained Silty SAND (SW), some fine to medium Gravel (subrounded).					Drill chattering.
55	24 21 24 26	S-16 14	55.0 - 57.0			GW	Dense, olive brown, fine to medium grained GRAVEL (GW), some medium to coarse Sand, little Silt and red brown Shale fragments at 55.7'.					
60	56 27 87 100/1"	S-17A S-17B 19	60.0 - 62.0		60.0	CL	Hard, light gray, Silty CLAY (CL), little fine grained Gravel, moist.					Spoon had to be driven 6-12" before 60'. Refusal at 61.5 feet, end of boring.
65												
70												

NOTES:

PROJECT NO.: 218967

BORING NO.: B-17

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system



TEST BORING LOG

BORING NO.:

B-18

Page 1 of 2

PROJECT: Edison Pump Station Force Main Expansion
 LOCATION: Borough of Sayreville And Township of Edison, Middlesex County, NJ
 CLIENT: Middlesex County Utility Authority
 DRILLING CO.: Warren George, Inc.
 DRILLER: Mike Kelly

PROJECT NO.: 218967
 PROJECT MGR.: P. Kocsik
 FIELD ENG. STAFF: S. Taranto
 DATE/TIME STARTED: 3/29/05 / 8:30 am
 DATE/TIME FINISHED: 3/30/05 / 10:00 am

Elev.:	35.8 ft.	Datum:	NGVD 29	Boring Location:	Treatment plant.	Coord.:	N 603490.27	E 543241.83
Item	Casing	Sampler	Core Barrel	Datum:			State Plane	
Type	Flush jt		NX	Rig Make & Model:			Hammer Type	Drilling Fluid
Length (ft)		2		<input checked="" type="checkbox"/> Truck	<input type="checkbox"/> Tripod	<input checked="" type="checkbox"/> Cat-Head	<input type="checkbox"/> Safety	<input type="checkbox"/> Bentonite
Inside Diameter (in.)	4.25			<input type="checkbox"/> ATV	<input type="checkbox"/> Geoprobe	<input type="checkbox"/> Winch	<input checked="" type="checkbox"/> Doughnut	<input checked="" type="checkbox"/> Polymer
Hammer Weight (lb.)		140		<input type="checkbox"/> Track	<input type="checkbox"/> Air Track	<input checked="" type="checkbox"/> Roller Bit	<input type="checkbox"/> Automatic	<input type="checkbox"/> None
Hammer Fall (in.)		30		<input type="checkbox"/> Skid	<input type="checkbox"/>	<input type="checkbox"/> Cutting Head	Drilling Notes:	

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr./m/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
0	5	S-1A	0.0 - 2.0		0.4		Topsail - very moist.					
	6	S-1B			1.1	SP	Medium dense, tan, fine to medium grained SAND (SP), trace Silt, moist.					
	6	17				CL	Tan and gray, Silty CLAY (CL), trace fine Sand, thin layer of medium to coarse Sand, mottled.					
	7											
	10	S-2A	2.0 - 4.0		2.3		-Grades to hard.					
	14	S-2B				ML	Hard, gray and olive, Clayey SILT (ML), some fine Sand, trace charred wood fragments, moist, mottled.					
	18											
	20											
5	9	S-3	4.0 - 6.0				-Grades to very stiff.					
	10	22										
	14											
	10											
	8	S-4	6.0 - 8.0									
	9	5										
	10											
	10											
	3	S-5	8.0 - 10.0				Stiff, gray, olive, Clayey SILT (ML), little medium to fine grained Sand, mottled, moist.					Started drilling with mud. w = 25%, LL = 27, PL = 18 Organic Content = 2.0%
	5	12										
	5											
	5											
10	10	S-6A	10.0 - 12.0				Very stiff, dark gray, Silty CLAY (ML), little fine Sand, moist.					
	12	S-6B										
	14	22										
	15											
	5	S-7	12.0 - 14.0			CL	Stiff, gray and olive gray, CLAY (CL), some fine to coarse grained Sand, mottled, moist.					w = 24%
	5	19										
	10											
	17											
	32	S-8	14.0 - 16.0				-Grades to hard.					
	32	11					From 14.7-14.9', red brown, Silty CLAY (CL), trace fine Sand, moist.					
	40											
	43											
15	10	S-9	16.0 - 18.0			ML	Hard, gray, Clayey SILT (ML), some orange brown, fine grained Sand, moist.					
	10	21										
	24											
	27											
	13	S-10A	18.0 - 20.0				Hard, gray, SILT (ML), little fine grained Sand, wet.					
	18	S-10B					Gray, SILT, some orange brown, fine Sand, trace Clay, moist.					
	30	17										
	28											
20	7	S-11	20.0 - 22.0				Medium dense, orange gray, fine grained Sandy SILT (ML), moist.					w = 26%
	11	21										
	12											
	13											
25	4	S-12A	25.0 - 27.0				Very stiff, gray, Clayey SILT (ML), trace fine grained Sand, moist.					
	9	S-12B										
	12	23										
	16											

Water Level Data						Sample Type	Instrum./Well Diagram	NOTES:
Date	Time	Elapsed Time (hr.)	Depth in feet to:			O Open End Rod T Thin-Wall Tube U Undisturbed Sample S Split Spoon Sample G Geoprobe	<input type="checkbox"/> Riser Pipe <input type="checkbox"/> Screen <input type="checkbox"/> Filter Sand <input type="checkbox"/> Cuttings <input type="checkbox"/> Cement Grout <input type="checkbox"/> Concrete <input type="checkbox"/> Bentonite Seal <input type="checkbox"/> Permeability Test <input type="checkbox"/> Transducer	BORING NO.: B-18
			Bottom of Casing	Bottom of Hole	Water			

Field Test Legend: Dilatancy: N - None S - Slow R - Rapid Plasticity: NP - Non-Plastic L - Low M - Medium H - High
 Toughness: L - Low M - Medium H - High Dry Strength: N - None L - Low M - Medium H - High VH - Very High

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.
 NOTE: Soil identifications based on visual-manual methods of the USCS system

TEST BORING LOG

Depth (ft)	Sampler Blows per 6 in.	Sample No. & Recovery (in.)	Sample Depth (ft.)	Instr'mt/ Well Diag'm	Stratum Change (ft.)	USCS Group Symbol	Visual-Manual Identification & Description (density/consistency, color, GROUP NAME & SYMBOL, maximum particle size*, structure, odor, moisture, optional descriptions, geologic interpretation)	Field Tests				Remarks
								Dilatancy	Toughness	Plasticity	Dry Strength	
30	10	S-13	30.0 - 32.0			CL	Very stiff grey Silty CLAY (CL), trace fine grained Sand.					w = 25% Drill chattering from 33.5-34.5'.
	14	23										
	18											
35	9	S-14	35.0 - 37.0			CL/SM	Alternating layers of Silty CLAY (CL/SM), trace fine Sand and Silty fine SAND, gray, moist. Layers are no thicker than 3/4".					Lost water intake, refilled tub.
	13	24										
	14											
	20											
40	7	S-15A	40.0 - 42.0			ML						w = 22%
	14	S-15B										
	20	21										
	10											
45	9	S-16A	45.0 - 47.0		46.0	CL SM	Gray, Silty CLAY (CL), trace fine Sand, trace light gray Shale fragments, moist. Light gray, fine grained Silty SAND (SM), wet.					
	13	S-16B										
	28	18										
	25											
50	13	S-17	50.0 - 52.0		50.0	ML/SP	Hard, gray, alternating layers of Clayey SILT (ML/SP), trace fine Sand, moist and fine SAND, wet. Layers range from 3/4" to 4" thick.					Drill chattering at 52.5'.
	20											
	30											
	34											
55	13	S-18	55.0 - 57.0		55.0	CL	Hard, gray, Silty CLAY (CL), trace fine grained Sand, moist.					
	18	24										
	24											
	30											
60	30	S-19	60.0 - 62.0			CL	Dark gray band with trace Organics from 60.8-60.9'.					End of Boring at 62.0 feet.
	49	24										
	75											
	65											
65												
70												

NOTES:

PROJECT NO.: 218967

BORING NO.: B-18

*NOTE: Maximum Particle Size is determined by direct observation within the limitations of sampler size.

NOTE: Soil identifications based on visual-manual methods of the USCS system

1. GENERAL:

Soil description on logs of subsurface explorations are based on Standard Penetration Test (SPT) results, visual-manual examination of exposed soil and soil samples, and the results of laboratory tests on selected samples. The criteria, descriptive terms, and definitions are presented herein.

The natural soils are identified and described by visual-manual procedures (ASTM D2488)/or classified by criteria of the Unified Soil Classification System (USCS) (ASTM D2487 as noted), with appropriate group symbol in parenthesis for each soil description. Fill materials may not be classified by USCS criteria.

Soil descriptions are presented with the following data:

Apparent density/consistency, color, visual-manual identification and description or USCS classification (if applicable) Group Name with Group Symbol in parenthesis, maximum particle size (mps), supplemental soil descriptions and structure, odor, moisture content, optional descriptions (particle angularity, cementation, HCl reaction?), inclusions, geologic interpretation.

Examples:

Fine-grained / cohesive soil - Stiff, red-brown, lean CLAY with sand (CL), mps = 0.10 in., moist, subangular coarse sand particles - GLACIOLACUSTRINE DEPOSITS-

Granular / cohesionless soil - Loose, yellow-brown, well-graded SAND with gravel (SW), mps = 0.70 in., wet, subrounded coarse sand and fine gravel particles - ALLUVIAL DEPOSITS -

2. PENETRATION RESISTANCE:

Standard Penetration Test (SPT) (ASTM D1586) - Number of blows required to drive a standard 2-in. O.D. split spoon sampler one foot (from the 6 - 12 in. and 12 - 18 in. intervals) with a 140 lb. weight falling 30 inches freely downward.

3. DENSITY/CONSISTENCY:

GRANULAR/COHESIONLESS SOILS

APPARENT DENSITY	SPT RESISTANCE, N (BPF)	MODIFIED CA. SAMPLER RES. (BPF)	CALIFORNIA SAMPLER RES. (BPF)	RELATIVE DENSITY (%)
VERY LOOSE	0-4	0-4	0-5	0-15
LOOSE	5-10	5-12	6-15	15-35
MEDIUM DENSE	11-30	13-35	16-40	35-65
DENSE	31-50	36-60	41-70	65-85
VERY DENSE	>50	>60	>70	85-100

NOTE: BPF=BLOWS PER FOOT (UNCORRECTED)

FINE-GRAINED/COHESIVE SOILS

APPARENT CONSISTENCY	SPT RESISTANCE, N (BPF)	TORVANE UNDRAINED SHEAR STR. (TSF)	POCKET PENETROMETER COMPR. STR. (TSF)	MANUAL MANIPULATION CHARACTER
VERY SOFT	0-2	<0.13	<0.25	Thumb penetrates soil >1 in. Specimen extrudes between fingers
SOFT	2-4	0.13-0.25	0.25-0.50	Thumb penetrates soil about 1 in. Specimen remolded by light finger pressure
MEDIUM STIFF	4-8	0.25-0.50	0.50-1.00	Specimen easily indented with thumb Specimen remolded by strong finger pressure
STIFF	8-15	0.50-1.00	1.0-2.0	Specimen indented by thumb considerable or strong pressure or indented by thumbnail
VERY STIFF	15-30	1.0-2.0	2.0-4.0	Specimen barely indented by thumb pressure or indented by thumbnail
HARD	>30	>2.0	>4.0	Thumb will not indent specimen but readily indented by thumbnail

NOTE: BPF=BLOWS PER FOOT (UNCORRECTED)
TSF=TONS PER SQUARE FOOT

GENERAL NOTES:

LOGS OF SUBSURFACE EXPLORATIONS DEPICT SOIL, ROCK, AND GROUNDWATER CONDITIONS ONLY AT THE BORING LOCATIONS SPECIFIED ON THE DATES INDICATED. SUBSURFACE CONDITIONS MAY VARY AT OTHER LOCATIONS AND AT OTHER TIMES.

WATER LEVELS NOTED ON THE LOGS WERE MEASURED AT THE TIMES AND UNDER THE CONDITIONS INDICATED. DURING TEST BORINGS, THESE WATER LEVELS COULD HAVE BEEN AFFECTED BY THE INTRODUCTION OF WATER INTO THE BOREHOLE, EXTRACTION OF TOOLS OR OTHER PROCEDURES AND THUS MAY NOT REFLECT THE ACTUAL GROUNDWATER LEVEL AT THE TEST BORING LOCATION. GROUNDWATER LEVEL FLUCTUATIONS MAY ALSO OCCUR AS A RESULT OF VARIATIONS IN PRECIPITATION, TEMPERATURE, SEASON, TIDES, RIVER STAGE, ADJACENT CONSTRUCTION OPERATIONS, CONSTRUCTION DEWATERING SYSTEMS, WATER SUPPLY WELL PUMPING, AND OTHER CONDITIONS.

4. COLOR:

Basic colors (black, brown, gray, olive, red, and yellow) and combinations (ie., gray-brown, olive-brown, olive-gray, red-gray, red-brown, yellow-brown, and red-yellow). Modifiers such as light and dark may be used. Color is determined from wet samples.

5. FIELD TESTING:

DILATANCY:

DESCRIPTION	CRITERIA
NONE	(N) No visible change in the specimen
SLOW	(S) Water appears slowly on the specimen surface during shaking and does not disappear or disappears slowly upon squeezing
RAPID	(R) Water appears quickly on the specimen surface during shaking and disappears quickly upon squeezing

TOUGHNESS:

DESCRIPTION	CRITERIA
LOW	(L) Only slight pressure is required to roll the thread near the plastic limit. The thread and lump are weak and soft.
MEDIUM	(M) Medium pressure is required to roll the thread near the plastic limit. The thread and lump have medium stiffness.
HIGH	(H) Considerable pressure is required to roll the thread near the plastic limit. The thread and lump have very high stiffness.

PLASTICITY:

DESCRIPTION	CRITERIA
NON-PLASTIC (NP)	A 1/8-in. thread cannot be rolled at any water content.(PI=0)
LOW	(L) The thread can barely be rolled and the lump cannot be formed when drier than the plastic limit. Smallest thread is 1/4 to 1/8-in. diameter. (PI = 1 - 10)
MEDIUM	(M) The thread is easily rolled and not much time is required to reach the plastic limit. The thread cannot be re-rolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit. Smallest thread is 1/16-in. diameter. (PI = 10 - 20)
HIGH	(H) Considerable time is required to knead and roll the thread to reach the plastic limit. The thread can be re-rolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit. Smallest thread is 1/32-in. diameter.(PI=20-40)

DRY STRENGTH:

DESCRIPTION	CRITERIA
NONE	(N) Dry specimen crumbles into powder with mere handling pressure
LOW	(L) Dry specimen crumbles into powder with some finger pressure
MEDIUM	(M) Dry specimen breaks into pieces or crumbles with considerable finger pressure
HIGH	(H) Dry specimen cannot be broken with finger pressure. Specimen will break into pieces under pressure between thumb and a hard surface
VERY HIGH	(VH) Dry specimen cannot be broken under pressure between thumb and a hard surface.

