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July 19, 2013
Revised February 21, 2014

EMH&T, Inc.
5500 New Albany Road
Columbus, Ohio 43054

Attention: Mr. Michael Brehm, P.E.

Reference: Geotechnical Exploration - Final
City of Columbus - Hayden Run Boulevard, Part II (2302 Dr. E)
Columbus, Ohio
CTL Project No. 09050029COL

Dear Mr. Brehm:

CTL Engineering, Inc. has completed the Geotechnical Exploration for the above referenced structure. Enclosed is one copy of the Final Report.

Thank you for the opportunity to work with you on this project. If you have any questions or need further information, please feel free to contact our office.

Respectfully Submitted

CTL ENGINEERING, INC.

Joe Grani, P.E.
Project Engineer

GEOTECHNICAL EXPLORATION-FINAL

GEOTECHNICAL EXPLORATION-FINAL
CITY OF COLUMBUS-HAYDEN RUN BLVD, PART II (2302 DR. E)
COLUMBUS, OHIO
CTL PROJECT NO. 09050029COL

PREPARED FOR:

EMH&T, INC.
5500 NEW ALBANY ROAD
COLUMBUS, OHIO 43054

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February 21, 2014

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I. PROJECT LOCATION AND DESCRIPTION

The project involves the construction of the City of Columbus, Hayden Run Boulevard, Part II (2302 Dr. E). The project begins at the current eastern terminus of Hayden Run Boulevard, near the intersection with Golden Cascade Drive, Station 87+86.59, and ends at Avery Road, Station 112+31.61.

Some widening and improvements are also planned along Avery Road and a new retention or detention basin is planned east of Avery Road. New traffic signal mast arm installations are planned at the intersection of Hayden Run Boulevard and Avery Road. A new pump station was planned near station 102+30, 70' right. The bottom of the pump station was to be constructed about 35 feet below existing grade.

The initial plan was to have Hayden Run Boulevard cross under the existing railroad, with a proposed bridge to carry the railroad over Hayden Run Boulevard at or near the existing grade. This would have required a temporary relocation of the railroad in the area of the bridge. The current plan is to take Hayden Run Boulevard up and over the existing railroad. The proposed bridge for Hayden Run Boulevard over the railroad will be a single-span structure. Current plans indicate MSE Retaining Walls at both abutments of the proposed bridge, and along the north side of Hayden Run Boulevard east of the bridge.

Hayden Run Boulevard will be constructed over the existing railroad. Maximum cut depths and fill embankments along the proposed centerline of Hayden Run Boulevard are summarized below.

Station	Maximum Cut (feet)	Maximum Fill (feet)
87+86.59 to 107+50	---	37
107+50 to 112+31.61	2	2

II. SUBSURFACE EXPLORATION

Sixteen (16) soil test borings and one (1) pavement core were initially performed for this project, in 2009. Recently, six (6) additional borings were performed, for the currently proposed roadway embankments, MSE walls, and the new retention or detention basin. The borings were drilled at the approximate locations shown on the appended plan/profile sheets and are summarized below.

Location	Boring Numbers
Hayden Run Boulevard	SB-1 through SB-4
Storm Sewer Outfall	SB-5
Originally Proposed Railroad Bridge	B-1 and B-2
Avery Road Widening	SB-6 through SB-9 and P-1*
Originally Proposed Temporary Railroad Track	RB-1 thru RB-4
Pump Station	PS-1
Proposed MSE Walls	B-003-0-12 through B-007-0-12
Retention or Detention Basin	B-008-0-12

* Pavement Core

The test borings were performed with truck-mounted and track-mounted drill rigs utilizing hollow stem augers (HSA). The initial borings were drilled from March 24 through April 24, 2009. The recent borings were drilled in October and November 2012. Standard penetration tests were conducted in all the borings using 140-pound automatic hammers falling 30 inches to drive a 2-inch O.D. split barrel samplers.

Soil samples obtained were preserved in glass jars, visually classified in the field and laboratory, and tested for natural moisture content. Representative soil samples were subjected to laboratory testing including grain size distribution and Atterberg limits.

Survey information at the test boring locations was provided by EMH&T personnel.

III. SITE GEOLOGY

The site lies on the Columbus Lowland Till Plain. Both the Wisconsin and Illinoian glaciers passed over the area. Soils at the site generally consist of clays and silts over glacial tills with interbedded sand or sand and gravel pockets. Bedrock below the site consists of Devonian Age, limestone of the Columbus formation. No bedrock was encountered in the test borings, which were extended to a maximum depth of 60 feet below existing grade.

IV. FINDINGS

The pavement core P-1, performed in the Avery Road pavement, exhibited 17.1 inches of asphalt and asphalt concrete base overlying granular base. The thickness of each asphalt layer, from the top, is shown in the following table.

Pavement Core P-1	Thickness (inches)	Comment
Asphalt Concrete Layer 1	1.0	Top Layer
Asphalt Concrete Layer 2	1.0	
Asphalt Concrete Layer 3	1.9	
Asphalt Concrete Layer 4	2.6	
Asphalt Concrete Base	5.2	Well compacted - Not bonded to Asphalt Layer 4
Asphalt Concrete Base	2.4	Poorly compacted & not bonded to layer above. Likely Scratch Course.
Asphalt Concrete Base	3.0	Approximately 3 inches of the core dropped into the hole and could not be recovered with the equipment
Total	17.1	Includes 3 inches of core that could not be recovered

Boring RB-2 exhibited 3 inches of gravel at the surface and boring SB-9 exhibited gravel and stone fragments and sand at the surface. The remaining borings exhibited 2 to 15 inches of topsoil at the surface.

Below the surface cover, the test borings generally exhibited silt and clay, silty clay or clay of the A-6a, A-6b or A-7-6 soil categories to depths ranging from 1.5 to 8.5 feet. However, gravel and stone fragments with sand (A-1-b), sandy silt (A-4a), silt (A-4b) and elastic clay (A-7-5) soils were encountered in borings SB-9, SB-4, B-1 and SB-7, respectively. These upper soils exhibited standard penetration values ranging from 2 to 39 blows per foot (bpf), with natural moisture content values ranging from 9 to 35 percent.

The underlying soils generally consisted of sandy silt of the A-4a soil category. Additional soil types encountered included gravel and stone fragments (A-1-a), gravel and stone fragments with sand (A-1-b), gravel and stone fragments with sand and silt (A-2-4), gravel and stone fragments with sand, silt and clay (A-2-6), fine sand (A-3), silt (A-4b) and silt and clay (A-6a). Cobbles, boulders and sand seams were also encountered within these deposits. These soils exhibited penetration values ranging from 5 bpf to in excess of 50 bpf, and natural moisture content values ranging from 7 to 25 percent.

A subgrade analysis was performed for this the pavement borings were samples were obtained from within 4 feet of the proposed subgrade level, using guidelines published in ODOT's Geotechnical Bulletin GB1. The lowest N_{60} values ranged from 6 to 11 bpf, averaging 7.2 bpf.

Group Index values were calculated for each of the samples tested from within 4 feet of the proposed pavement grade. Group Index values ranged from 0 to 17, averaging 10.0. This average Group Index value corresponds to an estimated California Bearing Ratio (CBR) value of 6 percent. These soils exhibited an average PI value of 24.9 percent.

In addition, Optimum Moisture Content (OMC) values for these samples were estimated using procedures outlined in ODOT's GB1. The natural moisture content values of the soil samples ranged from 9 to 32 percent, averaging 20.8 percent. The estimated OMC values ranged from 10 to 21 percent, averaging 15.3 percent.

On average, the natural moisture content of the samples tested were about 5.5 percent above the estimated OMC values. Soil samples in all 5 test borings where samples were obtained from within 4 feet of the proposed pavement grade exhibited natural moisture content values of more than 3 percent above the estimated OMC.

No groundwater was noted in borings B-008-0-12, RB-1 through RB-4, SB-1, SB-4, SB-7 and SB-8.

Shallow groundwater levels, ranging from 1.5 to 8.5 feet below existing grade, were measured in borings SB-6 and SB-9, drilled along Avery Road south of the proposed intersection with Hayden Run Boulevard. Groundwater was measured at a depth of 12.0 feet in boring SB-5, drilled in the area of the storm sewer outfall. The remaining borings exhibited groundwater levels at depths ranging from 23.5 to 38.5 feet below existing grade.

V. ANALYSIS AND RECOMMENDATIONS

The following discussion presents the assumptions, analysis, and recommendations for the walls and bridge foundations.

A. Retaining Wall

1. Global Stability

Global stability analyses were performed using soil data from the test boring logs along with the geometry obtained from the plans prepared by EMH&T. The most critical condition (maximum wall height) was evaluated. The global stability analyses were performed using the SLOPE/W program. This program is based on two-dimensional limit equilibrium methods in which the calculation of the factor of safety against instability of a slope is performed by the method of slices. The Bishop method was used for the analysis.

The soil parameters used in the analysis of the retaining wall are based on the subsurface conditions encountered in the test borings and ODOT's Office of Geotechnical Engineering (OGE) criteria for embankment construction. The soil parameters were obtained from correlation with SPT data, moisture content, Atterberg Limits, literature and our experience with similar soil conditions. The soil parameters used for this analysis are summarized in a table presented in Appendix D.

Results of the stability analysis are submitted in graphical form and are presented along with the printed data input and output files in Appendix D. The graphs present the geometry of the slope and wall; the modeled soil strata and their corresponding parameters; and the most critical failure surface along with the minimum factor of safety. Factor of safety is defined as the ratio of forces resisting movement (generally the shear strength value along the assumed failure surface) to forces acting on the slope, generally gravity and applied vehicular loads.

Table 1. Global Stability Factor of Safety

Location	Minimum Calculated Factor of Safety		Minimum Acceptable Factor of Safety
	Effective Stress	Total Stress	
MSE Wall	2.1	4.2	1.5
2:1 Embankment Slope	2.1	3.3	1.3

2. Other Stability Calculations

In addition to the global stability, the wall was evaluated for Bearing Resistance, Sliding, and Limiting Eccentricity. Results of the evaluations are presented below.

Wall configurations used in the analyses were obtained from the cross sections and plan profile sheets. These are summarized in Table 2 below. Calculations for these analyses are provided in Appendix E.

Table 2. Wall Geometry

Location	Top of Wall Elevation	Roadway Grade	Top of Leveling Pad	Wall Face Height (feet)	Effective Wall Height (feet)	Reinforcement Length (feet)
MSE at Abutments	959	968	929 to 930	30	39	27.3
MSE Perpendicular to Road	955	966	925	30	41	28.7

The LRFD requirements for Limiting Eccentricity, Sliding and Bearing Resistance were met. No required foundation soil improvements are anticipated.

A factored bearing resistance value of 8.13 Ksf may be used in the design of the MSE walls at the abutments. In other areas, a factored bearing resistance value of 15.54 Ksf may be used in the design of the MSE wall. The factored bearing resistance was computed using a resistance factor of 0.65 per AASHTO Table 11.5.6-1.

3. Settlement

Settlement analyses have been performed in the vicinity of the proposed MSE walls and approach embankments. Results of the settlement analysis are included in Appendix F.

At the abutments, it is estimated that the foundation soils below the MSE wall will undergo an estimated total settlement of about 2.5 to 3.0 inches as a result of fill placement. Total settlement below the approach embankment behind the MSE walls is anticipated to be on the order of 5.5 inches.