6. SOIL IDENTIFICATION AND DESCRIPTION:

Clear Square Sieve Openings				U.S. Standard Series Sieve			
12"	3"	3/4"	4	10	40	200	
Boulders	Cobbles	Gravel		Sand			Silts and Clays
		Coarse	Fine	Coarse	Medium	Fine	
305 mm	76 mm	19 mm	4.75 mm	2.00 mm	0.43 mm	0.075 mm	
UNIFIED SOIL CLASSIFICATION SYSTEM							
MAJOR DIVISIONS				GROUP SYMBOL	TYPICAL NAMES		
COARSE-GRAINED SOILS: MORE THAN HALF RETAINED ON NUMBER 200 SIEVE	GRAVELS MORE THAN HALF OF COARSE FRACTION RETAINED ON NUMBER 4 SIEVE	GRAVELS WITH LITTLE OR NO FINES	GW	Well graded gravels, gravel-sand mixtures			
			GP	Poorly graded gravels, gravel-sand mixtures			
		GRAVELS WITH OVER 12% FINES	GM	Silty gravels, poorly graded gravel-sand-silt mixtures			
	SANDS MORE THAN HALF OF COARSE FRACTION PASSING NUMBER 4 SIEVE	SANDS WITH LITTLE OR NO FINES	SW	Well graded sands, gravelly sands			
			SP	Poorly graded sands, gravelly sands			
		SANDS WITH OVER 12% FINES	SM	Silty sands, poorly graded sand-silt mixtures			
FINE-GRAINED SOILS: MORE THAN HALF PASSING NUMBER 200 SIEVE	SILTS AND CLAYS LIQUID LIMIT 50% OR LESS		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity			
			CL	Inorganic clays to low medium plasticity gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic clays and organic silty clays of low plasticity			
	SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50%		MH	Inorganic silty, micaceous or diatomaceous fine sandy or silty soils, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity, organic silts			
HIGHLY ORGANIC SOILS				PT	Peat and other highly organic soils		

7. SUPPLEMENTAL SOIL DESCRIPTIONS AND STRUCTURE:

Lamina	- 0 to 1/16-in. thick (cohesive)
Parting	- 0 to 1/16-in. thick (granular)
Seam	- 1/16 to 1/2-in. thick
Layer	- 1/2 to 12-in. thick
Stratum	- >12-in. thick
Pocket	- Small, erratic, isolated deposit less than 12-in. size
Lens	- Lenticular deposit larger than a pocket
Occasional	- One or less per 12-in. interval
Frequent	- More than one per 12-in. interval
Interbedded	- Alternating soil layers of different composition
Varved	- Alternating thin seams of silt and clay
Mottled	- Variation of color
Stratified	- Alternating layers of varying material or color
Laminated*	- Alternating layers of varying cohesive material with layers <0.25-in. thick
Fissured*	- Broken along definite fracture planes with little fracture resistance
Slickensided*	- Fracture planes appear polished or glossy, sometimes striated
Blocky*	- Characteristic in which cohesive soil can be broken down into small angular lumps that resist further breakdown
Lenses	- Inclusions of small pockets of different soils
Homogeneous	- Same color, textural, structural character or appearance throughout
Bed	- Sedimentary layer bounded by depositional surfaces
Bonded	- Attached or adhering
Foliated	- Planar arrangement of textural or structural features
Interbedded	- Alternating soil layers of different composition

8. MOISTURE CONTENT:

DESCRIPTION	CRITERIA
DRY	Absence of moisture, dusty, dry to the touch
MOIST	Damp but no visible water
WET	Visible free water, usually soil is below water table

9. OPTIONAL DESCRIPTIONS

ANGULARITY OF GRANULAR SOIL PARTICLES:

DESCRIPTION	CRITERIA
ANGULAR	Particles have sharp edges and corners and relatively plane sides
SUBANGULAR	Particles shaped similar to angular particles, except with rounded edges
SUBROUNDED	Particles with nearly plane sides and well-rounded corners and edges
ROUNDED	Particles have smoothly curved sides and no edges

CEMENTATION:

DESCRIPTION	CRITERIA
WEAK	Crumbles or breaks with handling or light finger pressure
MODERATE	Crumbles or breaks with considerable finger pressure
STRONG	Does not crumble or break with finger pressure

HYDROCHLORIC ACID (HCl) REACTION:

DESCRIPTION	CRITERIA
NONE	No visible reaction
WEAK	Some reaction with bubbles forming slowly
STRONG	Violent reaction with bubbles forming immediately

10. GEOLOGIC INTERPRETATION:

Deposit Type - WEATHERED BEDROCK, RESIDUAL SOIL, GLACIAL TILL, GLACIOFLUVIAL, GLACIOLACUSTRINE, GLACIOMARINE, LACUSTRINE, MARINE, AEOLIAN, ALLUVIAL, COLLUVIAL, FILL.....

	SOIL IDENTIFICATION AND DESCRIPTION LEGEND				
	Designed RCD	Drawn DJ	Checked MAP	Approved MGV	Date 2/03

1. GENERAL:

Rock descriptions on logs of subsurface explorations are based on visual-manual examination of rock core samples. The criteria, descriptive terms, and definitions are presented herein. Rock descriptions are presented with the following data:

Lithology or rock name, color, texture/grain size, structure (bedding or foliation), weathering, field hardness, discontinuity descriptions (spacing, type, dip, roughness, weathering, aperture, infilling, fracture index), other features, and geologic formation.

Examples:

Sedimentary rock -
SHALE, gray to dark gray, very fine-grained, laminated to very thin bedding with 0° to 5° dip, fresh to slightly weathered, medium hard with frequent interbeds of moderately hard light gray siltstone; moderately spaced joints dip 0° to 5° and are smooth, planar, fresh, and open with no infilling, FI = 1.
- CHAGRIN SHALE -

Metamorphic/igneous rock -
Biotite GNEISS, dark gray to black, fine-grained, very thin foliation dipping 25° to 30°, fresh to slightly weathered, hard; primary joints are moderate to widely spaced, dip 10° to 15° and are rough, undulating, fresh, and open with no infilling, FI=0.5; secondary joints are widely spaced, dip 70° to 80°, rough, undulating, discolored, and open with clay infilling, FI = 0.3.
- FORDHAM FORMATION -

2. LITHOLOGY:

MUDSTONE, SILTSTONE, SANDSTONE, CLAYSTONE, SHALE, DOLOMITE, LIMESTONE, ARGILLITE, COAL, GYPSUM, PEGMATITE, GABBRO, SYENITE, QUARTZITE, CONGLOMERATE, SLATE, MARBLE, PHYLLITE, GRANITE, DIORITE, ANDESITE, SERPENTINITE, MICA, GNEISS, SCHIST, DIABASE, BASALT????

Include appropriate modifiers and combinations to describe the character and inclusions associated with the rock. Modifiers include argillaceous, arenaceous, carbonaceous, calcareous, siliceous, carboniferous, fossiliferous in sedimentary rocks and combinations of various rock types in metamorphic and igneous rocks.

3. COLOR:

Rock color is described in basic colors and combinations, such as black, brown, red, gray, blue, green, olive, yellow, pink, and white. These colors and combinations are often preceded by modifiers, such as light and dark. Color is determined from wet rock core samples.

4. TEXTURE / GRAIN SIZE:

SEDIMENTARY ROCK

DESCRIPTION	GRAIN SIZE (IN.)
VERY FINE-GRAINED	< 0.0008
FINE-GRAINED	0.0008 - 0.002
MEDIUM-GRAINED	0.002 - 0.080
COARSE-GRAINED	0.08 - 2.40
VERY COARSE-GRAINED	> 2.40

METAMORPHIC & IGNEOUS ROCK

DESCRIPTION	CRITERIA
APHANITIC	Grains not visible to unaided eye
FINE-GRAINED	Grains barely visible to unaided eye up to 1/16-in. diameter
MEDIUM-GRAINED	Grains range 1/16 to 3/16-in. diameter
COARSE-GRAINED	Grains range 3/16 to 1/4-in. diameter
VERY COARSE-GRAINED	Grains larger than 1/4-in.

5. STRUCTURE (BEDDING OR FOLIATION):

SPACING:

DESCRIPTION	SPACING (IN.)
LAMINAR	< 0.40
VERY THIN	0.4 - 1.2
THIN	1.2 - 3.6
MODERATE	3.6 - 12.0
THICK	12 - 36
VERY THICK	36 - 120
MASSIVE	> 120
OCCASIONAL	Occurring once or less per foot
FREQUENT	Occurring more than once per foot
INTERBEDDED	Alternating materials of differing composition varying in thickness relatively equally

DIP: Directly measured angle below horizontal plane for exposed rock and vertical rock core. For inclined or angled borings, the angle measured below the plane perpendicular to the rock core axis.

6. WEATHERING / ALTERATION OF ROCK MASS:

DESCRIPTION	SYMBOL	CRITERIA
FRESH OR UNWEATHERED	FR	No visible sign of rock material weathering, except slight discoloration on major discontinuity surfaces.
SLIGHTLY WEATHERED	SL	Discoloration indicates weathering of rock material and discontinuity surfaces. All rock material may be discolored by weathering and may be somewhat weaker than externally than in its fresh condition.
MODERATELY WEATHERED	M	Less than half of the rock material is decomposed and/or disintegrated to soil. Fresh or discolored rock is present either as a continuous framework or as corestones.
HIGHLY WEATHERED	H	More than half of the rock material is decomposed and/or disintegrated to a soil. Fresh or discolored rock is present either as a discontinuous framework or as corestones.
COMPLETELY WEATHERED	C	All rock material is decomposed and/or disintegrated to soil. The original mass structure remains largely intact.
RESIDUAL SOIL	RS	All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soil has not been significantly transported.

7. FIELD HARDNESS:

DESCRIPTION	SYMBOL	CRITERIA
VERY HARD	VH	Cannot be scratched with a knife or sharp pick. Breaking of hand specimens requires several hard blows of geologist's pick.
HARD	SL	Can be scratched with knife or pick only with difficulty. Hard blow of hammer required to detach hand specimen.
MODERATELY HARD	MH	Can be scratched with knife or pick. Gouges or grooves to 1/4-in. depth can be excavated with by hard blow with sharp end or point of a geologist's pick. Hand specimens can be detached by moderate hammer blow.
MEDIUM	M	Can be grooved or gouged 1/16-in. deep by firm pressure on knife or pick point. Can be excavated in small chips to pieces about one-inch maximum size by hard blows with sharp end or point of a geologist's pick.
SOFT	S	Can be grooved or gouged readily with knife or pick point. Can be excavated in chips to several inches in size by moderate blows of a pick point. Small thin pieces can be broken by finger pressure
VERY SOFT	VS	Can be carved with knife. Can be scratched readily by fingernail. Can be excavated with pick point. Pieces of one-inch or greater thickness can be broken with finger pressure.

8. DISCONTINUITIES

SPACING:

DESCRIPTION	SYMBOL	SPACING (IN.)	DESCRIPTION	SYMBOL	SPACING (IN.)
EXTREMELY CLOSE	EC	< 0.75	WIDE	W	24 - 80
VERY CLOSE	VC	0.75 - 2.5	VERY WIDE	VW	80 - 240
CLOSE	C	2.5 - 8.0	EXTREMELY WIDE	EW	> 240
MODERATE	M	8 - 24			

TYPE:

DESCRIPTION	SYMBOL	CRITERIA
JOINT	J	A natural fracture along which no displacement has occurred. May occur in parallel groups called sets.
SHEAR	S	A natural fracture along which differential movement has occurred. May be slickensided or striated.
FAULT	F	A natural fracture along which displacement has occurred. Usually lined with gouge and slickensides.
VEIN	V	A thin, sheet-like igneous intrusion into a fissure.
BEDDING JOINT	B	Joints that occur along bedding planes.
FOLIATION JOINT	FJ	Joints that occur parallel to the foliation of a rock mass.
SHEAR ZONE	SZ	Zone of fractured rock and gouge bordering the displacement plane.

DIP: Directly measured angle below horizontal plane for exposed rock and vertical rock core. For inclined or angled borings, the angle measured below the plane perpendicular to the rock core axis.

ROUGHNESS:

INTERMEDIATE SCALE	SYMBOL	SMALL SCALE	SYMBOL
STEPPED	S	ROUGH	R
UNDULATING	U	SMOOTH	Sm
PLANAR	P	SLICKENSIDED	K
NOT DETERMINED	X	WAVY	Wa
NOT DETERMINED	X		

WEATHERING / ALTERATION OF DISCONTINUITIES:

DESCRIPTION	SYMBOL	CRITERIA
FRESH	FR	No visible sign of weathering on the rock discontinuity surfaces.
DISCOLORED	DS	Discoloration of rock material discontinuity surfaces. Degree of discoloration and specific discolored mineral constituents (if applicable) indicated.
DISINTEGRATED	DG	Discontinuity surface rock material is weathered to a soil with the rock material fabric intact. Rock material is friable, but the mineral grains are not decomposed.
DECOMPOSED	DE	Discontinuity surface rock material is weathered to a soil with the rock material fabric intact and with some or all mineral grains decomposed.

APERTURE:

DESCRIPTION	SYMBOL	APERTURE (IN.)	DESCRIPTION	SYMBOL	APERTURE (IN.)
VERY TIGHT	VT	< 0.004	WIDE	W	> 0.4
TIGHT *	T	0.004 - 0.010	VERY WIDE	VW	0.4 - 4.0
PARTLY OPEN	PO	0.01 - 0.02	EXTREMELY WIDE	EW	4.0 - 40.0
OPEN **	O	0.02 - 0.10	CAVERNOUS	CA	> 40
MODERATELY WIDE	MW	0.1 - 0.4			

* TIGHT denotes that core pieces can be manually joined such that no void space is visible.
** OPEN denotes that core pieces cannot be manually joined and exhibit visible voids.