The underlying soils should be allowed to settle sufficiently prior to pile driving so that downdrag forces resulting from settlement of the underlying soils are not applied to the piles. A temporary surcharge should be installed above the MSE walls in the vicinity of the proposed abutments up to the proposed roadway grade.

Once the temporary surcharge is in place, the settlement of the embankments should be monitored until the settlement rates have attenuated. It is estimated that a 45-day waiting period will be required at the Rear and Forward Abutments. A waiting period of 15 days is estimated for other embankment areas (at least 30 feet away from proposed abutments).

Settlement monitoring should be performed during construction by means of settlement plates and/or surface monuments. As a minimum, settlement monitoring plates or monuments should be installed every 150 feet where the depth of fill exceeds 10 feet. Readings should be obtained on a daily basis or as otherwise specified by the engineer. Settlement data should be provided to the engineer to determine when the settlement rate has attenuated and when driving of piles can begin and construction of pavement can occur.

B. Bridge Foundation Support

The proposed bridge will be single-span structure. The proposed abutments may be supported onto driven steel piles. Based upon the subsurface conditions encountered, it is believed that cast-in-place reinforced concrete piles (CIP) would be well suited for this project. The estimated minimum individual pile lengths and pile tip elevations are presented in Table 3 below.

The estimated pile lengths include a 1-foot penetration into pile cap and are rounded to the nearest 5-foot segment length. Lateral stability of the piles should be considered. The piles should be furnished and driven in accordance with ODOT Specification Sections 507 and 523.

Table 3. Estimated Pile Lengths and Pile Tip Elevations

Bottom of Pile Cap Elevation (feet)*	Pile Type	Maximum Ultimate Bearing Value, R_{ndr} (Kips)	Estimated Pile Length (feet)	Estimated Pile Tip Elevation (feet)
955.64	12-inch CIP	330	80	879
	14-inch CIP	390	80	879
	16-inch CIP	450	80	878

* Piles to be sleeved through the MSE Wall fill, down to Elevation 929 to 930

Pile driving should follow ODOT Item 507. Stress applied to the pile from the pile-driving hammer should be monitored during driving to avoid damage the piles. A Pile Driving Analyzer (PDA) should be used to monitor the pile during driving and to determine driving criteria for the piles.

Pile Driveability Analysis

Pile driveability analyses were performed using the GRLWEAP computer program. These analyses were based upon the Maximum Ultimate Bearing Values for the pile sections. Average subsurface conditions from borings B-1 and B-2 were used in the analysis of both the Rear and Forward Abutments. A copy of the GRLWEAP output is included in Appendix H. Results of the driveability analysis are summarized in Tables 4, 5, and 6 below.

Table 4 - 12-inch Diameter CIP Pile

Pile Hammer Rated Energy (kip-ft)	Comments
43	High blow counts (±135 bpf) needed to reach the ultimate bearing value.
72	Hammer operating at maximum, overstress to pile with 0.375' wall, Grade 3 Steel*. Reasonable blow counts (±35 bpf) needed to reach the ultimate bearing value.

* Wall thickness of 0.375 inch is typically maximum available for 12-inch diameter piles, use of Modified Grade Steel, with higher yield strength would be required.

Table 5 - 14-inch Diameter CIP Pile

Pile Hammer Rated Energy (kip-ft)	Comments
43	Unreasonably high blow counts (±280 bpf) needed to reach the ultimate bearing value.
72	Hammer operating at maximum, no overstress to pile with 0.5" wall, Grade 3 Steel. Reasonable blow counts (±53 bpf) needed to reach the ultimate bearing value.

Table 6 - 16-inch Diameter CIP Pile

Pile Hammer Rated Energy (kip-ft)	Comments
43	Unreasonably high blow counts (±250 bpf) needed to reach the ultimate bearing value.
72	Hammer operating at maximum, no overstress to pile with 0.5" wall, Grade 3 Steel. Reasonable blow counts (±63 bpf) needed to reach the ultimate bearing value.

A pile hammer with a rated energy of about 72 kip-ft could be used for driving the expected CIP piles for this project to the Maximum Ultimate Bearing Value. An ICE I-30 pile hammer was evaluated. If operated at the maximum fuel level, 12-inch diameter CIP piles with 0.375-inch thick walls (the maximum wall thickness generally available for 12-inch piles) would be overstressed, even using standard Grade 3 steel. Higher strength Modified Grade 3 steel with a yield strength of 50 ksi or higher, would be needed. For the 14-inch and 16-inch piles, 0.5-inch thick walls, Grade 3 steel would need to be used to avoid overstressing the piles. It is possible that thinner walled piles could be used if the stroke of this hammer was limited, for example by operating the hammer at a lower fuel setting, or if the actual required capacities are less than the Maximum Ultimate Bearing Values.

The actual pile hammer and drive system, the proposed pile size and type, and the final design pile capacity should be evaluated prior to construction. In addition, stresses applied to the pile from the pile-driving hammer should be monitored during driving to avoid pile damage. A Pile Driving Analyzer (PDA) should be used to monitor the piles during driving and to determine driving criteria for the piles.

C. Bridge Abutments

Abutments and any wingwalls should be supported on the same type of foundation as the bridge. The active pressure on the abutment walls and wingwalls can be computed using an equivalent friction angle of 30 degrees for the retained soils.

The design of the walls should also take into account the influence of loads that will be applied adjacent to the structures, such as vehicular traffic. Lateral pressure equivalent to the applied load should be added to the soil pressure when designing these walls.

A drainage layer should be placed immediately behind the walls. The drainage layer should consist of free draining granular material such as washed No. 57.

D. Subgrade Considerations

Topsoil and vegetation should be expected in areas where the new pavement will extend over currently unpaved areas. Undercutting and/or bridge lifts may be needed in areas where the new roadway will extend over the existing ditches.

As stated previously, the lowest N_{60} value in the upper 6 feet of the proposed subgrade ranged from 6 to 11 bpf, averaging 7.2 bpf. Additionally, the natural moisture content values of the samples tested were an average of 5.5 percent above the estimated optimum moisture content value.

Based upon the above information as well as the requirements outlined in GB1, it is expected that the proposed subgrade will need to be improved by means of undercutting along Avery Road. It is estimated that undercuts of 2 feet will generally be required for the entire length of the pavement work along Avery Road. In addition, Elastic Clay (A-7-5) soil was encountered at the subgrade level in boring SB-7. These type soils should be removed to a depth of at least 36 inches below the subgrade elevation.

Along Hayden Run Boulevard, from the beginning of the project to station 89+50, the GB1 analysis indicates that the in-place soils should be removed to a depth of 14 inches below the proposed subgrade level.

The undercut values are only an estimate. The actual depth and limits of undercutting will be determined by the Project Engineer in the field based upon proofrolling. The undercut should be backfilled with crushed granular material.

In areas where undercut is not required, the underlying soils may exhibit unstable conditions. In such an event, a bridge lift should be placed as outlined in Section 203.05 of the CMS.

Approximately 17.1 inches of asphalt and asphalt concrete base was encountered over granular base at pavement core location P-1 obtained from Avery Road. The Avery Road pavement exhibited some transverse cracks and some depressions along the wheel paths. The edge of the pavement in several areas exhibits cracks. Pavement patches are present along the edges in several areas. The distresses along the edges of the pavement are likely due to shear failure (lateral movement) of the soils below the edges of the pavement.

Group Index values were calculated for each of the samples tested. Group Index values ranged from 0 to 17, averaging 10.0. This average Group Index value corresponds to an estimated CBR value of 6 percent. Assuming the new fill will consist of soils similar to those encountered at the site, it is recommended that the pavement design be based upon a CBR value of 6.

E. Drainage Considerations

Hayden Run Boulevard

In the vicinity of the proposed bridge, groundwater levels were measured during drilling at depths ranging from 23.5 to 38.5 feet below existing grade. Upon completion of drilling, the groundwater level in boring B-1 was measured at a depth of 17.0 feet.

For the currently proposed configuration, Hayden Run Boulevard will be constructed almost entirely in fill. Adequate surface drainage should be provided, but no special subsurface drainage would be required.

Avery Road

As stated previously, shallow groundwater levels were measured in borings SB-6 and SB-9 drilled along Avery Road, south of the proposed intersection with Hayden Run Boulevard. The groundwater levels measured in this area ranged from 1.5 to 8.5 feet below existing grade. However, no groundwater was noted in borings SB-7 and SB-8 drilled along Avery Road north of the proposed intersection.

Standing water was noted west of Avery Road and north of the proposed intersection. The surface drainage along the west side of Avery Road should be improved.

In addition to adequate surface drainage, it is recommended that underdrains be installed along Avery Road south of the proposed intersection. This drainage system should be installed as early as practical in the construction sequence, to allow the soils to drain.

F. General Construction and Earthwork

General construction and earthwork recommendations for this project are provided in the following paragraphs. Site preparation and earthwork should be performed in accordance with the City of Columbus Construction and Material Specifications (CMS). Particularly:

1. All surface objects, brush, and roots within the proposed construction limits should be cleared and/or grubbed. Clearing, grubbing and/or scalping should be performed in accordance with CMS Item 201 and related sections. Excavation of the soils at this site can be accomplished using conventional equipment.

2. Subsequent to excavation to the proposed grade and prior to fill placement, the exposed grade should be compacted and/or proofrolled in the presence of the Soils Engineer. Compaction of the exposed subgrade should be performed in accordance with the CMS, Section 204. In the event that the exposed soils exhibit unstable conditions, then a bridge lift should be placed in accordance with the CMS, Section 203.05.

3. During construction, adequate drainage should be provided on the surface of the exposed soils. Absorption of heavy rainfall, accumulations of water and heavy construction traffic may result in softening these soils, hence, severely weakening the strength of the subgrade soils.

4. Engineered fill required to raise the grade may consist of Item 203 embankment material provided that proper moisture content is maintained during placement. Backfill required for grade restoration and embankments should be placed and compacted in accordance with CMS, Section 203 and related sections. Topsoil and organically contaminated materials are not acceptable for use as fill. All fill materials should be observed and approved by the Soils Engineer.

5. Where new embankment fill will be placed on or adjacent to existing natural slopes or existing embankments, slopes that are steeper than 8:1 Horizontal to Vertical (H:V) should be continuously benched over those areas. Benching should be of sufficient width to permit operations of placing and compacting equipment.

6. Cut slopes and/or embankment side slopes (other than along the detention/ retention basin) constructed at a rate of 2:1 Horizontal to Vertical (H:V) are generally considered safe against sliding and slope failure. The slopes should be seeded and vegetation growth permitted to limit erosion, sloughing and slope failure.

7. Temporary excavations in excess of 4 feet in depth should be sloped or shored according to OSHA requirements.

G. Detention/Retention Basin

Boring B-008-0-12 was drilled in the area of the proposed detention/retention basin east of Avery Road. The test boring generally exhibited silt and clay (A-6a) and sandy silt glacial till deposits to the drilled depth. A gravel layer was noted between depths of 8.5 and 11.0 feet.

Published values of permeability for silt and clay soils are generally about $1x10^{-7}$ cm/sec. Permeability values for sandy silt soils are generally in the range of $1x10^{-4}$ cm/sec to $1x10^{-6}$ cm/sec. The gravel layer encountered would have a much higher permeability than the surrounding cohesive soils.