FRACTURE INDEX OR FREQUENCY:

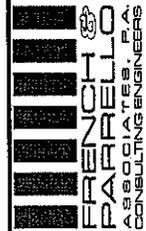
Number of naturally-occurring fractured per lineal foot of rock core prior to removal from the core barrel, not including healed discontinuities. The "EF" symbol denotes fractured zones at least 8 inches in length. Fractured zones less than 8 inches long are counted as joints. An asterisk denotes intervals containing fracture zones and individual joints. Denoted as "FI = ".

SOLUTION FEATURES:

DESCRIPTION	SIZE (IN.)
PIT	< 0.25
VUG	0.25 - 2.00
CAVITY	2 - 24
VOID	> 24

		ROCK IDENTIFICATION AND DESCRIPTION LEGEND				
		Designed RCD	Drawn DJ	Checked MAP	Approved MGV	Date 2/03

[Laboratory Test Results]
Appendix D



SUMMARY OF LABORATORY TESTING



PROJECT: Hatch Mott MacDonald - MCUA - Edison PSEFM

PROJECT #: 04L021A

DATE: 5/05

Boring & Sample Number	Depth (ft)	Classification	Natural Water Content %	Atterberg Limits		Unconfined Compression		Unit Dry Weight PCF	Specific Gravity	Permeability cm/sec @ 20 deg C	Compaction	Grain Size	Consolidation	Triaxial	CBR	pH	Organic Content %
				Liquid Limit	Plastic Limit	Stress TSF	Strain %										
B-13 S-6	10 - 12	Grey cmf SAND, some- mf+ Gravel, little Clayey Silt	23									*					
B-13 S-9	16 - 18	Dark Brown Organic SILT with fibers, trace mf Sand	88	66	36												10.4
B-13 S-12	25 - 27	Brown cm+ SAND, some mf+ Gravel, trace+ Silt	19									*					
B-13 S-13	30 - 32	Red Brown cm+f SAND, some mf+ Gravel, little- Silt	17									*					
B-13 S-15	40 - 42	Brown m+f SAND, little- Silt, trace- f Gravel	22									*					
B-14 S-4	6 - 8	Tan f SAND, some Silt, trace mf Gravel	19									*					
B-14 S-5	8 - 10	Grey & Brown Mottled CLAY & SILT, little mf Sand	24	34	20												
B-14 S-9	16 - 18	Light Brown c+m SAND, trace+ f Gravel, trace+ Silt	13									*					
B-14 S-12	25 - 27	Grey cm+ SAND, some- mf+ Gravel, little Silt	18									*					
B-14 S-14	30 - 32	Red Brown cm+f SAND, some+ mf+ Gravel, trace+ Silt	18									*					
B-15 S-4	6 - 8	Brown c-mf SAND, some Clayey Silt, trace mf+ Gravel	15									*					
B-15 S-10B	18 - 20	Dark Brown Organic SILT with fibers	107	70	43												12.2
B-15 S-12	25 - 27	Grey cm+f SAND, some+ mf Gravel, little- Silt	18									*					
B-15 S-15	40 - 42	Dark Grey m+f SAND, little- mf+ Gravel, trace Silt	21									*					
B-16 S-6	10 - 12	Grey & Red Brown mf+ SAND, some Clayey Silt, trace- f Gravel	32									*					
B-16 S-12	25 - 27	Red Brown c+mf Sand, and- mf+ Gravel, some Silt with one large stone retained on the 1" sieve	14									*					

* SEE TEST CURVES



SUMMARY OF LABORATORY TESTING

PROJECT: Hatch Mott MacDonald - MCUA - Edison PSFM

PROJECT #: 04L021A

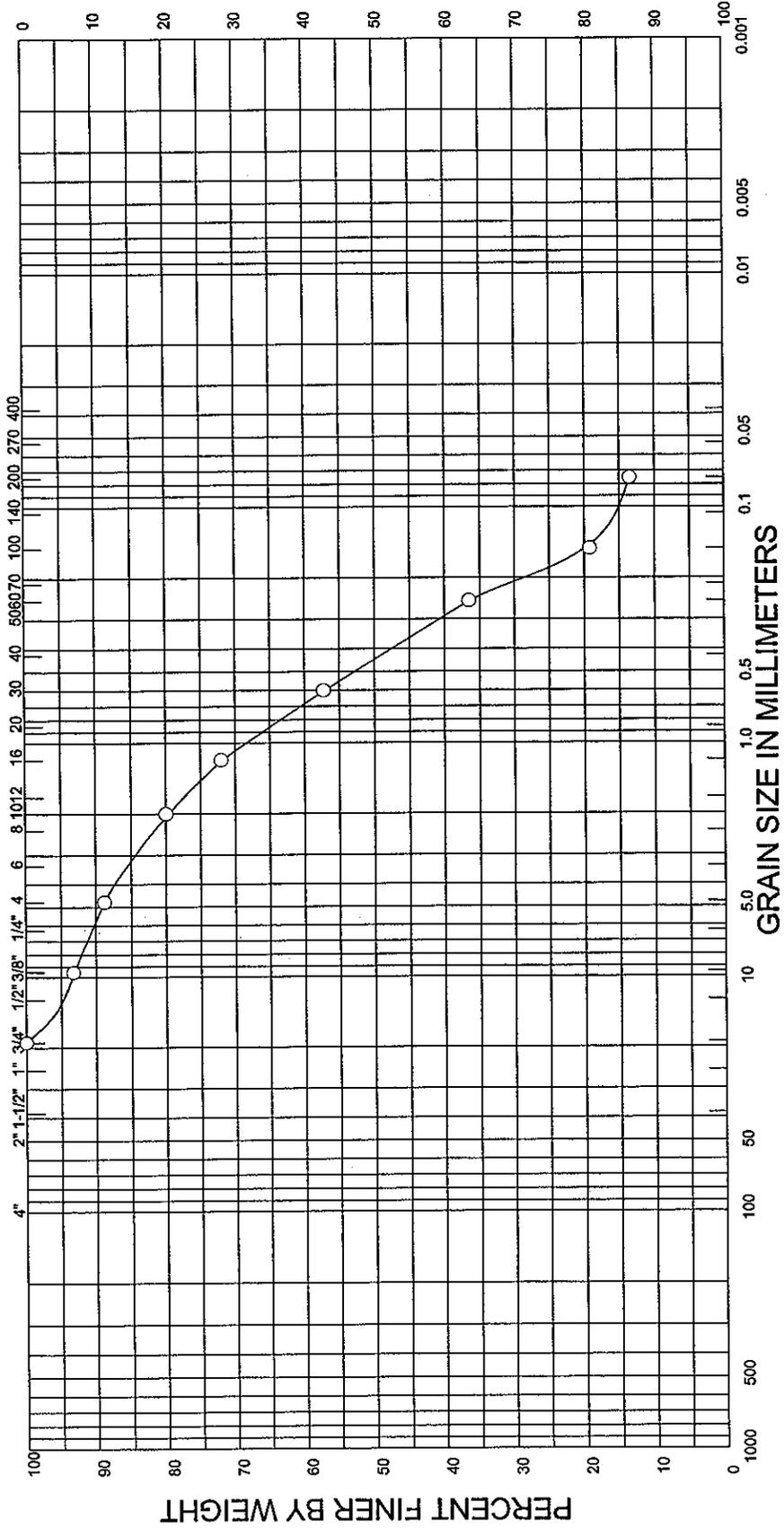
DATE: 5/05

PROJECT: Hatch Mott MacDonald - MCUA - Edison PSFM

Boring & Sample Number	Depth (ft)	Classification	Natural Water Content %	Atterberg Limits		Unconfined Compression		Unit Dry Weight PCF	Specific Gravity	Permeability cm/sec @ 20 deg C	Compaction	Grain Size	Consolidation	Triaxial	CBR	pH	Organic Content %
				Liquid Limit	Plastic Limit	Stress TSF	Strain %										
B-16	45 - 47	Brown mf GRAVEL, and- cmf Sand, trace+ Silt	11									*					
S-15																	
B-17	11 - 13	Grey & Dark Grey mf+ SAND, little Silt, trace mf Gravel	20									*					
S-6																	
B-17	20 - 22	Grey cm+ SAND, little Organic Silt, trace mf Gravel	23									*					1.3
S-9B																	
B-17	30 - 32	Red Brown cm+ SAND, some- mf+ Gravel, trace+ Silt	18									*					
S-11																	
B-17	40 - 42	Brown cm+f SAND, little- f Gravel, trace+ Silt	19									*					
S-13																	
B-18	8 - 10	Grey & Brown Mottled SILT & CLAY, little+ mf Sand	25	27	18							*					2.0
S-5																	
B-18	12 - 14	Grey, Red Brown & Light Grey CLAY, some cm+ Sand, trace mf Gravel	24									*					
S-7																	
B-18	20 - 22	Yellow Brown SILT, and+ f Sand	26									*					
S-11																	
B-18	30 - 32	Grey Silty CLAY, trace- f Sand	25									*					
S-13																	
B-18	40 - 42	Grey SILT, some- f Sand	22									*					
S-15B																	

* SEE TEST CURVES

U.S. STANDARD SIEVE NUMBER



PERCENT COARSER BY WEIGHT

PERCENT FINER BY WEIGHT

BURMISTER CLASSIFICATION	GRAVEL		SAND		SILT OR CLAY	
	m	f	m	f	mm	Sieves
	76.2	25.4	0.59	0.25	0.074	200
	3 in.	1 in.	3/8 in.	60	200	200

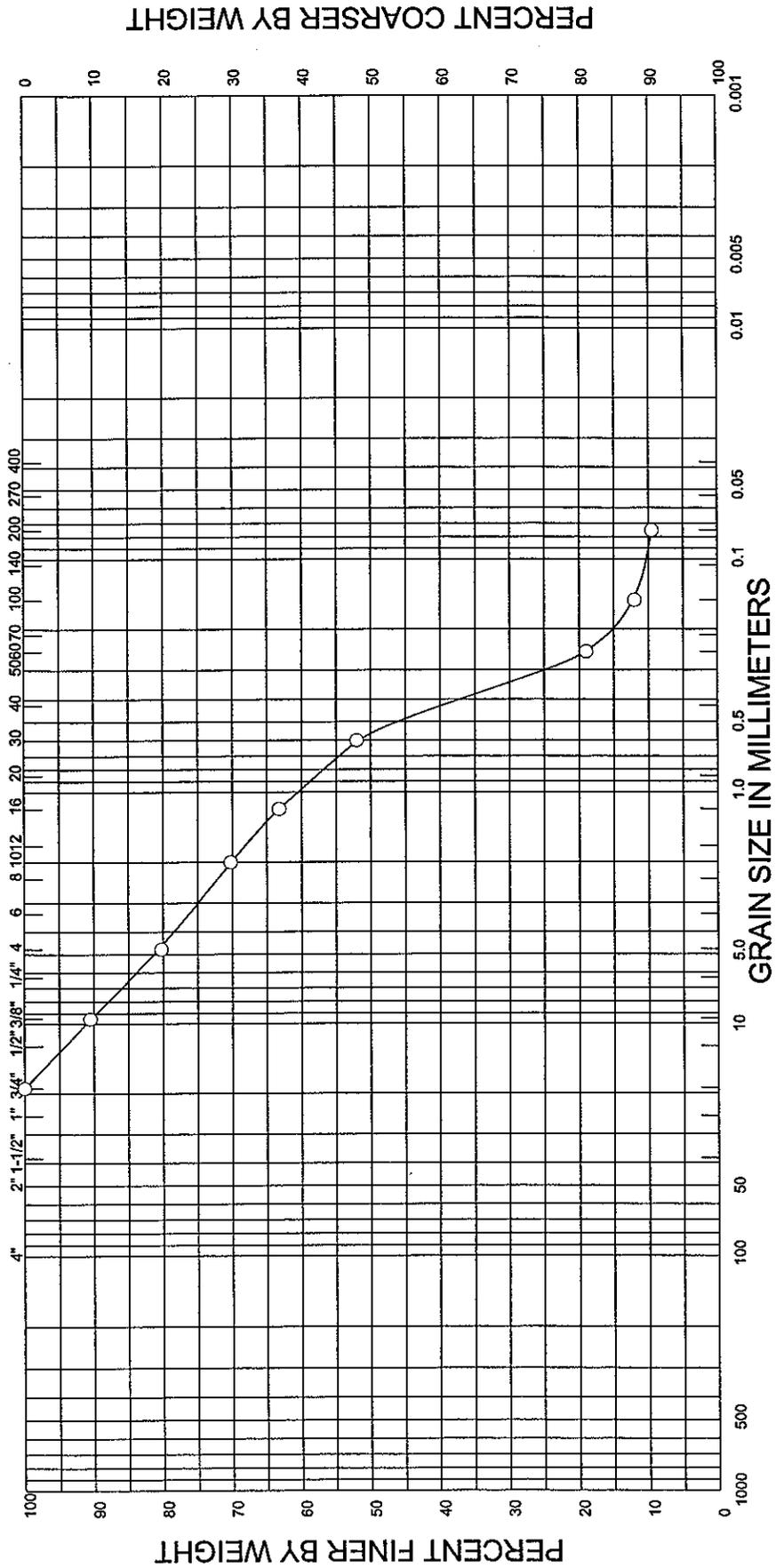
04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

B-13, S-6 10' - 12'

Grey cmf SAND, some- mf+ Gravel, little Clayey Silt

GRADATION CURVE

U.S. STANDARD SIEVE NUMBER



BIRMISTER CLASSIFICATION	COBBLES		GRAVEL		SAND		SILT OR CLAY	
	c	m	f	m	c	f	m	f
	76.2	25.4	9.52	0.59	0.074	0.074	0.074	0.074
	3 in.	1 in.	3/8 in.	30	200	200	200	200
			Nos. 10					

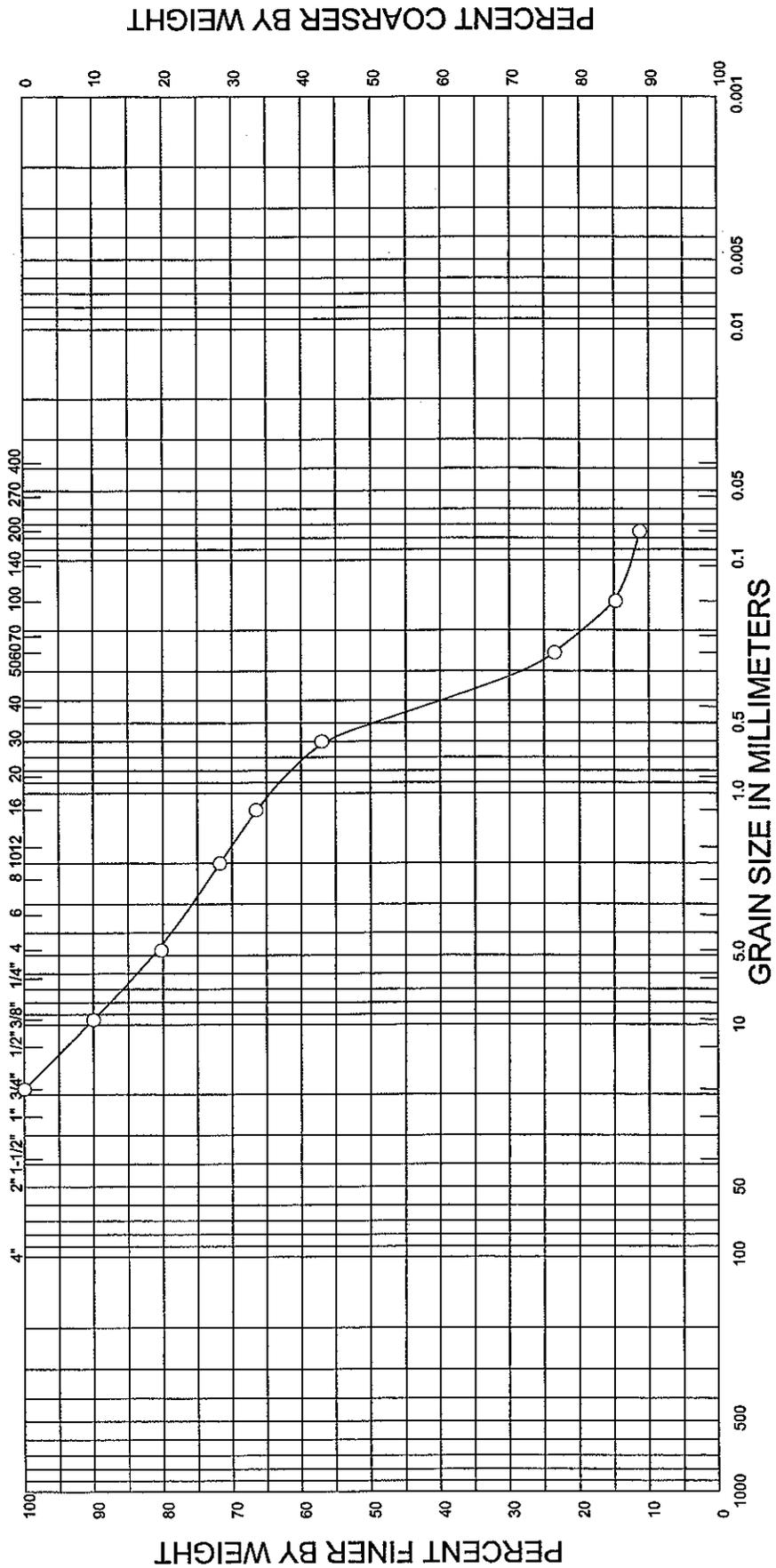
04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

B-13, S-12 25' - 27'

Brown cm+ SAND, some mf+ Gravel, trace+ Silt

GRADATION CURVE

U.S. STANDARD SIEVE NUMBER



BIRMINGHAM CLASSIFICATION	COBBLES		GRAVEL		SAND			SILT OR CLAY	
	c	m	f	m	c	m	f	mm	mm
	76.2	25.4	9.52	0.25	0.074	0.074	0.074	0.074	0.074
	3 in.	1 in.	3/8 in.	60	200	200	200	200	200

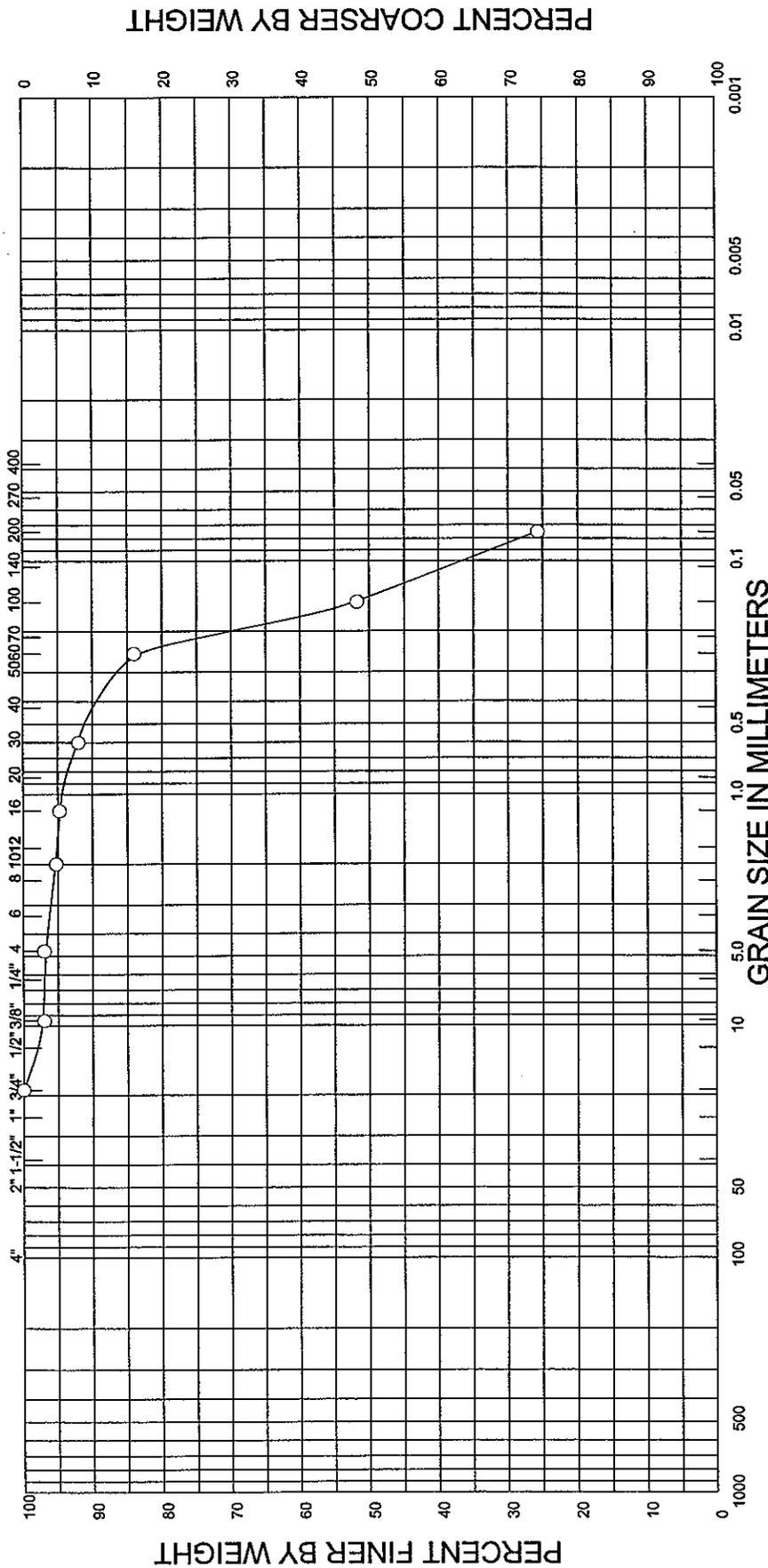
04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

B-13, S-13 30' - 32'

Red Brown cm+f SAND, some mf+ Gravel, little-Silt

GRADATION CURVE

U.S. STANDARD SIEVE NUMBER



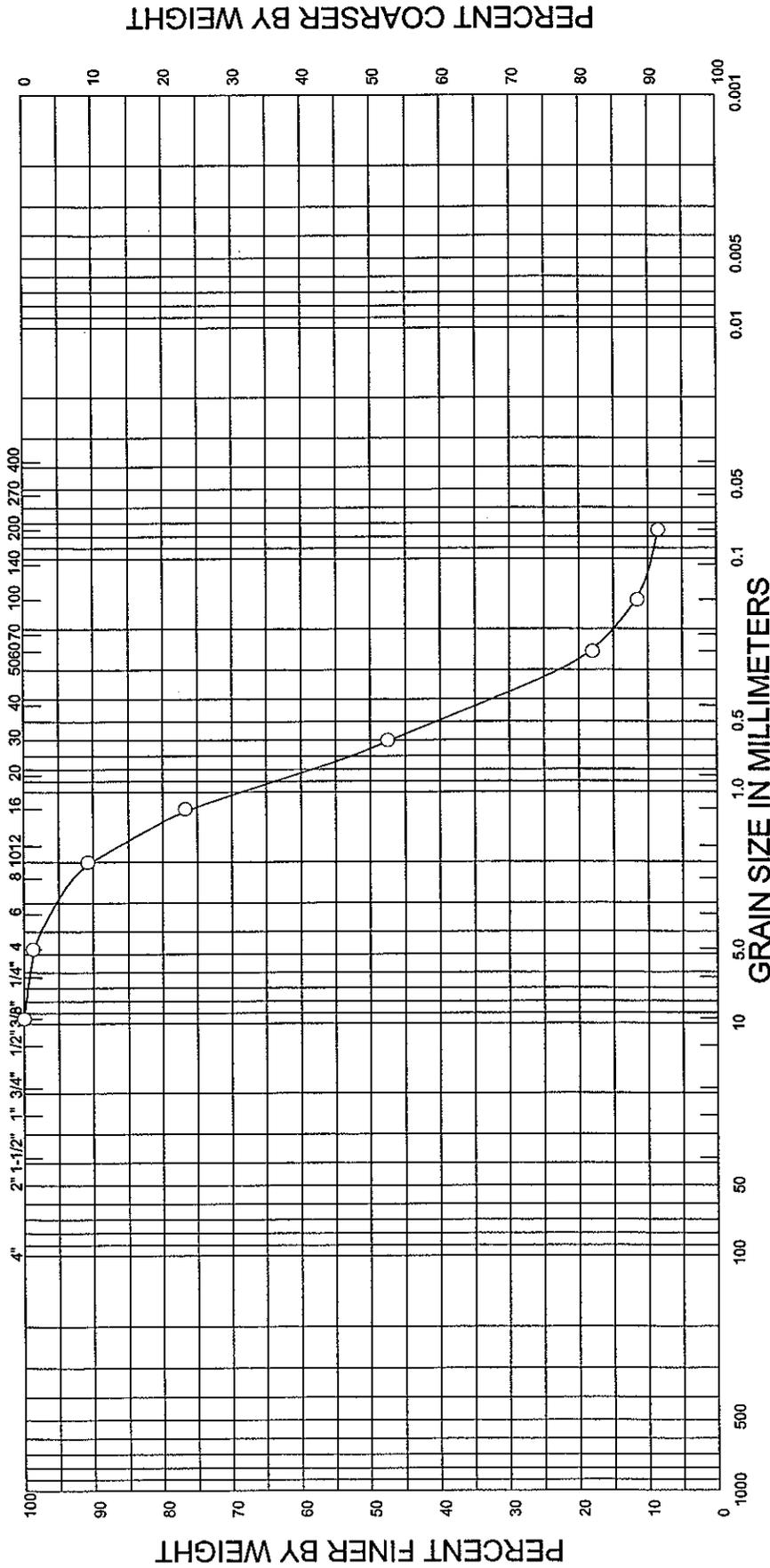
COBBLES		GRAVEL		SAND		SILT OR CLAY	
c	m	f	c	m	f	mm	mm
76.2	25.4	9.52	2.0	0.59	0.074	0.075	0.0075
3 in.	1 in.	3/8 in.	Nos. 10	60	200	0.075	0.0075

04L021A Hatch Mott MacDonald - MQUA - Edison PSFM
 B-14, S-4 6' - 8'
 Tan f SAND, some Silt, trace mf Gravel

GRADATION CURVE



U.S. STANDARD SIEVE NUMBER



BURMISTER CLASSIFICATION	COBBLES		GRAVEL		SAND		SILT OR CLAY	
	c	m	f	m	m	f	Millimeters	Sieves
	76.2	25.4	9.52	0.59	0.25	0.074	200	200
	3 in.	1 in.	3/8 in.	30	60	200		

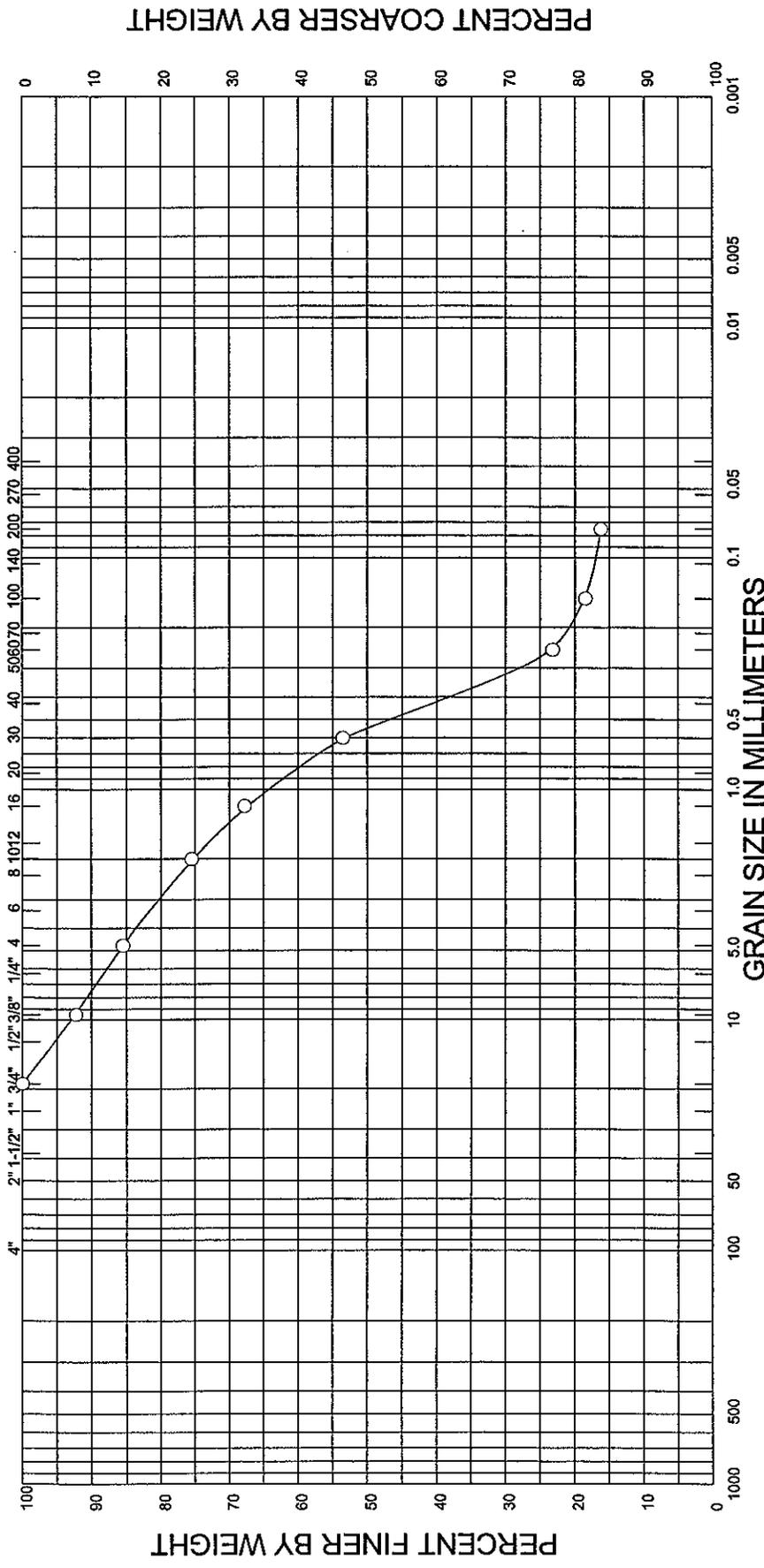
04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