In the event that the basin is being designed as a retention basin with a normal pool elevation, then a liner will need to be installed due to the sand seams. The liner may consist of approved and properly compacted clay soils, a geomembrane with a soil cover or other approved liner systems. If soil is used as the liner, the soils should be kept moist until the basin is filled with water. If the liner soils are allowed to dry, cracks may form causing the liner system to leak.

In the event that the basin is being designed as a detention basin to temporarily hold the water, then no liner would be required.

The basin sidewalls should be laid back at a slope rate no steeper than 3:1 H:V. The slopes should be seeded and vegetation growth permitted or another suitable form of erosion protection should be provided.

H. Signal Mast Arm Foundation Support

Foundations for the proposed signal mast arms at the intersection of Hayden Run Boulevard and Avery Road could be supported on standard spread foundations or drilled piers founded on either the medium-stiff to very-stiff sandy silt soils, such as encountered in borings SB-6 and SB-7 at and below depths of 4.0 feet, or in the very-dense granular soils, encountered in borings SB-6 below a depth of 8.5 feet, or the very-stiff to hard sandy silt soils, encountered in borings SB-6 and SB-7 below depths of 13.5 feet.

Foundations supported in the medium-stiff to very-stiff sandy silt soils, such as encountered in borings SB-6 and SB-7 at and below depths of 4.0 feet, may be designed using the following parameters.

Parameter	Value
Nominal Bearing Resistance (q_n), Ksf	12.6
Resistance Factor (φ_b)	0.45*
Factored Bearing Resistance (q_R), Ksf	5.6

* AASHTO LRFD Table 10.5.5.2.2-1

Foundations supported in either the very-dense granular soils, encountered in borings SB-6 below a depth of 8.5 feet, or the very-stiff to hard sandy silt soils, encountered in borings SB-6 and SB-7 below depths of 13.5 feet, may be designed using the following parameters.

Parameter	Value
Nominal Bearing Resistance (q_n), Ksf	19.0
Resistance Factor (φ_b)	0.45*
Factored Bearing Resistance (q_R), Ksf	8.5

* AASHTO LRFD Table 10.5.5.2.2-1

VI. CHANGED CONDITIONS

Should details or layout for the proposed structures or roadways be changed from those used in preparing this report, the Soils Engineer should be notified to make the necessary modifications in our recommendations to account for changed conditions.

VII. TESTING AND OBSERVATION

Experience shows that subsurface conditions in an area sometimes vary from the ones indicated in the borings at their specific locations. It is therefore recommended that a Soils Technician, under the supervision of a qualified Soils Engineer, be retained on site to monitor all earthwork and foundation installation.

VIII. CLOSING

CTL Engineering, Inc. has prepared this report for your use in accordance with generally accepted soil and foundation engineering practices. Analysis, conclusions and other work product of CTL Engineering, Inc. are instruments of service for this project only.

Soil samples will be retained in our laboratory for a period of 90 days, after which they will be discarded unless instructions are received from you as to their disposal.

CTL Engineering's assignment does not include, nor does this geotechnical report address the environmental aspects of this particular site.

Respectfully Submitted,

CTL ENGINEERING, INC.

Roger Evans, P.E.
Project Engineer

Joe Grani, P.E
Project Engineer

APPENDIX A
STRUCTURE FOUNDATION EXPLORATION SHEETS

PROJECT DESCRIPTION:

THE PROJECT INVOLVES THE CONSTRUCTION OF THE CITY OF COLUMBUS, HAYDEN RUN BOULEVARD, PART II (2302 DR. E). THE PROJECT BEGINS ON HAYDEN RUN BOULEVARD AT STATION 87+86.59 AND ENDS AT STATION 112+31.61. SOME WIDENING AND IMPROVEMENTS ARE ALSO PLANNED ALONG AVERY ROAD. NEW TRAFFIC SIGNAL MAST ARM INSTALLATIONS ARE PLANNED AT THE INTERSECTION OF HAYDEN RUN BOULEVARD AND AVERY ROAD. A NEW RETENTION OR DETENTION BASIN IS PLANNED EAST OF AVERY ROAD.

SUBSURFACE EXPLORATION:

SIXTEEN (16) SOIL TEST BORINGS AND ONE (1) PAVEMENT CORE WERE INITIALLY PERFORMED FOR THIS PROJECT IN 2009. SIX (6) ADDITIONAL BORINGS WERE PERFORMED IN 2012, FOR THE CURRENTLY PROPOSED FEATURES.

THE TEST BORINGS WERE PERFORMED WITH TRUCK-MOUNTED AND TRACK-MOUNTED DRILL RIGS UTILIZING HOLLOW STEM AUGERS (HSA) FROM MARCH 24 THROUGH APRIL 24, 2009 AND FROM OCTOBER 25 TO NOVEMBER 16, 2012. STANDARD PENETRATION TESTS WERE CONDUCTED USING 140-POUND AUTOMATIC HAMMERS FALLING 30 INCHES TO DRIVE A 2-INCH O.D. SPLIT BARREL SAMPLERS.

SITE GEOLOGY:

THE SITE LIES ON THE COLUMBUS LOWLAND TILL PLAIN. BOTH THE WISCONSIN AND ILLINOIAN GLACIERS PASSED OVER THE AREA. SOILS AT THE SITE GENERALLY CONSIST OF CLAYS AND SILTS OVER GLACIAL TILLS WITH INTERBEDDED SAND OR SAND AND GRAVEL POCKETS. BEDROCK BELOW THE SITE CONSISTS OF DEVONIAN AGE, LIMESTONE OF THE COLUMBUS FORMATION. NO BEDROCK WAS ENCOUNTERED IN THE TEST BORINGS, WHICH WERE EXTENDED TO A MAXIMUM DEPTH OF 60 FEET BELOW EXISTING GRADE.

SUBSURFACE CONDITIONS:

BORING RB-2 EXHIBITED 3 INCHES OF GRAVEL AT THE SURFACE AND BORING SB-9 EXHIBITED GRAVEL AND/OR STONE FRAGMENTS AND SAND AT THE SURFACE. THE REMAINING BORINGS EXHIBITED 2 TO 15 INCHES OF TOPSOIL AT THE SURFACE.

BELOW THE SURFACE COVER, THE TEST BORINGS GENERALLY EXHIBITED SILT AND CLAY, SILTY CLAY OR CLAY OF THE A-6a, A-6b OR A-7-6 SOIL CATEGORIES TO DEPTHS RANGING FROM 1.5 TO 8.5 FEET. HOWEVER, GRAVEL AND STONE FRAGMENTS WITH SAND (A-1-b), SANDY SILT (A-4a), SILT (A-4b) AND ELASTIC CLAY (A-7-5) SOILS WERE ENCOUNTERED WITHIN THIS ZONE IN BORINGS SB-9, SB-4, B-1 AND SB-7, RESPECTIVELY.

THE UNDERLYING SOILS GENERALLY CONSISTED OF SANDY SILT OR SILT AND CLAY SOILS OF THE A-4a AND A-6a SOIL CATEGORIES. WITHIN THIS ZONE HOWEVER, GRANULAR DEPOSITS CONSISTING OF GRAVEL AND STONE FRAGMENTS (A-1-a), GRAVEL AND STONE FRAGMENTS WITH SAND (A-1-b), GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT (A-2-4), GRAVEL AND STONE FRAGMENTS WITH SAND, SILT AND CLAY (A-2-6), FINE SAND (A-3), AND COARSE AND FINE SAND (A-3a) SOILS WERE ENCOUNTERED IN BORINGS PS-1, B-003-0-12 THROUGH B-008-0-12, SB-2, SB_3, SB-6, AND SB-9. IN ADDITION, SILT (A-4b) SOILS WERE ENCOUNTERED IN BORINGS B-1, B-005-0-12, B-008-0-12, SB-1, SB-3 AND SB-9, AND CLAY (A-7-6) SOILS WERE ENCOUNTERED IN BORING B-006-012. COBBLES AND BOULDERS WERE ALSO ENCOUNTERED WITHIN THESE DEPOSITS.

GROUNDWATER LEVELS WERE MEASURED IN THE TEST BORINGS AS INDICATED ON THE SOIL PROFILE AND STRUCTURE FOUNDATION EXPLORATION SHEETS

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH./VISUAL	
GRAVEL AND/OR STONE FRAGMENTS	A-1-a	–	7
GRAVEL AND/OR STONE FRAGMENTS WITH SAND	A-1-b	–	8
GRAVEL AND/OR STONE FRAGMENTS W/SAND AND SILT	A-2-4	–	2
GRAVEL AND/OR STONE FRAGMENTS W/SAND, SILT & CLAY	A-2-6	–	2
FINE SAND	A-3	–	3
COARSE AND FINE SAND	A-3a	–	2
SANDY SILT	A-4a	28	63
SILT	A-4b	6	10
SILT AND CLAY	A-6a	18	40
SILTY CLAY	A-6b	5	10
ELASTIC CLAY	A-7-5	1	–
CLAY	A-7-6	12	9
	TOTAL	70	156

SOD AND TOPSOIL =X= APPROXIMATE THICKNESS

PAVEMENT OR BASE =X= APPROXIMATE THICKNESS

BORING LOCATION – PLAN VIEW

PAVEMENT CORE LOCATION – PLAN VIEW

DRIVE SAMPLE AND/OR ROCK CORE BORING PLOTTED TO VERTICAL SCALE ONLY. HORIZONTAL BAR INDICATES A CHANGE IN STRATIGRAPHY.

X/Y/Z — NUMBER OF BLOWS FOR STANDARD PENETRATION TEST
X= NUMBER OF BLOWS FOR FIRST 6 INCHES
Y= NUMBER OF BLOWS FOR SECOND 6 INCHES
Z= NUMBER OF BLOWS FOR THIRD 6 INCHES

N_{60} — INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.

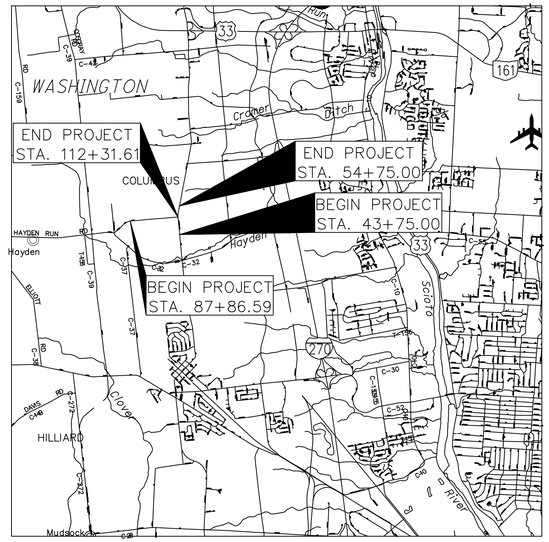
WC — INDICATES WATER CONTENT IN PERCENT.

W— — INDICATES FREE WATER ELEVATION.

● — INDICATES A PLASTIC MATERIAL WITH A MOISTURE CONTENT EQUAL TO OR GREATER THAN THE LIQUID LIMIT MINUS 3.

SS — INDICATES A SPLIT SPOON SAMPLE, STANDARD PENETRATION TEST.