B-14, S-9 16' - 18'

Light Brown c+m SAND, trace+ f Gravel, trace+ Silt

GRADATION CURVE

U.S. STANDARD SIEVE NUMBER



BURMISTER CLASSIFICATION	COBBLES		GRAVEL		SAND		SILT OR CLAY	
	c	m	f	m	m	f	Millimeters	Sieves
	76.2	25.4	9.52	2.0	0.59	0.074	200	
	3 in.	1 in.	3/8 in.	Nos. 10	30	60		

04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

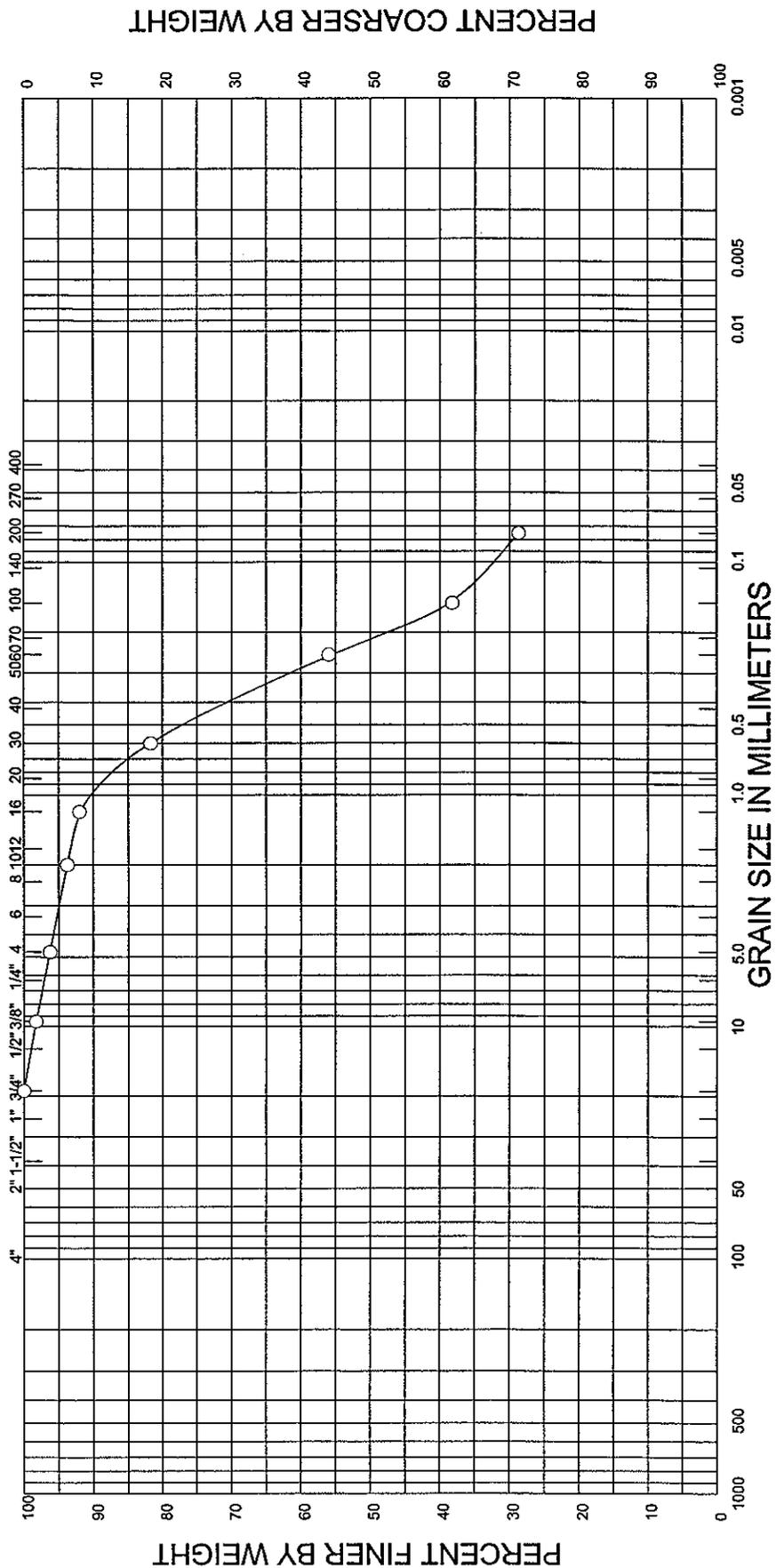
B-14, S-12 25' - 27'

Grey cm+ SAND, some- mf+ Gravel, little Silt

GRADATION CURVE



U.S. STANDARD SIEVE NUMBER



BIRMINGHAM CLASSIFICATION	COBBLES		GRAVEL		SAND			SILT OR CLAY				
	C	m	f	m	c	m	f	m	f			
	76.2	25.4	9.52	4.75	0.85	0.425	0.25	0.075	0.045	0.025	0.015	0.0075
	3 in.	1 in.	3/8 in.	1/4 in.	No. 20	No. 40	No. 60	No. 200	No. 400	No. 600	No. 1000	No. 2000

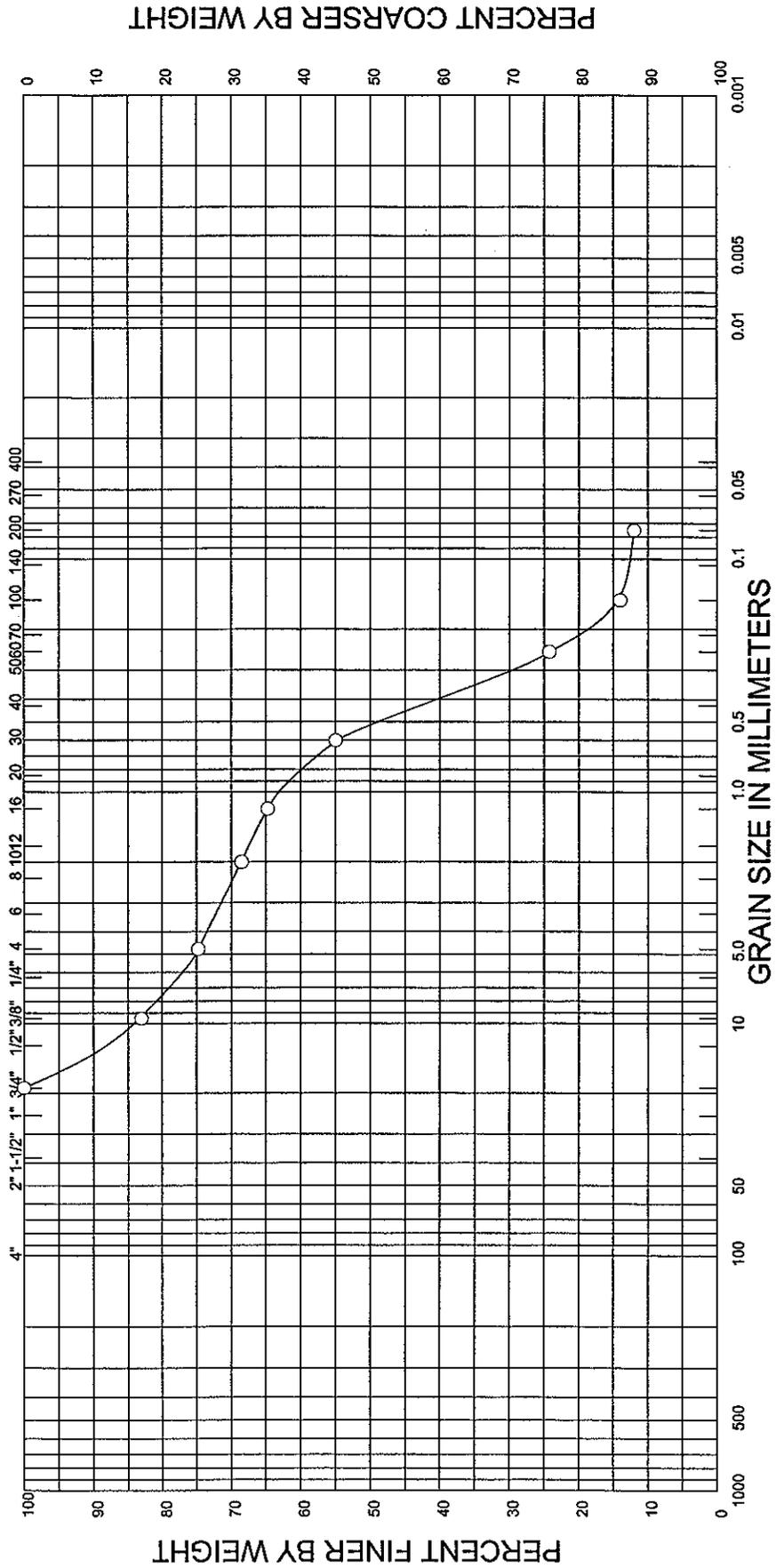
04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

B-15, S-4 6' - 8'

Brown c-mf SAND, some Clayey Silt, trace mf+ Gravel

GRADATION CURVE

U.S. STANDARD SIEVE NUMBER



BURMISTER CLASSIFICATION	COBBLES		GRAVEL		SAND		SILT OR CLAY	
	c	f	m	f	m	f	m	f
	76.2	25.4	9.52	4.75	0.59	0.25	0.074	0.0075
	3 in.	1 in.	3/8 in.	No. 10	Nos. 10	Nos. 60	200	0.0075

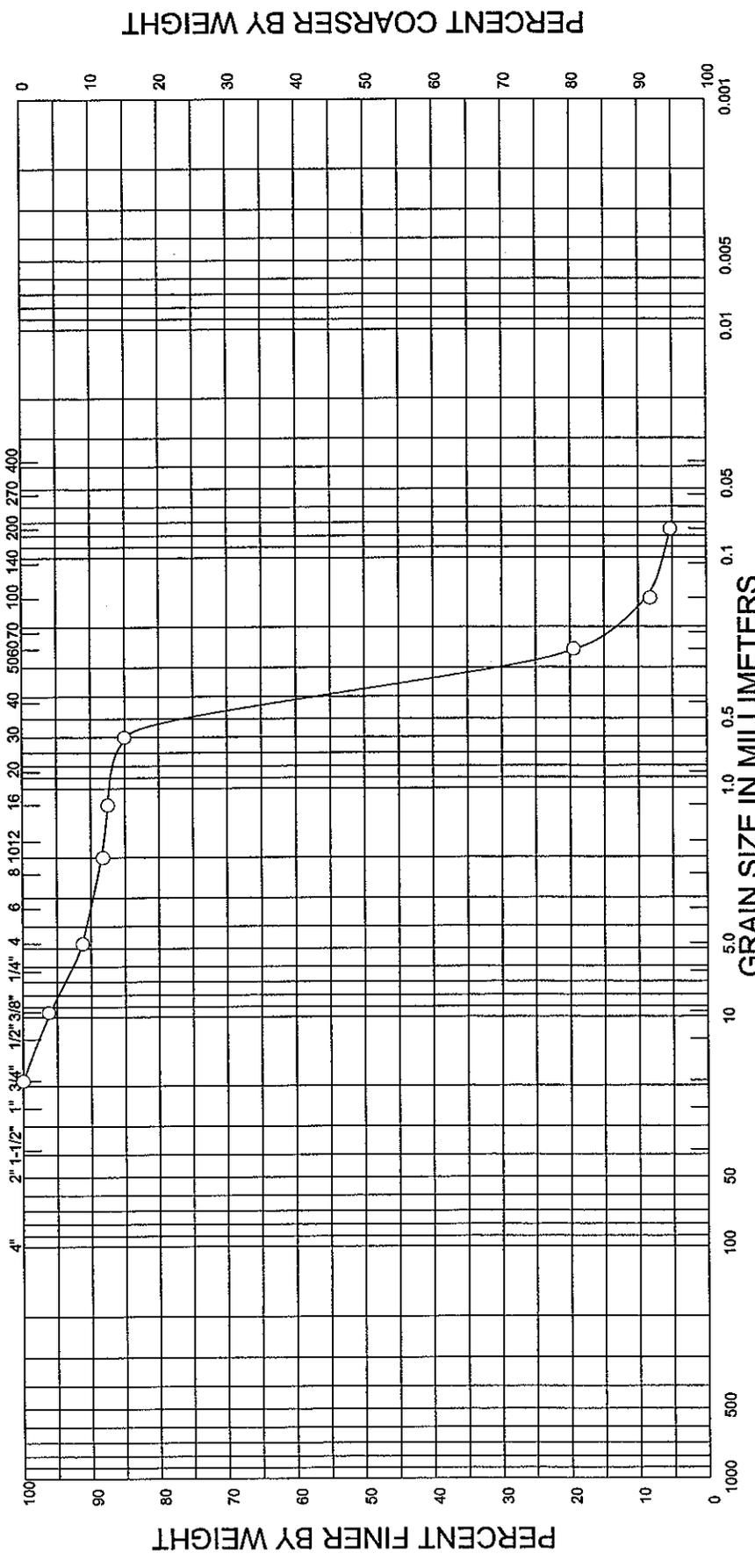
04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

B-15, S-12 25' - 27'