ST — INDICATES A SHELBY TUBE SAMPLE.



LOCATION MAP

SCALE IN MILES

0 1 2 3 4

N

PARTICLE SIZE DEFINITIONS

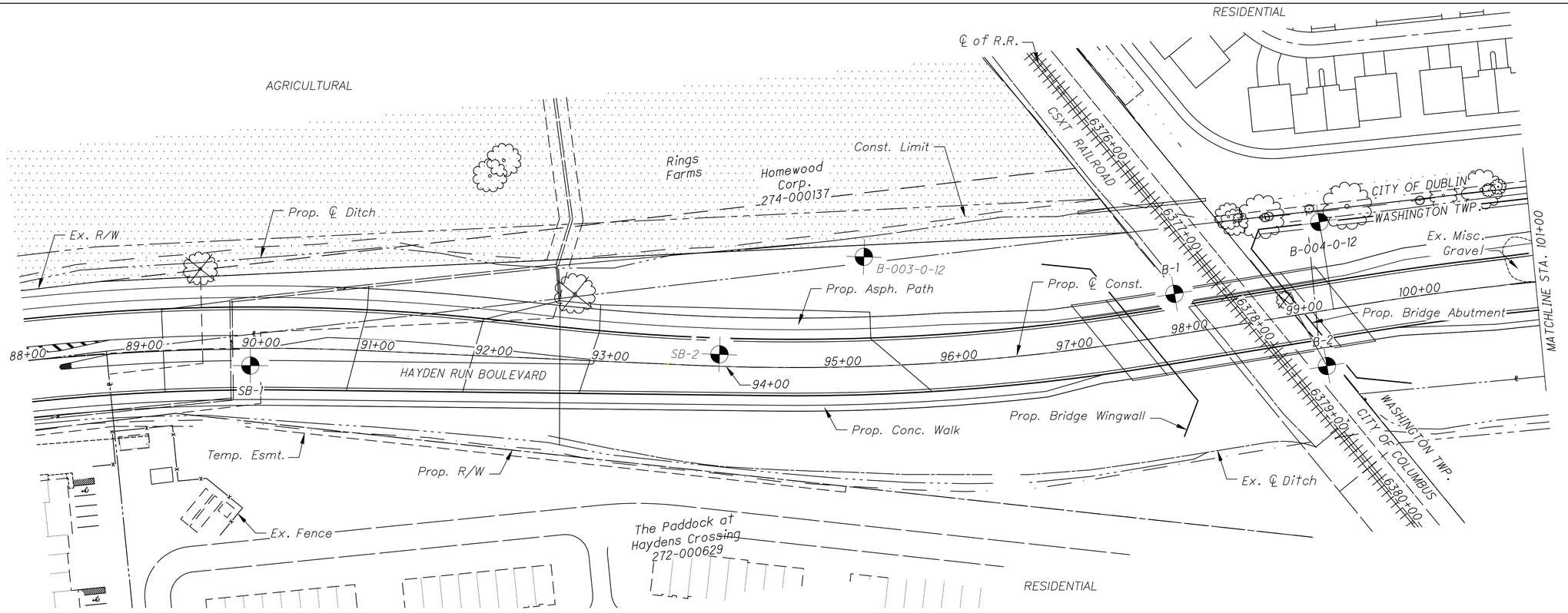
12"	3"	2.0 mm	0.42 mm	0.074 mm	0.005 mm
BOULDERS |	COBBLES |	GRAVEL |	COARSE SAND |	FINE SAND |	SILT |	CLAY
		NO. 10 SIEVE	NO. 40 SIEVE	NO. 200 SIEVE		

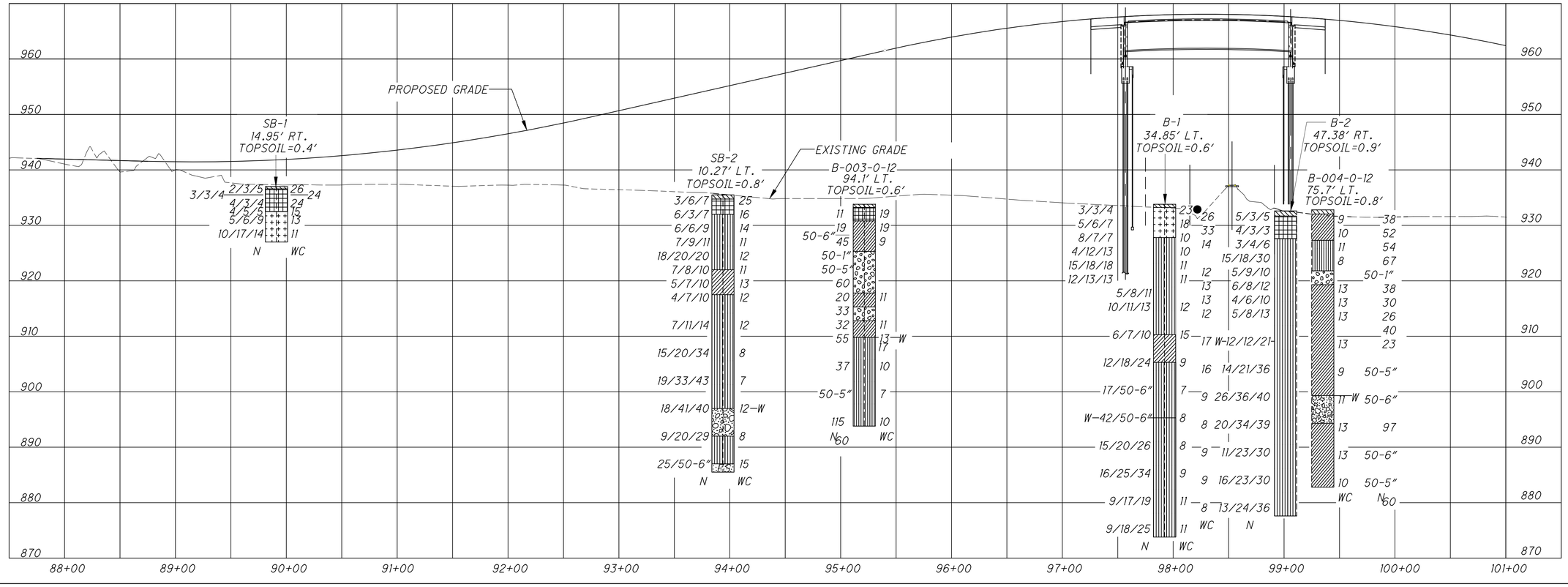
RECON. – CF
DRILLING – CTL ENGINEERING INC.
DRAWN – B.R.U.
REVIEWED – SM

CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE:1(614)276-8123 FAX:1(614)276-6377

SOIL PROFILE

HAYDEN RUN BLVD.





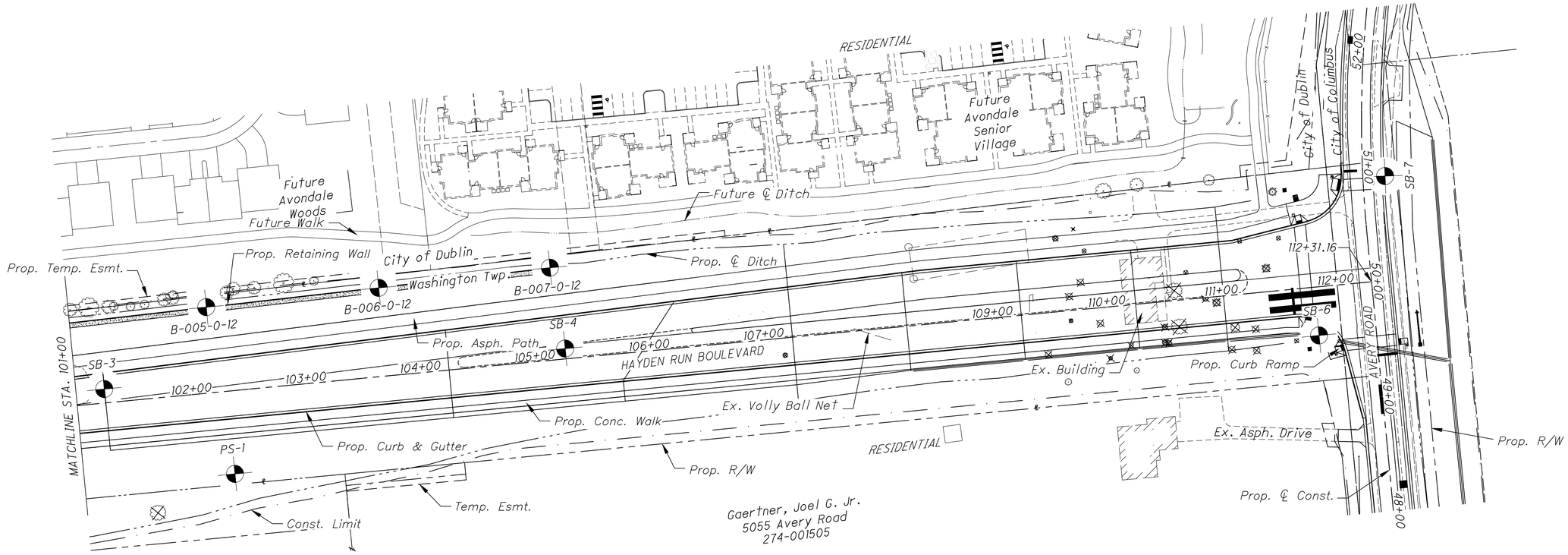
N

0 25 50 100 HORIZONTAL SCALE IN FEET

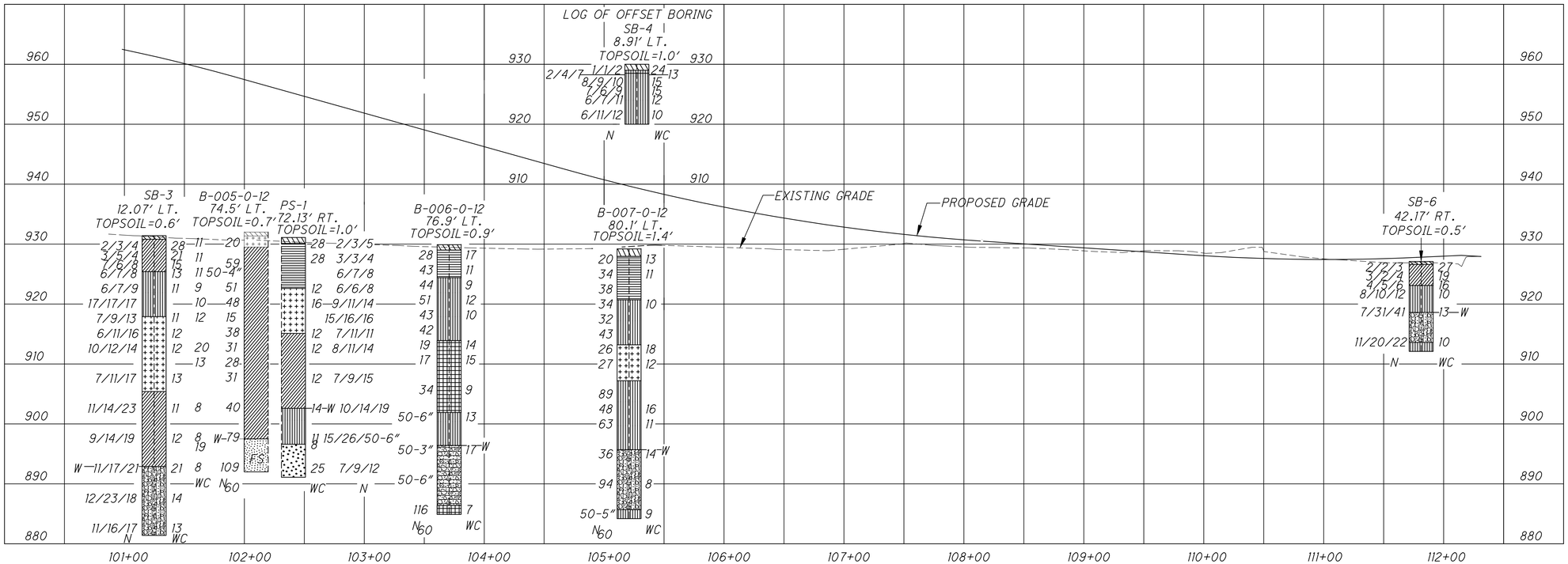
DRAWN N.K.S. CHECKED NT

SOIL PROFILE
STA. 88+00 TO STA. 101+00 - HAYDEN RUN BLVD.

HAYDEN RUN BLVD.



NOTE:
SEE SHEET 4 OF 33 FOR BORING SB-7 SOIL PROFILE

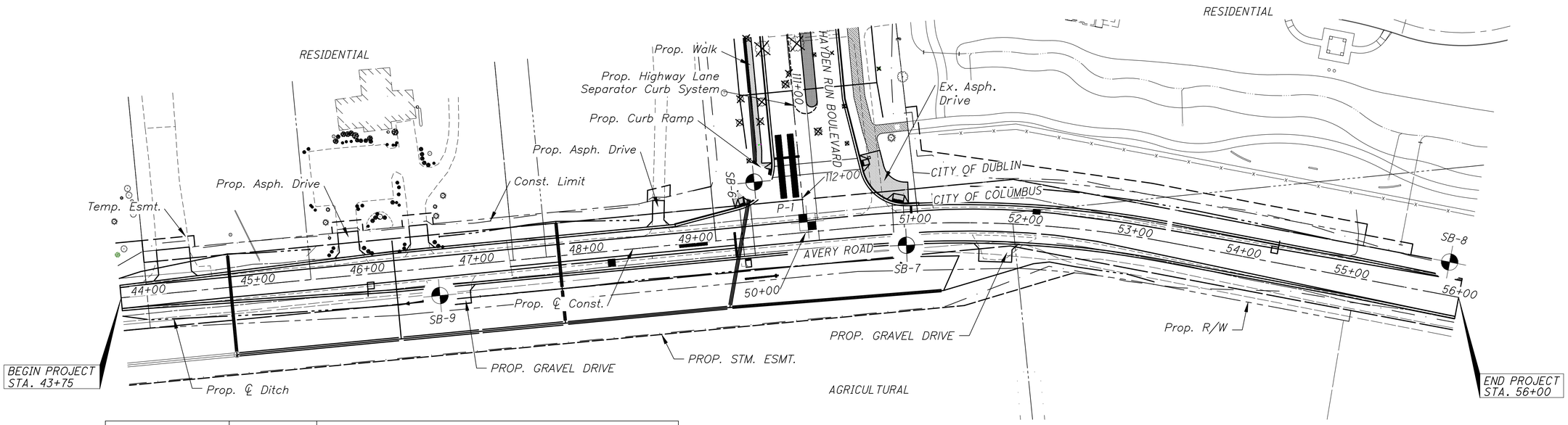


SOIL PROFILE
STA. 101+00 TO STA. 112+31.16 - HAYDEN RUN BLVD.

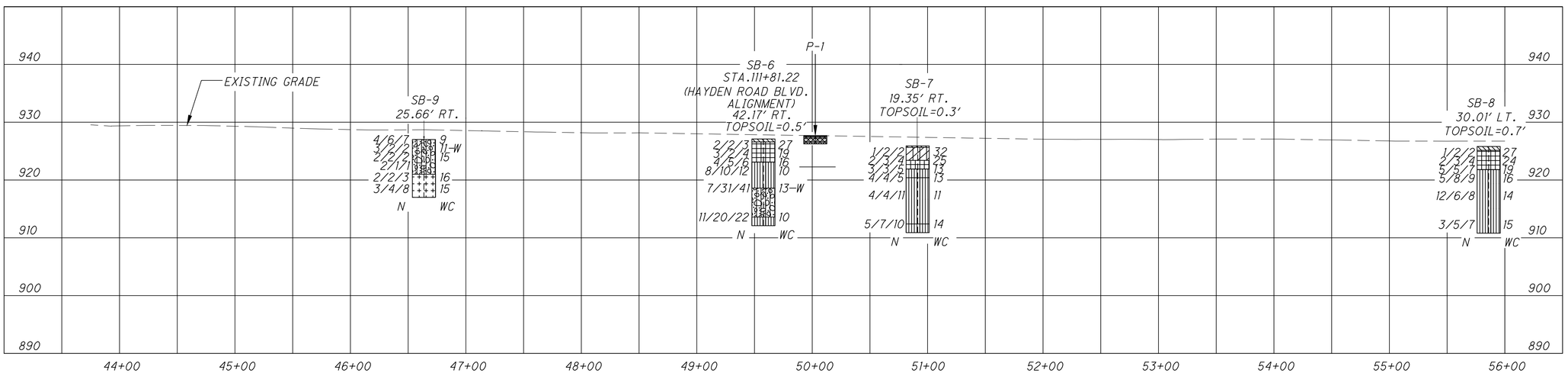
HAYDEN RUN BLVD.