Grey cm+f SAND, some+ mf Gravel, little- Silt

GRADATION CURVE

U.S. STANDARD SIEVE NUMBER



PERCENT COARSER BY WEIGHT

PERCENT FINER BY WEIGHT

BURMISTER CLASSIFICATION	COBBLES		GRAVEL		SAND			SILT OR CLAY	
	c	m	f	m	c	m	f	Millimeters	Sieves
	76.2	25.4	9.52	2.0	0.59	0.25	0.074		200
	3 in.	1 in.	3/8 in.	Nos. 10	30	60	200		

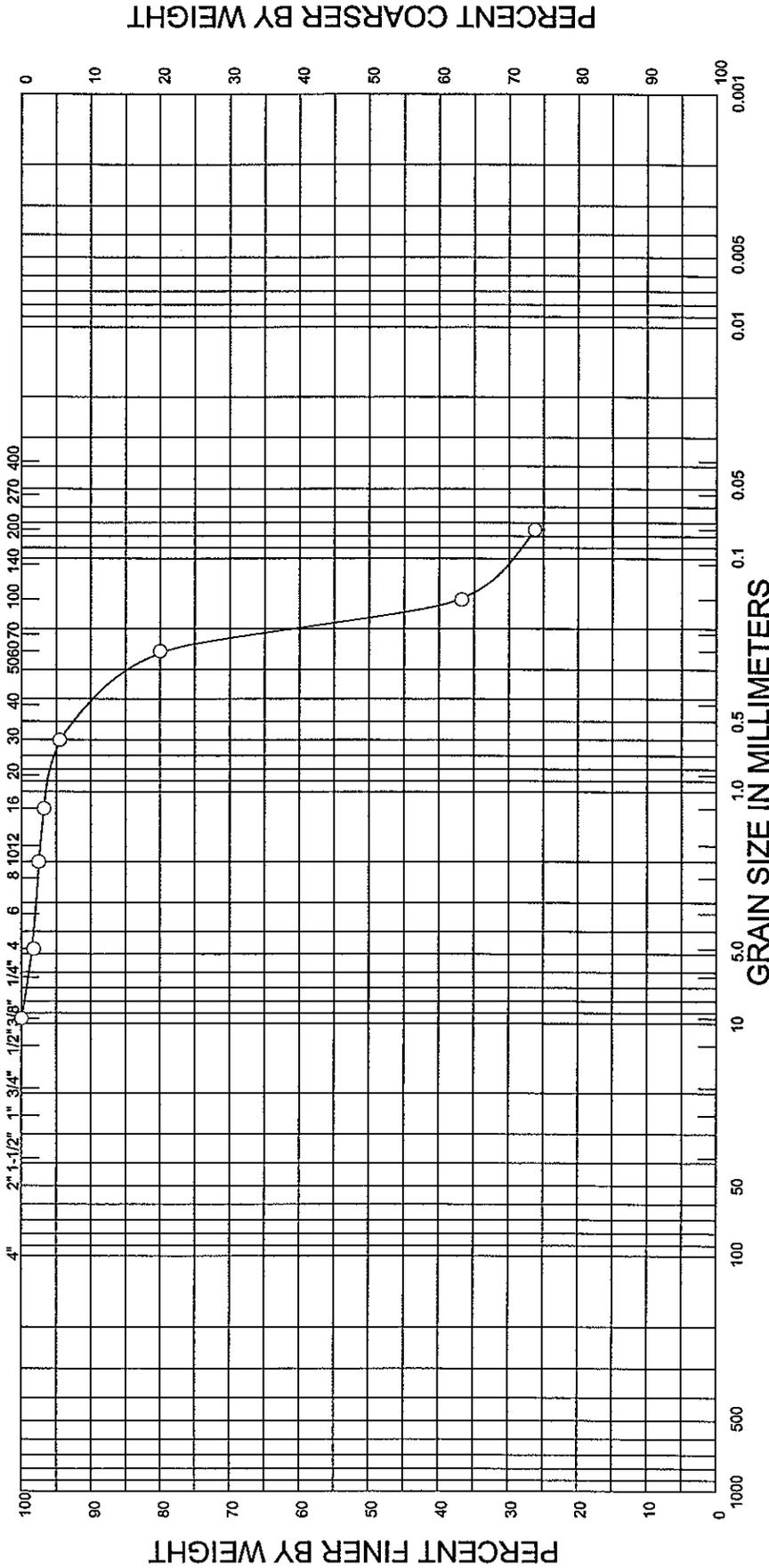
04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

B-15, S-15 40' - 42'

Dark Grey m+f SAND, little- mf+ Gravel, trace Silt

GRADATION CURVE

U.S. STANDARD SIEVE NUMBER



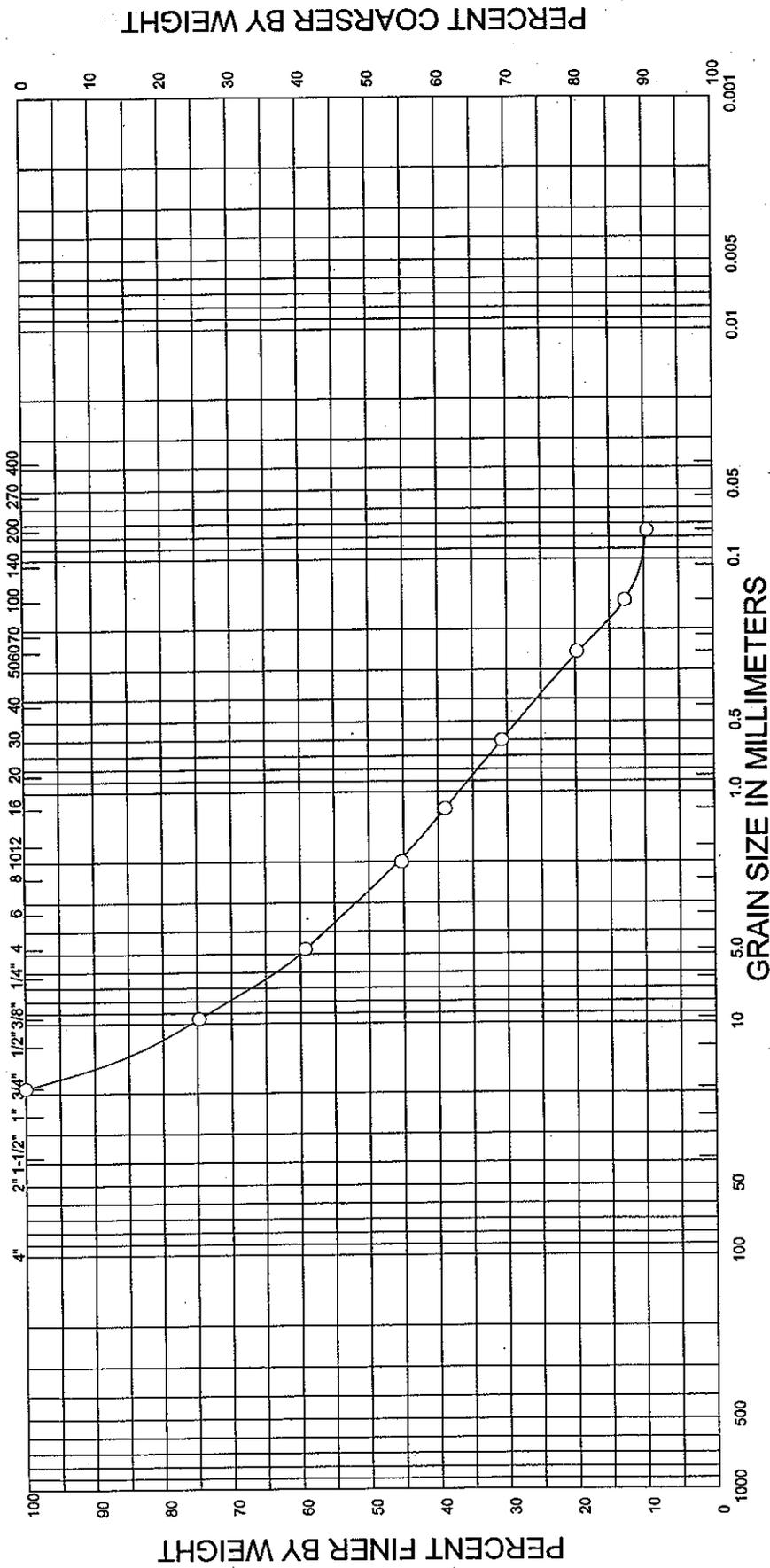
BURMISTER CLASSIFICATION	COBBLES		GRAVEL		SAND		SILT OR CLAY	
	c	m	f	c	m	f	0.075	0.0075
	76.2	25.4	9.52	2.0	0.59	0.25	0.074	0.005
	3 in.	1 in.	3/8 in.	Nos. 10	30	60	200	0.001

04L021A Hatch Mott MacDonald - MCUA - Edison PSFM
 B-16, S-6 10' - 12'
 Grey & Red Brown mf+ SAND, some Clayey Silt, trace- f Gravel

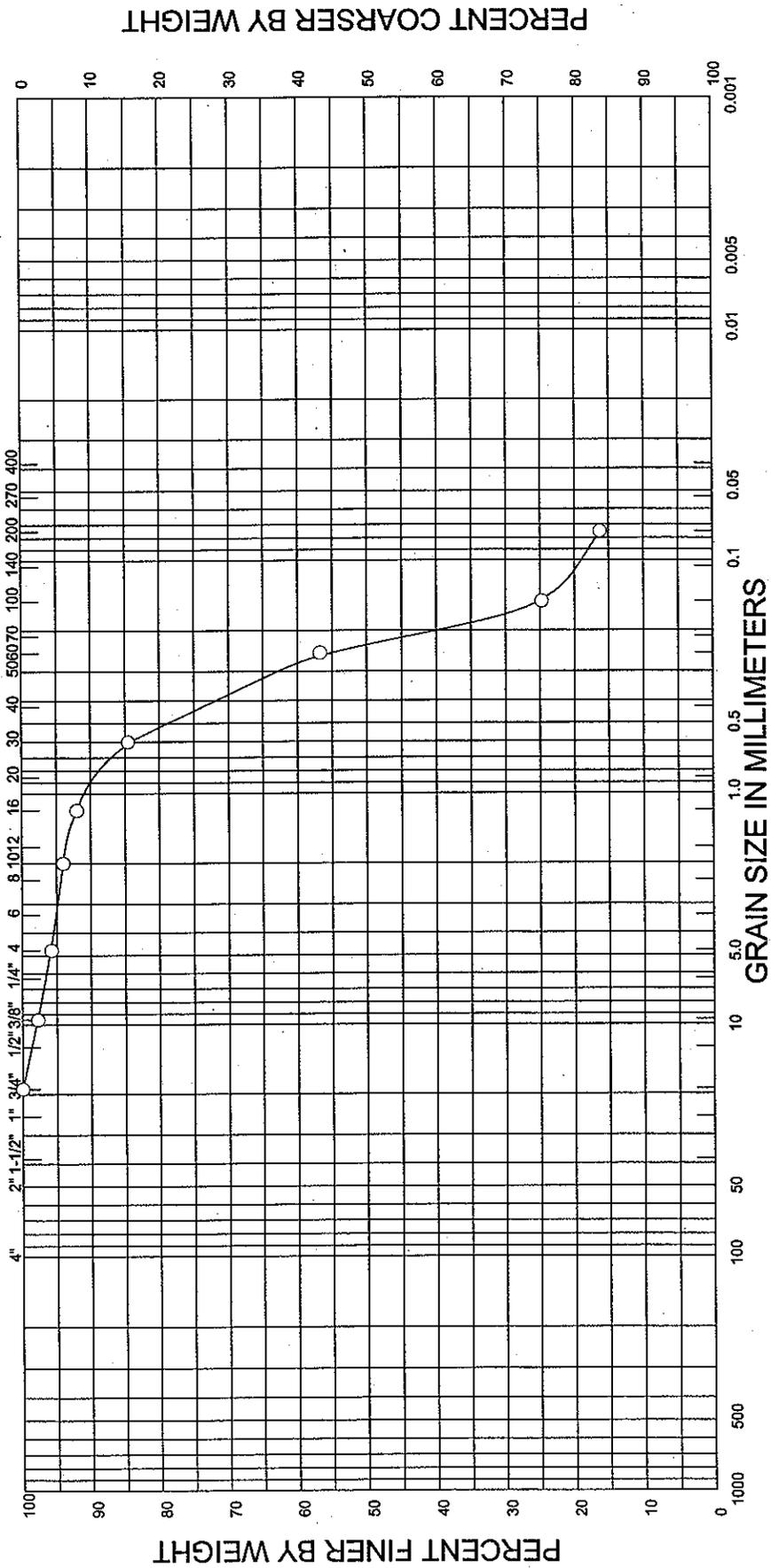
GRADATION CURVE



U.S. STANDARD SIEVE NUMBER



U.S. STANDARD SIEVE NUMBER



BURMISTER CLASSIFICATION	COBBLES		GRAVEL		SAND		SILT OR CLAY	
	c	m	f	m	f	m	f	
	76.2	25.4	9.52	0.59	0.25	0.074	0.005	0.001
	3 in.	1 in.	3/8 in.	30	60	200	0.01	0.001
			Nos. 10			Millimeters		
						Sieves		