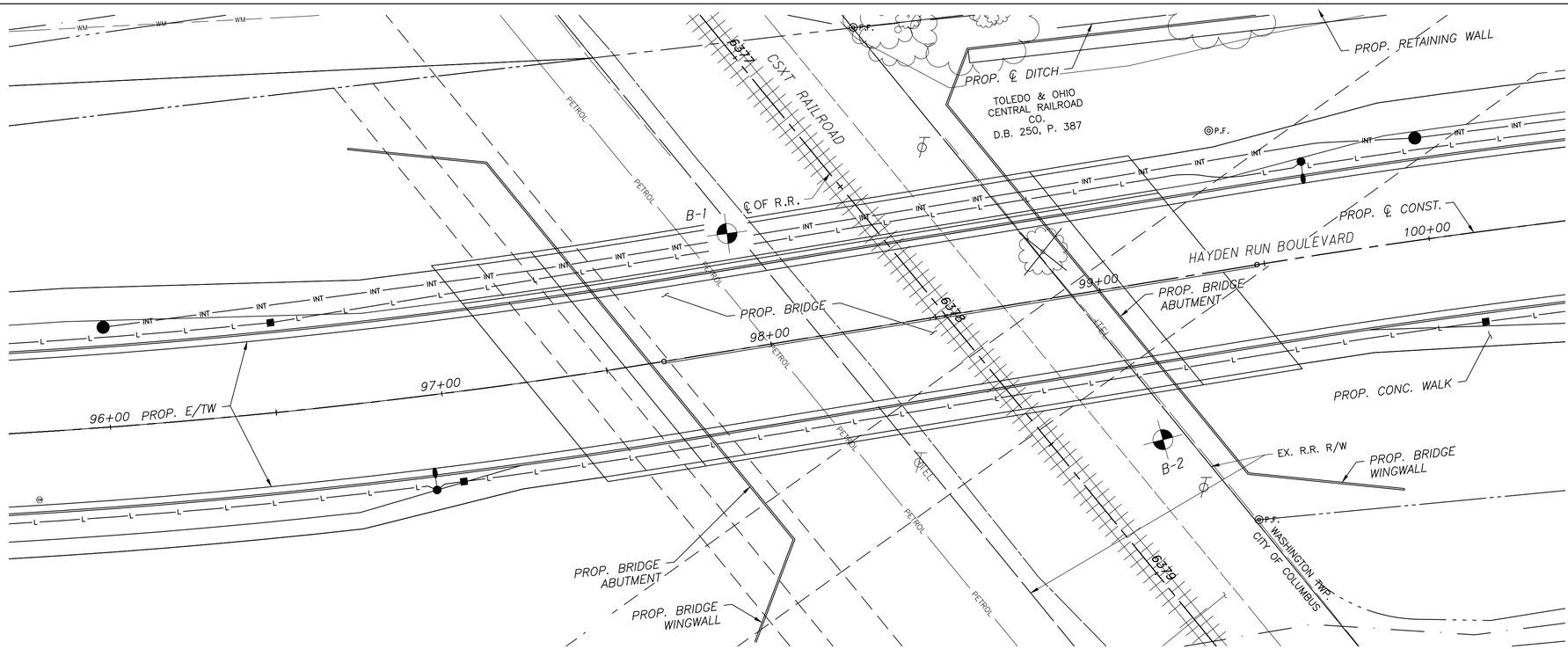
DRAWN N.K.S. CHECKED NT

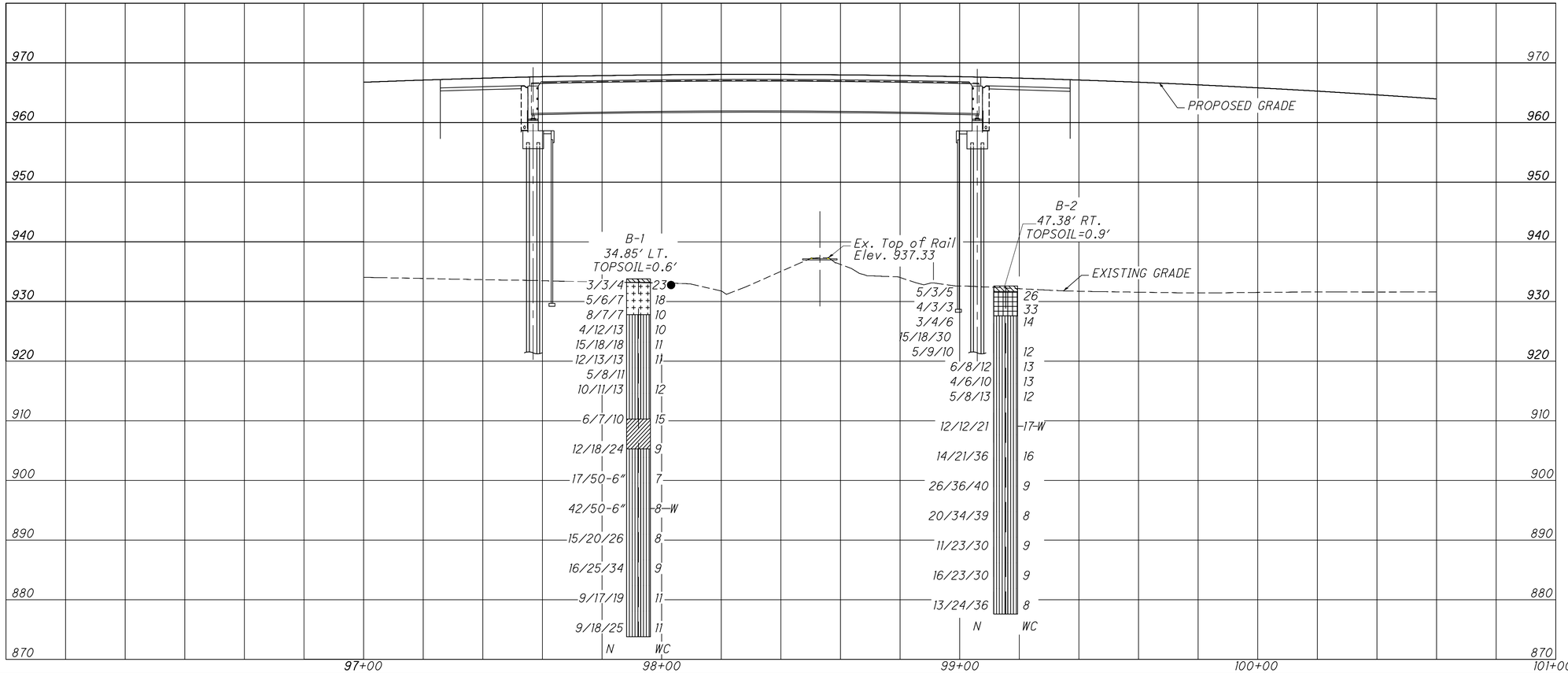
HORIZONTAL SCALE IN FEET
0 25 50 100



PAVEMENT CORE	THICKNESS (INCHES)	DESCRIPTION
P-1	1.0	ASPHALT CONCRETE
	1.0	ASPHALT CONCRETE
	1.9	ASPHALT CONCRETE
	2.6	ASPHALT CONCRETE
	5.2	ASPHALT CONCRETE BASE- WELL COMPACTED NOT BONDED TO LAYER ABOVE
	2.4	ASPHALT CONCRETE BASE- POORLY COMPACTED NOT BONDED TO LAYER ABOVE. LIKELY SCRATCH COURSE
	3.0	ASPHALT CONCRETE BASE







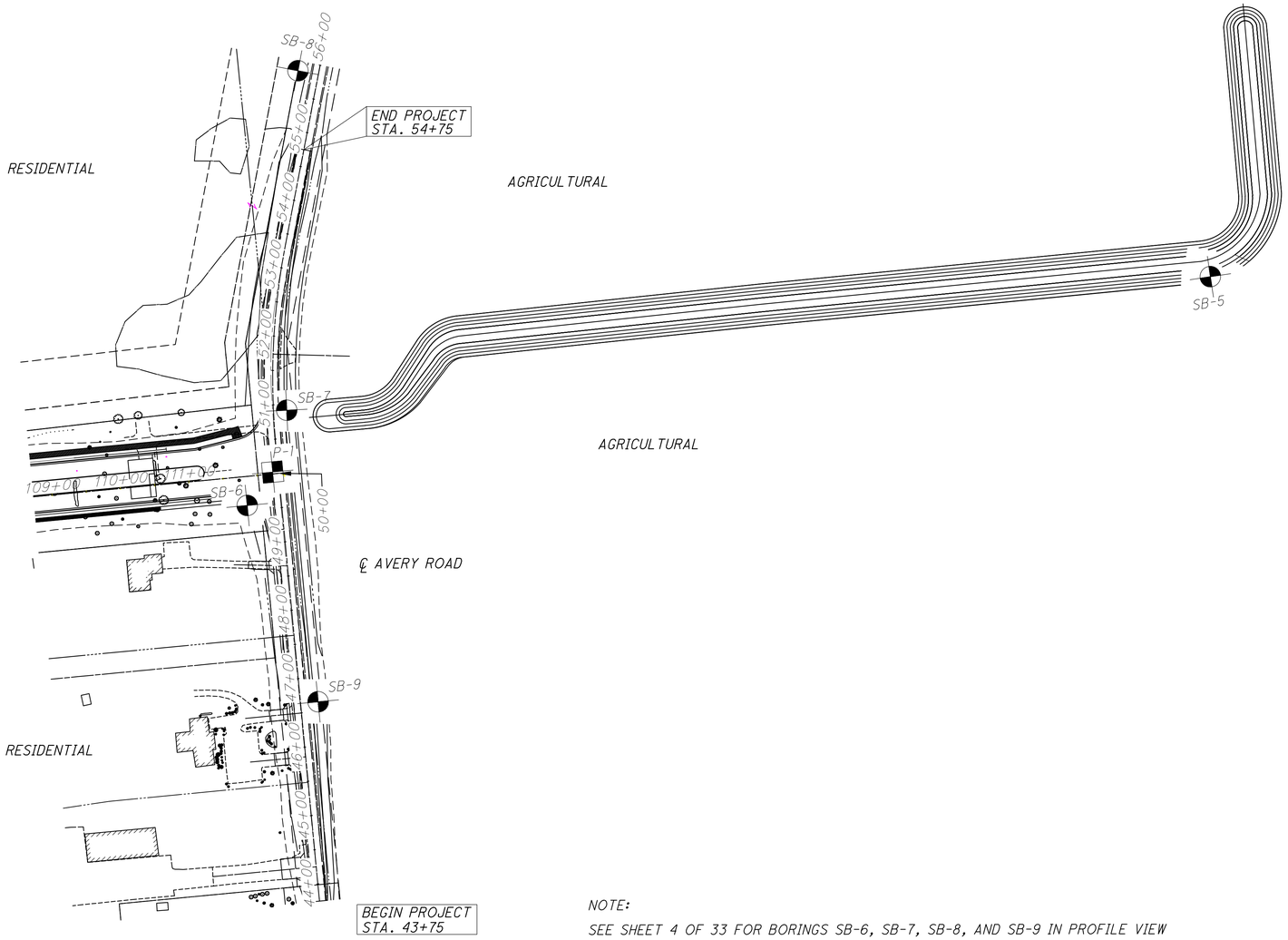
HORIZONTAL SCALE IN FEET
0 20 40

DRAWN N.K.S.
CHECKED NT

STRUCTURE FOUNDATION EXPLORATION
HAYDEN RUN BLVD. OVER CSXT RAILROAD

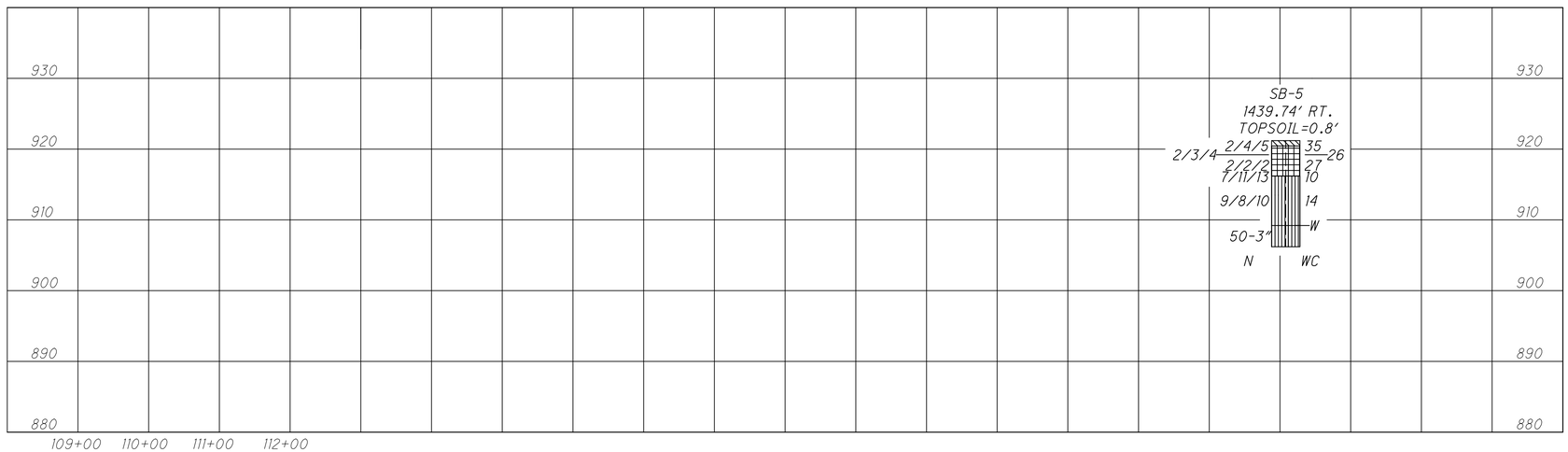
HAYDEN RUN BLVD.

5 / 33



NOTE:

SEE SHEET 4 OF 33 FOR BORINGS SB-6, SB-7, SB-8, AND SB-9 IN PROFILE VIEW

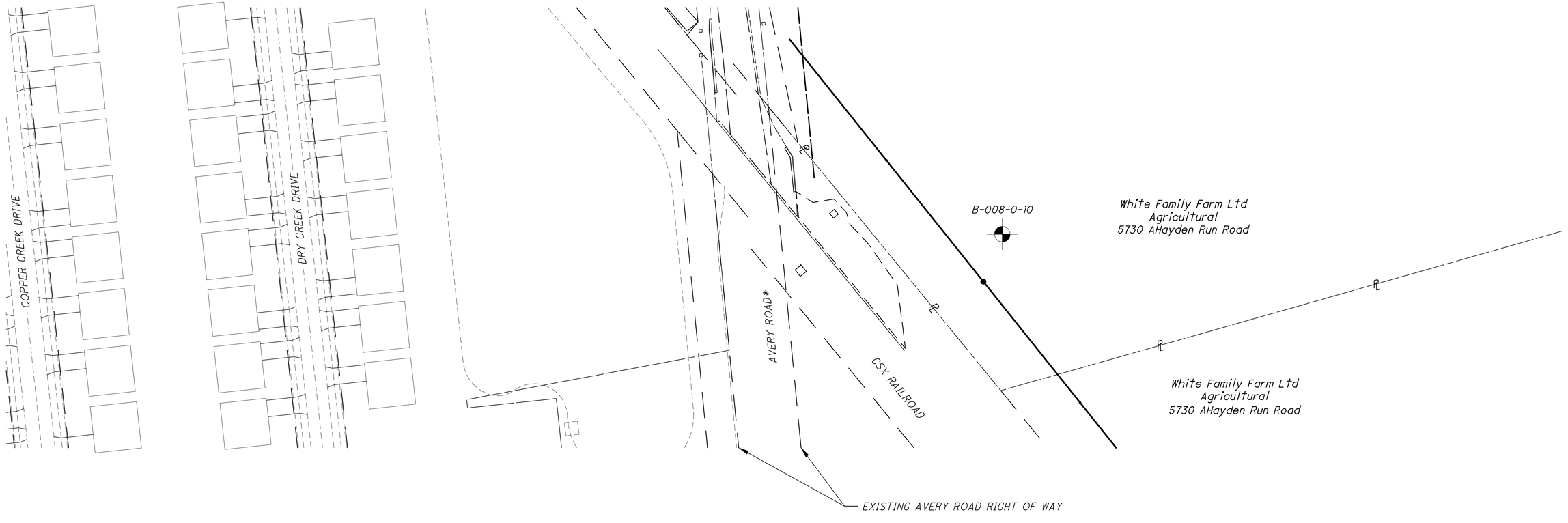


HORIZONTAL SCALE IN FEET
0 100 200

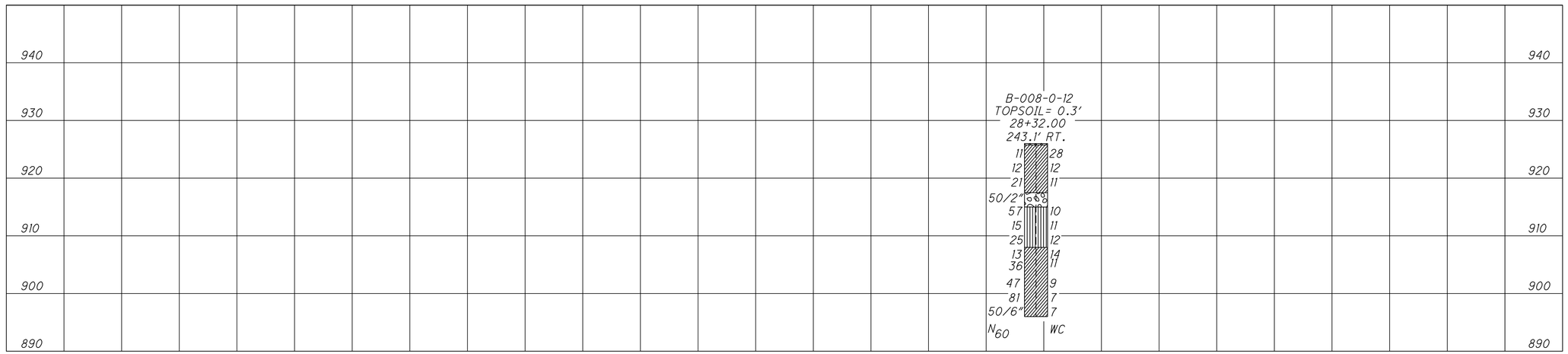
DRAWN N.K.S.
CHECKED NT

SOIL PROFILE
STORM SEWER OUTFALL

HAYDEN ROAD BLVD.



* AT THE TIME THAT THESE PLANS WERE PREPARED, CENTERLINE INFORMATION HAD NOT BEEN PROVIDED FOR THIS PORTION OF AVERY ROAD



N

0 50 100 HORIZONTAL SCALE IN FEET

DRAWN N.K.S. CHECKED NT

SOIL PROFILE
STORM SEWER OUTFALL

HAYDEN ROAD BLVD.

6A / 33

LOG OF BORING

Date Started 3/25/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/25/09 Casing: Length ____ Dia. 3.25"

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Water Elev. 895.3ft
Surface Elev. 933.8ft

Boring No. B-1 Station & Offset 97+92.23, 34.85' Lt

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
933.8	0																
933.8						0.6'	Topsoil (7")										
932.8	2	3/3/4					Medium stiff, brown and gray SILT, some clay, little sand, fill, moist	1	1	3	9	66	21	26	7	23	A-4b
930.3	4	5/6/7					Stiff, brown and gray SILT, some clay, little sand, fill, damp	2								18	VIS.
927.8	6	8/7/7				6.0'	Stiff, brown and gray SANDY SILT, little clay, little gravel with weathered clay-stone fragments, damp	3								10	VIS.
925.3	8	4/12/13					Very stiff, brown and gray SANDY SILT, little clay, little gravel with cobbles, damp	4	14	12	14	41	19	22	7	10	A-4a
922.8	10	15/18/18					Hard, brown and gray SANDY SILT, little clay, little gravel with cobbles, damp	5								11	VIS.
920.3	12	12/13/13					Very stiff, brown and gray SANDY SILT, little clay, little gravel with cobbles, damp	6								11	VIS.
917.8	14	5/8/11					No recovery	7									VIS.
915.3	16	10/11/13					Very stiff, brown and gray SANDY SILT, little clay, little gravel with cobbles, damp	8								12	VIS.
910.3	18	6/7/10				23.5'	Very stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, damp to moist	9	5	5	15	48	27	27	12	15	A-6a
905.3	20	12/18/24				28.5'	Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	10	8	7	21	44	20	21	8	9	A-4a
900.3	22	17/50-6"					Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	11								7	VIS.

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

HAYDEN RUN BOULEVARD

STRUCTURE FOUNDATION EXPLORATION

DRAWN B.R.U.
CHECKED SM

LOG OF BORING (Continued)

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. B-1

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
898.8															
895.3	36–38–40	42/50-6"			Hard, gray SANDY SILT, little gravel, trace clay with cobbles and wet sand seams, till, damp	12								8	VIS.
890.3	42–44–46	15/20/26			Hard, gray SANDY SILT, little gravel, trace clay with cobbles, till, damp	13								8	VIS.
885.3	48–50–52	16/25/34			Hard, gray SANDY SILT, little gravel, trace clay with cobbles, till, damp	14								9	VIS.
880.3	54–56–58	9/17/19			Hard, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	15	8	10	21	41	20	21	7	11	A-4a
875.3	58–60	9/18/25			Hard, gray SANDY SILT, little gravel, little clay with cobbles, till, damp	16								11	VIS.
873.8					60.0' Bottom of boring										

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

LOG OF BORING

Date Started 3/30/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/30/09 Casing: Length ____ Dia. 3.25"

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Water Elev. 909.1ft
Surface Elev. 932.6ft

Boring No. B-2 Station & Offset 99+11.42, 47.38' Rt

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
932.6	0																
932.6						0.9'	Topsoil (11")										VIS.
931.7																	
931.6		5/3/5					Medium stiff, brown CLAY and silt, trace sand, trace gravel, fill, moist	1	1	2	7	51	39	53	29	26	A-7-6
	2																
929.1	4	4/3/3					Medium stiff, brown and gray CLAY and silt, trace sand, trace gravel, fill, moist	2								33	VIS.
927.6						5.0'											
926.6	6	3/4/6					Stiff, brown and gray SANDY SILT, some gravel, little clay, damp	3	24	11	15	33	17	23	8	14	A-4a
	8																
924.1		15/18/30					No recovery	4									
	10																
921.6		5/9/10					Very stiff, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	5	2	5	16	48	29	25	10	12	A-4a
	12																
919.1	14	6/8/12					Very stiff, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	6								13	VIS.
916.6	16	4/6/10					Very stiff, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	7								13	VIS.
	18																
914.1		5/8/13					Very stiff, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	8	3	7	17	49	24	25	10	12	A-4a
	20																
	22																
909.1	24	12/12/21					Hard, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	9								17	VIS.
	26																
	28																
904.1		14/21/36					Hard, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	10								16	VIS.
	30																
	32																
899.1																	
	34	26/36/40					Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	11	8	11	22	43	16	21	8	9	A-4a

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

HAYDEN RUN BOULEVARD

STRUCTURE FOUNDATION EXPLORATION

DRAWN B.R.U.
CHECKED SM

LOG OF BORING (Continued)

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. B-2

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
897.6															
894.1	36–38	20/34/39			Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	12								8	VIS.
889.1	40–44	11/23/30			Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	13								9	VIS.
884.1	46–50	16/23/30			Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	14	9	10	21	42	18	21	8	9	A-4a
879.1	52–54	13/24/36			Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	15								8	VIS.
877.6					55.0' Bottom of boring										

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / JP	DRILL RIG: 0305R333-11	STATION / OFFSET: 95+21.4, 94.1 LT	EXPLORATION ID B-003-0-12
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / JP	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.	
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/4/11	ELEVATION: 933.8 (MSL) EOB: 40.0 ft.	PAGE 1 OF 1
START: 10/25/12 END: 10/25/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.1	LAT / LONG: Not Recorded	

MATERIAL DESCRIPTION AND NOTES	ELEV. 933.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (7")	933.2																	
VERY STIFF, BROWN, **CLAY**, AND SILT, LITTLE SAND, DAMP		1	2 3 5	11	94	SS-1	2.50	0	2	9	52	37	44	22	22	19	A-7-6 (14)	
	930.8	2																
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP Shelby Tube (ST-3) Obtained in Offset Hole from Depths of 5.0' to 7.0'		3																
		4	9 8 6	19	100	SS-2	2.25	-	-	-	-	-	-	-	-	19	A-6a (V)	
		5																
@6.0'; STIFF		6		-		ST-3	-	5	7	15	42	31	32	18	14	-	A-6a (9)	
		7	8 12 22	45	100	SS-4	1.25	-	-	-	-	-	-	-	-	9	A-6a (V)	
	925.3	8																
VERY DENSE, BROWN TO GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, DRY		9	6 45 50/1"	-	15	SS-5	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
		10																
		11	50/5"	-	120	SS-6	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
		12																
		13																
		14	13 20 25	60	6	SS-7	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
	917.8	15																
VERY STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP		16																
		17	13 6 9	20	83	SS-8	4.00	3	4	17	49	27	25	14	11	11	A-6a (8)	
	915.3	18																
DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, DRY		19	9 11 14	33	6	SS-9	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
		20																
	912.8	21																
STIFF, GRAY, **SILT AND CLAY**, SOME SAND, MOIST		22	6 10 14	32	100	SS-10	1.00	-	-	-	-	-	-	-	-	11	A-6a (V)	
		23																
@23.5'; VERY STIFF	909.8 W	24	21 17 24	55	100	SS-11	2.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
VERY STIFF, GRAY, **SANDY SILT**, LITTLE CLAY, SOME GRAVEL, DAMP		25					-	-	-	-	-	-	-	-	-	17	A-4a (V)	
		26																
		27																
		28																
		29	6 11 17	37	78	SS-12	3.25	28	15	15	28	14	21	12	9	10	A-4a (1)	
		30																
		31																
		32																
		33																
		34	17 45 50/5"	-	88	SS-13	4.00	-	-	-	-	-	-	-	-	7	A-4a (V)	
		35																
		36																
		37																
		38																
		39	21 41 45	115	83	SS-14	3.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
	893.8	40	EOB															

NOTES: CAVED AT 17.2'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 2/18/14 15:35 - J:\DEPT5\2008-2011 PROJECT - PROPOSAL FOLDERS\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GPJ

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / MF	DRILL RIG: 03050TKR349-11	STATION / OFFSET: 99+24.9, 75.7 LT	EXPLORATION ID B-004-0-12
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / MF	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.	
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/17/11	ELEVATION: 932.8 (MSL) EOB: 50.0 ft.	PAGE 1 OF 1
START: 10/25/12 END: 10/25/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.7	LAT / LONG: Not Recorded	