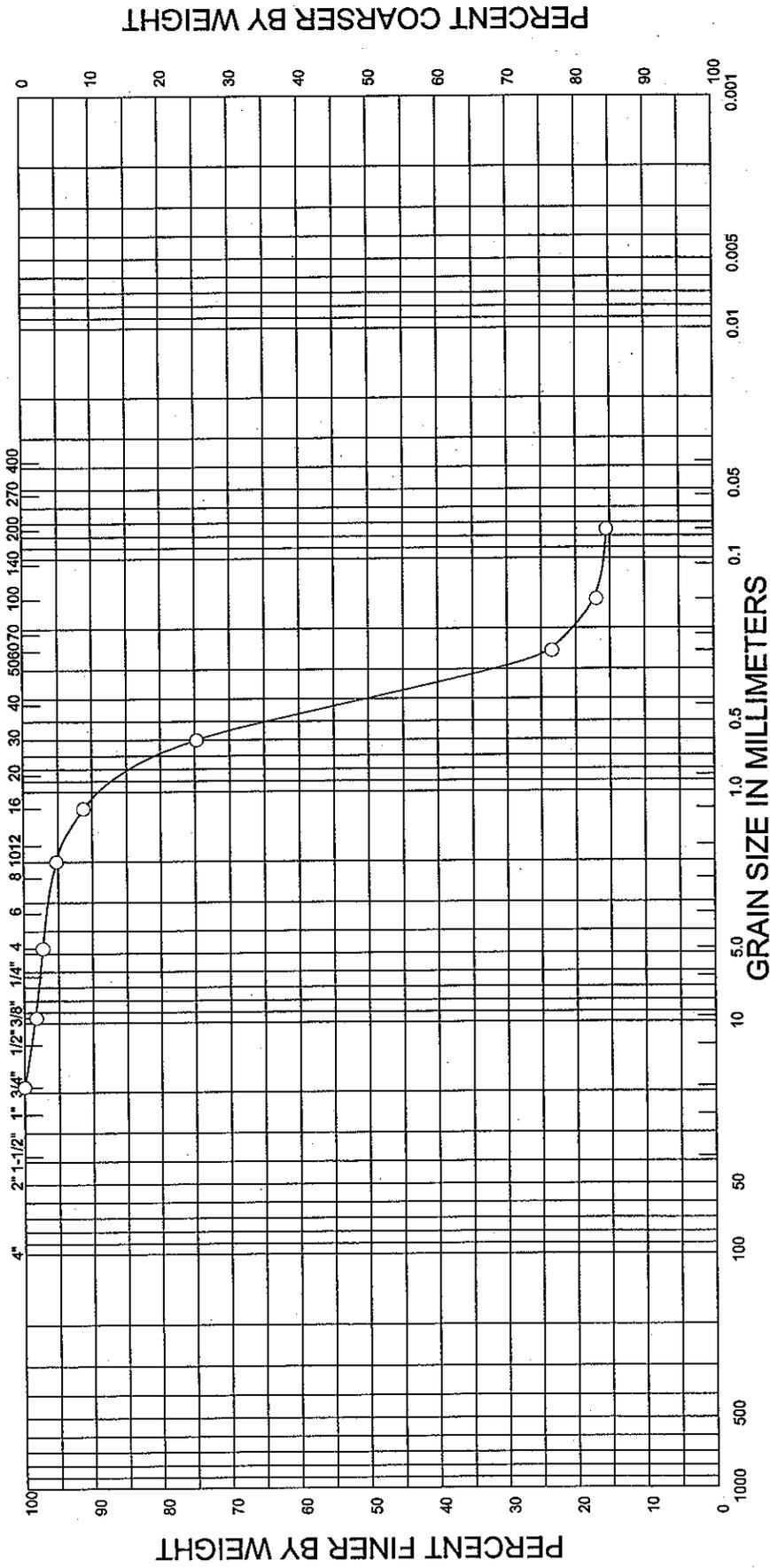
04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

B-17, S-6 11' - 13'

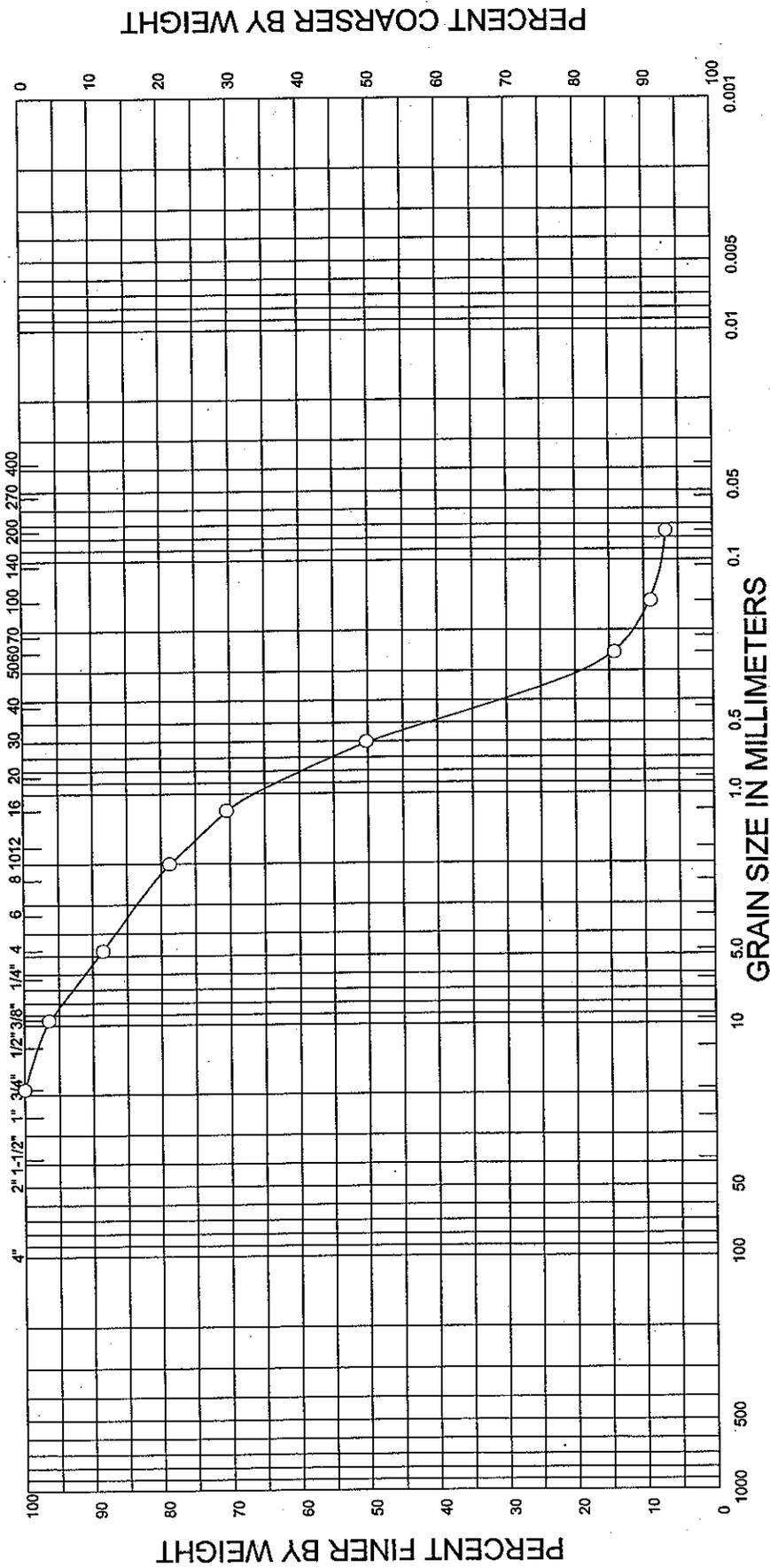
Grey & Dark Grey mf+ SAND, little Silt, trace mf Gravel

GRADATION CURVE

U.S. STANDARD SIEVE NUMBER



U.S. STANDARD SIEVE NUMBER



BURMISTER CLASSIFICATION	COBBLES		GRAVEL		SAND			SILT OR CLAY	
	c	m	f	m	m	f	Millimeters	Sieves	
	76.2	25.4	9.52	2.0	0.59	0.25	0.074	200	
	3 in.	1 in.	3/8 in.	Nos. 10	30	60			

04L021A Hatch Mott MacDonald - MCUA - Edison PSFM

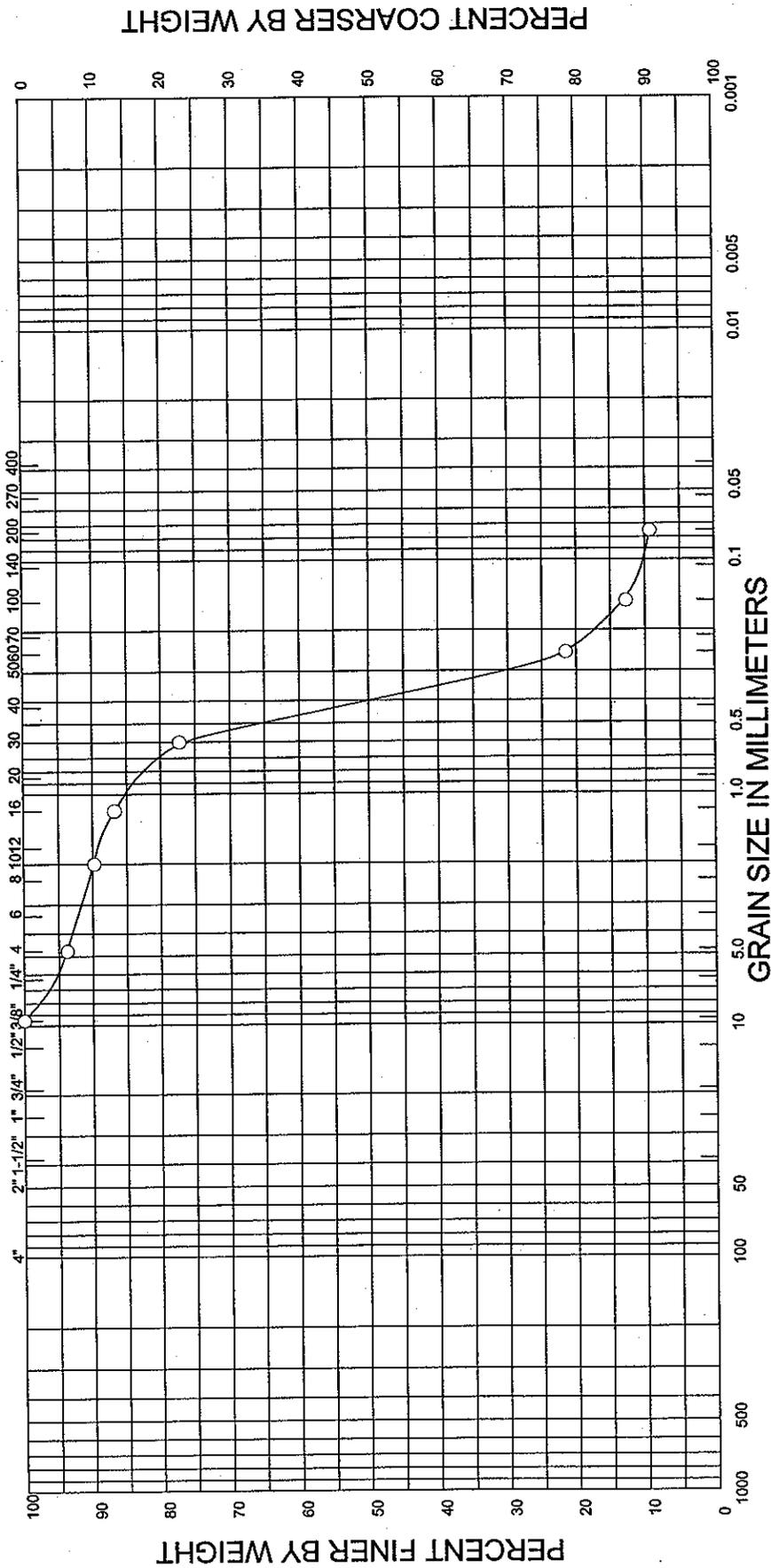
B-17, S-11 30' - 32'

Red Brown cm+ SAND, some- mf+ Gravel, trace+ Silt

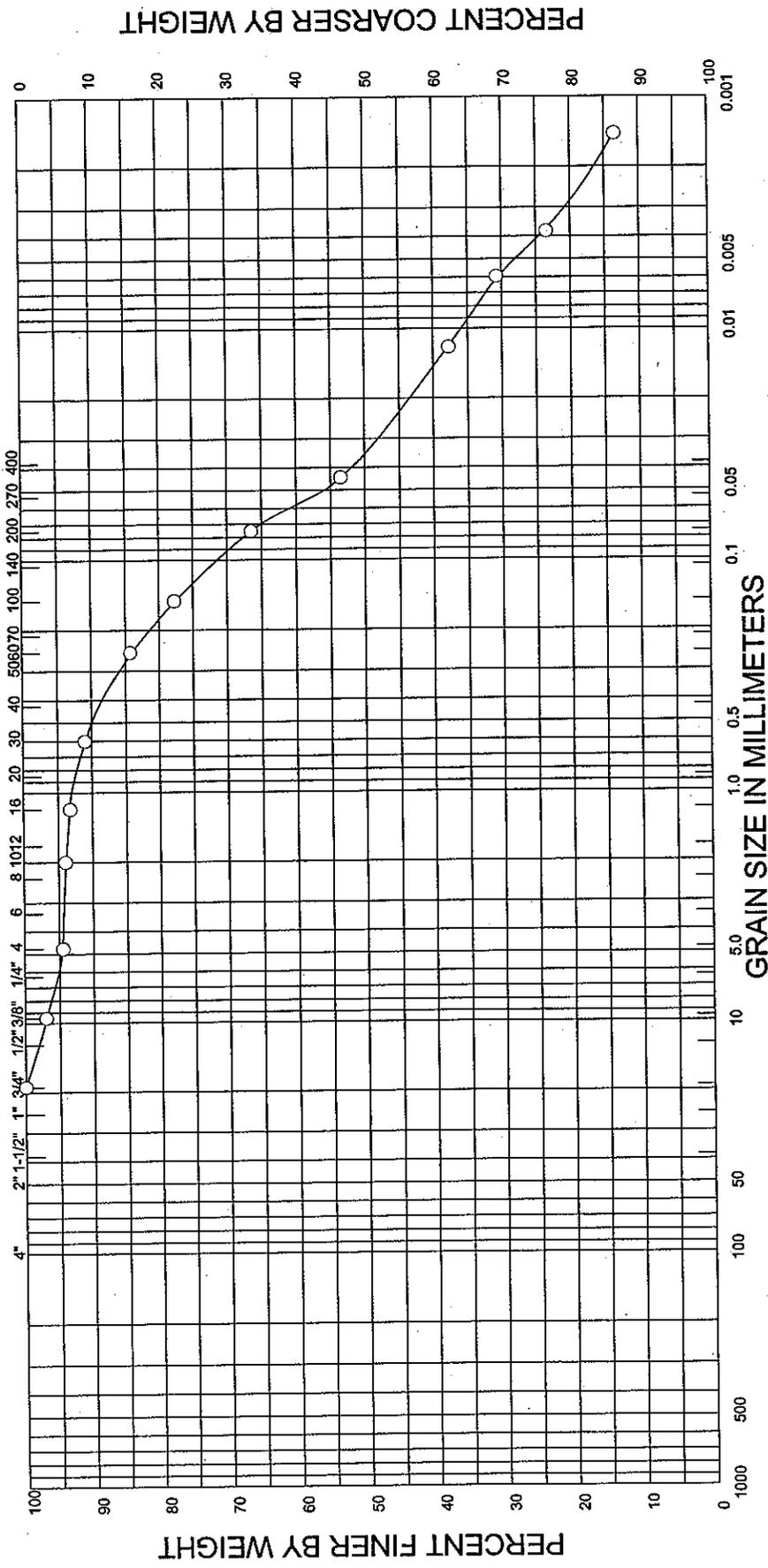
GRADATION CURVE



U.S. STANDARD SIEVE NUMBER



U.S. STANDARD SIEVE NUMBER

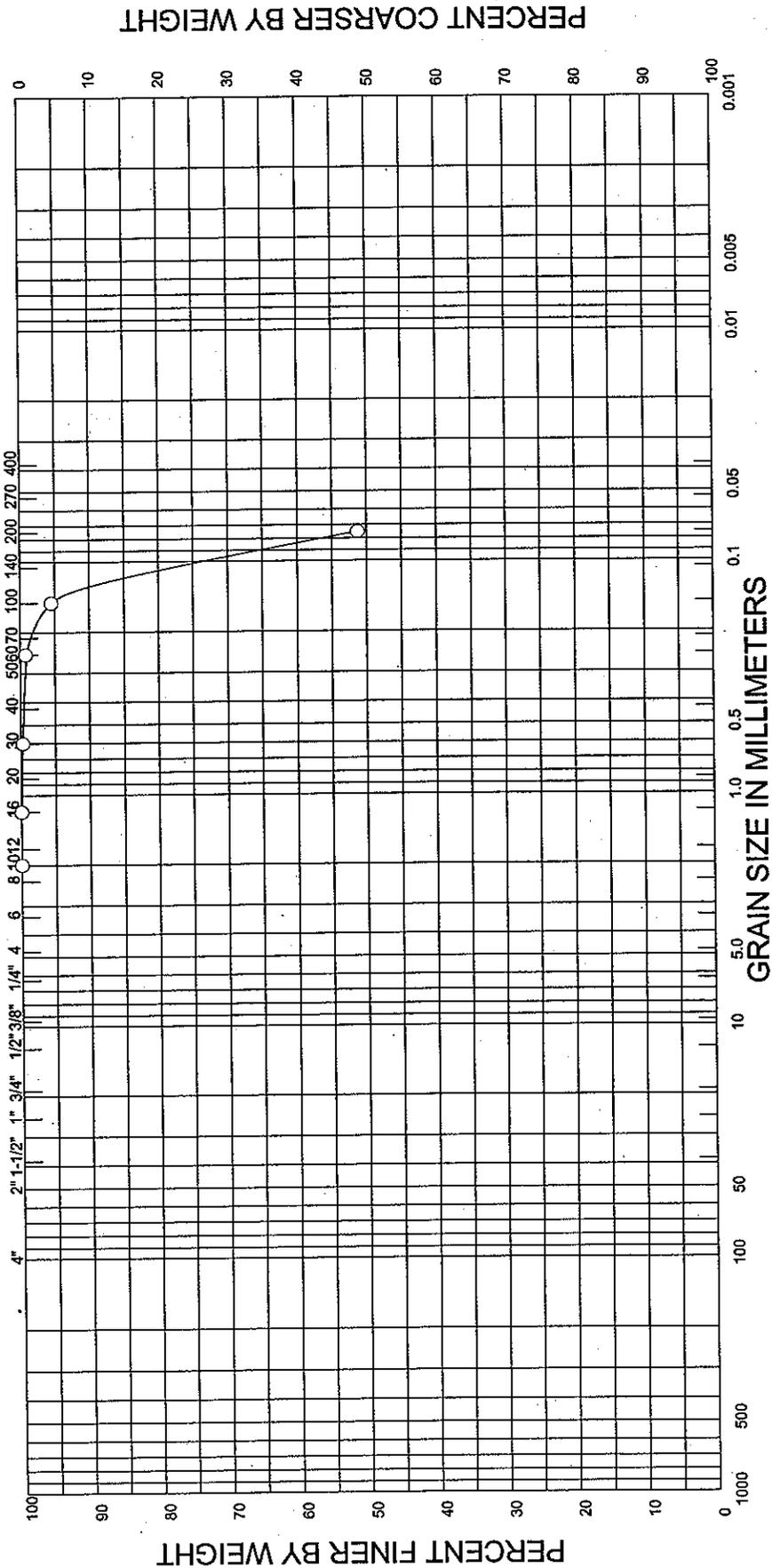


BURMISTER CLASSIFICATION	COBBLES		GRAVEL		SAND			SILT OR CLAY	
	c	m	f	m	c	m	f	Millimeters	Sieves
	76.2	25.4	9.52	0.59	0.074	0.25	0.075	200	
	3 in.	1 in.	3/8 in.	30	60	200			
04L021A Hatch Mott MacDonald - MCUA - Edison PSFM									
B-18, S-7 12' - 14'									
Grey, Red Brown & Light Grey CLAY, some cmf+ Sand, trace mf Gravel									

GRADATION CURVE



U.S. STANDARD SIEVE NUMBER



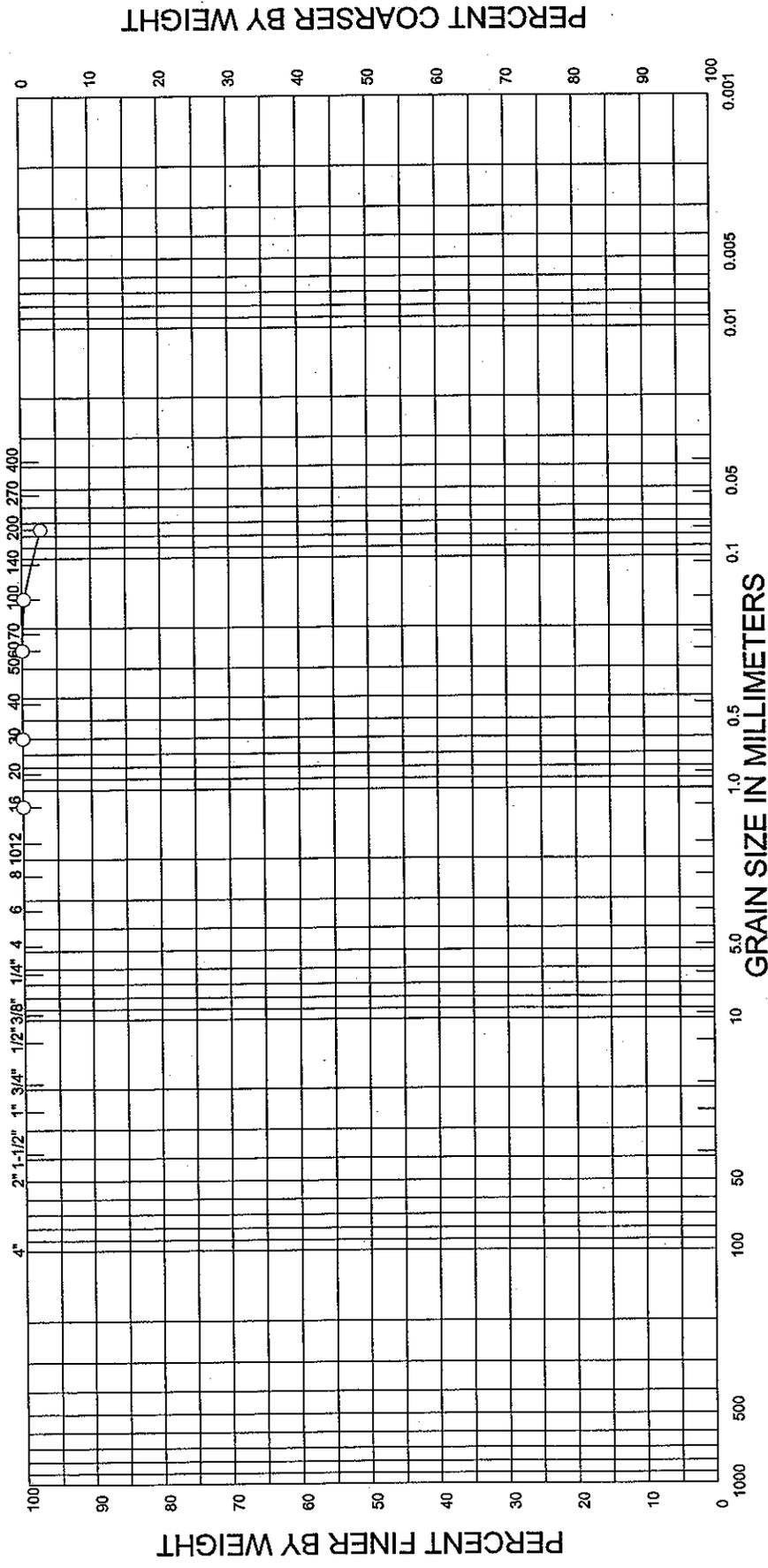
COBBLES		GRAVEL		SAND			SILT OR CLAY	
c	m	f	m	m	f	Millimeters	Sieves	
76.2	25.4	9.52	0.59	0.25	0.074	200		
3 in.	1 in.	3/8 in.	30	60	200			

04L021A Hatch Mott MacDonald - MCUA - Edison PSFM
 B-18, S-11 20' - 22'
 Yellow Brown SILT, and+ f Sand

GRADATION CURVE



U.S. STANDARD SIEVE NUMBER

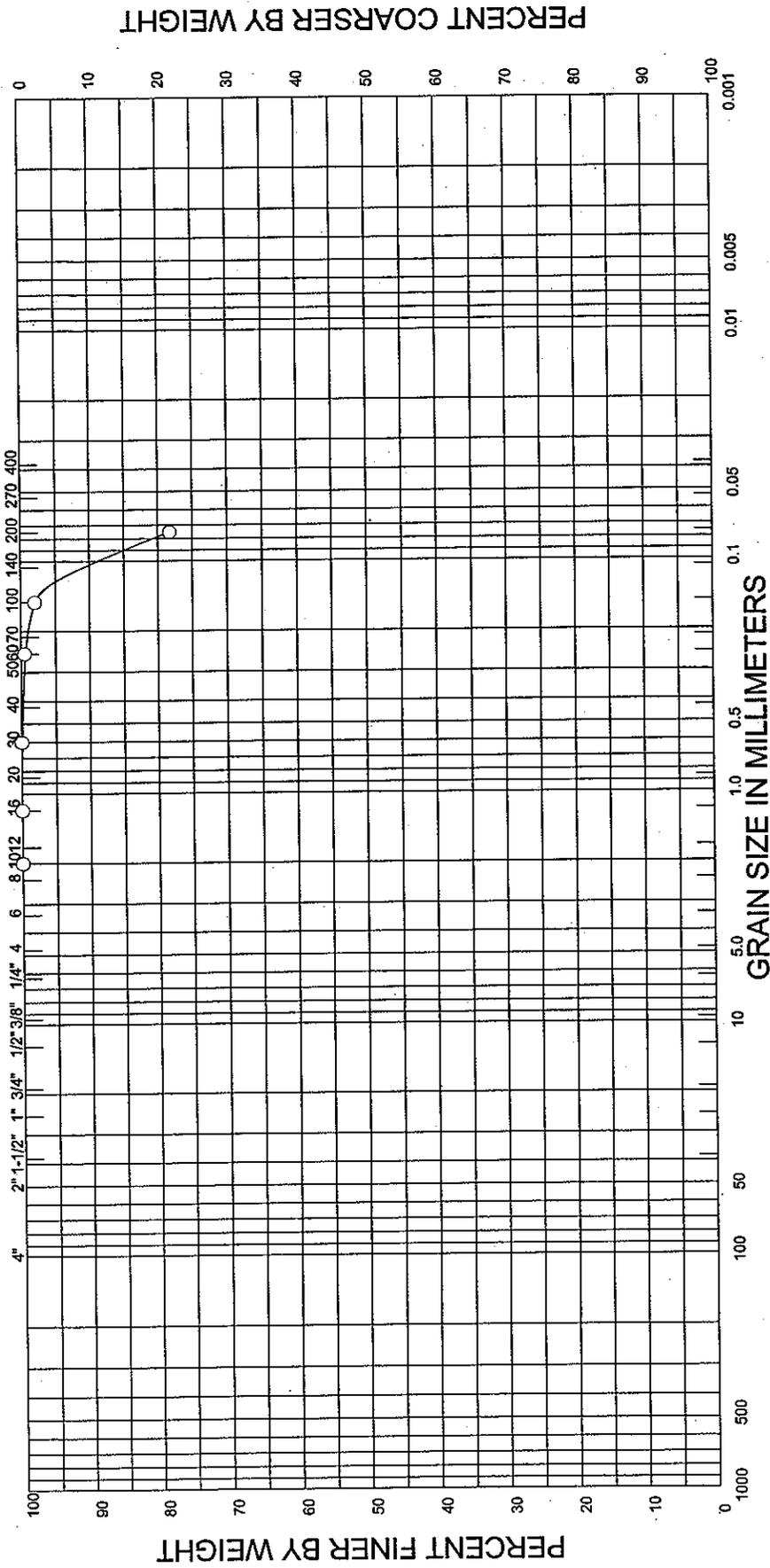


BIRMINGHAM CLASSIFICATION	COBBLES		GRAVEL		SAND			SILT OR CLAY	
	c	m	f	c	m	f	mm	mm	
	76.2	25.4	9.52	2.0	0.59	0.25	0.074	200	
	3 in.	1 in.	3/8 in.	Nos. 10	30	60	200		

04L021A Hatch Mott MacDonald - MCUA - Edison PSFM
 B-18, S-13 30' - 32'
 Grey Silty CLAY, trace- f Sand

GRADATION CURVE

U.S. STANDARD SIEVE NUMBER



BIRMINGHAM CLASSIFICATION	COBBLES		GRAVEL		SAND			SILT OR CLAY		
	C	f	m	f	m	f	Millimeters	Sieves		
	76.2	3 in.	25.4	1 in.	9.52	3/8 in.	0.59	30	0.074	200
							0.25	60		
							0.075	20		
							0.075	20		

04L021A Hatch Mott MacDonald - MCUA - Edison PSFM
 B-18, S-15B 40' - 42'
 Grey SILT, some- f Sand

GRADATION CURVE

[References]
Appendix E

References

1. - Goodman, Richard E., *Introduction to Rock Mechanics, 2nd Ed.*, John Wiley and Sons, 1989.
2. - Das, Braja M., *Principals of Foundation Engineering, 5th Ed.*, Brooks/Cole-Thomson Learning, 2004.
3. - Bowles, Joseph E., *Foundation Analysis and Design, 5th Ed.*, McGraw Hill, 1996.
4. - Department of the Navy, NAVFAC (1982), *Soil Mechanics Design Manual 7.1 and Foundations And Earth Structures 7.2*, Alexandria, VA.
5. - IBC, *The International Building Code – New Jersey Edition*, 2000.
6. - ASCE, *Minimum Design Loads for Buildings and Other Structures*, SEI/ASCE 7-02, Alexandria, VA.