MATERIAL DESCRIPTION AND NOTES	ELEV. 932.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (9")	932.1																	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, SOME GRAVEL, DAMP		1	6 12 16	38	44	SS-1	-	26	7	12	38	17	30	17	13	9	A-6a (5)	
		2																
		3																
		4	16 20 19	52	94	SS-2	1.00	-	-	-	-	-	-	-	-	10	A-6a (V)	
	927.3	5																
STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP		6	14 18 22	54	50	SS-3	-	-	-	-	-	-	-	-	-	11	A-4a (V)	
		7																
		8																
		9	16 22 28	67	56	SS-4	1.00	12	12	17	41	18	23	14	9	8	A-4a (5)	
	921.8	10																
DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, DRY		11	50/1"	-	100	SS-5	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
	919.3	12																
		13																
STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP		14	45 17 11	38	67	SS-6	1.75	-	-	-	-	-	-	-	-	13	A-6a (V)	
		15																
@16.0'; VERY STIFF		16																
		17	6 8 14	30	56	SS-7	2.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
		18																
		19	8 10 9	26	56	SS-8	2.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
		20																
		21																
		22	10 14 16	40	0	SS-9	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		23																
@23.5'; STIFF		24	5 7 10	23	94	SS-10	1.75	6	6	16	45	27	29	16	13	13	A-6a (9)	
		25																
		26																
		27																
		28																
@28.5'; VERY STIFF		29	36 50/5"	-	64	SS-11	3.50	-	-	-	-	-	-	-	-	9	A-6a (V)	
		30																
		31																
		32																
		33																
	899.3 W	34	50	-	50	SS-12	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, DAMP		35																
		36																
		37																
		38																
	894.3	39	36 38 34	97	44	SS-13	0.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
MEDIUM STIFF, GRAY, **SILT AND CLAY**, MOIST		40																
		41																
		42																
		43																
		44	30 50	-	50	SS-14	0.75	-	-	-	-	-	-	-	-	13	A-6a (V)	
		45																
		46																
		47																
		48																
@48.5'; STIFF		49	12 33 50/5"	-	71	SS-15	1.25	-	-	-	-	-	-	-	-	10	A-6a (V)	
	882.8	50 EOB																

NOTES: CAVED AT 30'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / MF	DRILL RIG: 03050TKR349-11	STATION / OFFSET: 102+19.9, 74.5 LT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / MF	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/17/11	ELEVATION: 932.0 (MSL) EOB: 40.0 ft.
START: 10/25/12 END: 10/25/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.7	LAT / LONG: Not Recorded

EXPLORATION ID B-005-0-12

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 932.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (8")	931.3																	
VERY STIFF, BROWN, **SILT**, SOME CLAY, LITTLE SAND, DAMP	929.5		5 5 10	20	94	SS-1	2.00	0	2	9	64	25	27	17	10	11	A-4b (8)	
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP Shelby Tube (ST-2) Obtained in Offset Hole from Depths of 3.0' to 5.0'			12 20 24	59	- 67	ST-2 SS-3	- 2.25	5 -	8 -	12 -	44 -	31 -	34 -	19 -	15 -	- 11	A-6a (10) A-6a (V)	
@6.5'; STIFF			12 20 50/4"	-	75	SS-4	1.50	-	-	-	-	-	-	-	-	11	A-6a (V)	
@8.5'; VERY STIFF			18 19 19	51	56	SS-5	3.00	-	-	-	-	-	-	-	-	9	A-6a (V)	
@11.0'; GRAY, SOME SAND			15 18 18	48	50	SS-6	3.50	8	5	16	47	24	26	14	12	10	A-6a (8)	
			2 5 6	15	67	SS-7	2.50	-	-	-	-	-	-	-	-	12	A-6a (V)	
			9 12 16	38	0	SS-8	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
@18.5'; HARD			7 10 13	31	17	SS-9	4.50	-	-	-	-	-	-	-	-	20	A-6a (V)	
@21.0'; VERY STIFF			8 9 12	28	44	SS-10	2.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
			6 10 13	31	0	SS-11	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
			8 12 18	40	94	SS-12	3.00	8	5	21	39	27	23	12	11	8	A-6a (7)	
@33.5'; STIFF			39 32 27	79	56	SS-13	1.00 -	- -	- -	- -	- -	- -	- -	- -	- -	8 19	A-6a (V) A-3 (V)	
VERY DENSE, GRAY, **FINE SAND**, MOIST	897.5 W	F.S.																
@38.5'; COBBLES	892.0 EOB		22 35 46	109	56	SS-14	-	-	-	-	-	-	-	-	-	8	A-3 (V)	

NOTES: CAVED AT 26.6'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 2/18/14 15:36 - J:\DEPT5\2008-2011 PROJECT - PROPOSAL FOLDERS\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GPJ

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / MF	DRILL RIG: 03050TKR349-11	STATION / OFFSET: 103+70.8, 76.9 LT	EXPLORATION ID B-006-0-12
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / JP	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.	
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/17/11	ELEVATION: 929.9 (MSL) EOB: 45.0 ft.	PAGE 1 OF 1
START: 11/16/12 END: 11/16/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.7	LAT / LONG: Not Recorded	

MATERIAL DESCRIPTION AND NOTES	ELEV. 929.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (11")	929.0																	
HARD, BROWN, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL, DAMP Shelby Tube (ST-2) Obtained in Offset Hole from Depths of 2.0' to 4.0'			5 10 11	28	56	SS-1	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	
					-	ST-2	-	13	4	10	39	34	36	19	17	-	A-6b (10)	
			4 16 16	43	94	SS-3	4.00	-	-	-	-	-	-	-	-	11	A-6b (V)	
	924.4																	
HARD, BROWN, **SANDY SILT**, AND GRAVEL, LITTLE CLAY, DAMP			16 17 16	44	89	SS-4	4.50	-	-	-	-	-	-	-	-	9	A-4a (V)	
			15 18 20	51	94	SS-5	4.00	41	9	12	27	11	23	17	6	12	A-4a (1)	
			19 16 16	43	72	SS-6	4.50	-	-	-	-	-	-	-	-	10	A-4a (V)	
			13 16 15	42	0	SS-7	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
	913.9																	
VERY STIFF, GRAY, **CLAY**, DAMP			8 8 6	19	0	SS-8	3.00	-	-	-	-	-	-	-	-	14	A-7-6 (V)	
			5 6 7	17	0	SS-9	3.00	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
@23.5'; HARD			8 9 16	34	0	SS-10	4.50	-	-	-	-	-	-	-	-	9	A-7-6 (V)	
	901.9																	
STIFF, BROWN, **SILT**, LITTLE GRAVEL, TRACE CLAY, DAMP			26 50	-	83	SS-11	1.00	19	13	31	33	4	NP	NP	NP	13	A-4a (0)	
	896.4	W																
DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, WET			37 50/3"	-	0	SS-12	-	-	-	-	-	-	-	-	-	17	A-2-6 (V)	
			50	-	0	SS-13	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	886.4																	
HARD, GRAY, **CLAY**, DAMP			22 36 50	116	94	SS-14	4.50	-	-	-	-	-	-	-	-	7	A-7-6 (V)	
	884.9	EOB																

NOTES: GROUNDWATER ENCOUNTERD 33.5', CAVED AT 27.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / MF	DRILL RIG: 03050TKR349-11	STATION / OFFSET: 105+20.8, 80.1 LT	EXPLORATION ID B-007-0-12
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / JP	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.	
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/17/11	ELEVATION: 929.2 (MSL) EOB: 45.0 ft.	PAGE 1 OF 1
START: 11/16/12 END: 11/16/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.7	LAT / LONG: Not Recorded	

MATERIAL DESCRIPTION AND NOTES	ELEV. 929.2	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (15")	928.0																	
HARD, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP		1–4	6 6 9	20	78	SS-1	4.50	9	3	10	45	33	39	22	17	13	A-6b (11)	
		4–7	11 12 13	34	94	SS-2	4.50	-	-	-	-	-	-	-	-	11	A-6b (V)	
		6–9	21 14 14	38	6	SS-3	-	-	-	-	-	-	-	-	-	-	A-6b (V)	
	920.7	9–12	7 10 15	34	94	SS-4	4.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
VERY STIFF, BROWN, **SANDY SILT**, DAMP		11–14	12 12 12	32	0	SS-5	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
		14–16	10 16 16	43	0	SS-6	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
	913.2	16–19	6 8 11	26	83	SS-7	4.00	0	0	3	61	36	31	23	8	18	A-4b (8)	
HARD, BROWN, **SILT AND CLAY**, TRACE SAND, MOIST		19–21	6 9 11	27	89	SS-8	4.50	-	-	-	-	-	-	-	-	12	A-4b (V)	
	907.2	21–24																
VERY STIFF, BROWN, **SANDY SILT**, SOME GRAVEL, TRACE CLAY, MOIST		24–26	16 26 40	89	6	SS-9	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
		26–29	8 16 20	48	72	SS-10	3.00	-	-	-	-	-	-	-	-	16	A-4a (V)	
		29–31	18 22 25	63	94	SS-11	2.00	35	13	10	39	3	22	18	4	11	A-4a (1)	
	895.7 W	33–34																
DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, WET		34–36	16 12 15	36	44	SS-12	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)	
		36–39																
@38.5'; VERY DENSE		39–41	30 32 38	94	78	SS-13	-	-	-	-	-	-	-	-	-	8	A-2-4 (V)	
	885.7	41–44																
HARD, GRAY, **SANDY SILT**, DAMP		44–45	36 40 50/5"	-	41	SS-14	4.50	-	-	-	-	-	-	-	-	9	A-4a (V)	
	884.2 EOB																	

NOTES: GROUNDWATER ENCOUNTERED 33.5" CAVED AT 27.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 2/18/14 15:36 - J:\DEPT5\2008-2011 PROJECT - PROPOSAL FOLDERS\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GPJ

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / JP	DRILL RIG: 0305R333-11	STATION / OFFSET: 28+32, 243.1 RT	EXPLORATION ID B-008-0-12
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / JP	HAMMER: CME AUTOMATIC	ALIGNMENT: AVERY ROAD	
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/4/11	ELEVATION: 926.0 (MSL) EOB: 30.0 ft.	PAGE 1 OF 1
START: 10/25/12 END: 10/25/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.1	LAT / LONG: Not Recorded	

MATERIAL DESCRIPTION AND NOTES	ELEV. 926.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (3")	925.8																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP			1 3 5	11	78	SS-1	2.00	-	-	-	-	-	-	-	-	28	A-6a (V)	
			3 2 7	12	78	SS-2	1.62	11	11	18	38	22	29	17	12	12	A-6a (6)	
@6.0'; SOME GRAVEL			5 7 9	21	100	SS-3	2.50	-	-	-	-	-	-	-	-	12	A-6a (V)	
	917.5																	
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, DRY			8 50/2"	-	13	SS-4	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
	915.0																	
MEDIUM STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, SOME GRAVEL, DAMP			14 24 19	57	67	SS-5	0.50	35	8	12	30	15	23	14	9	10	A-4a (2)	
@13.5'; VERY STIFF, SOME CLAY, TRACE GRAVEL			2 5 6	15	78	SS-6	3.00	6	5	15	43	31	26	16	10	12	A-4a (8)	
			5 8 11	25	83	SS-7	2.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
	908.0																	
VERY STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP			2 3 7	13	100	SS-8	2.00	5	7	16	43	29	28	16	12	14	A-6a (8)	
			11 10 17	36	100	SS-9	3.00 -	- -	- -	- -	- -	- -	- -	- -	- -	11 -	A-6a (V)	
@23.5'; HARD			13 15 20	47	100	SS-10	4.50	6	8	16	37	33	27	14	13	9	A-6a (8)	
			15 20 41	81	100	SS-11	4.50	-	-	-	-	-	-	-	-	7	A-6a (V)	
@28.5'; VERY STIFF			50	-	100	SS-12	2.00	-	-	-	-	-	-	-	-	7	A-6a (V)	
	896.0	EOB																

NOTES: CAVED AT 14.9'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (11 X 17) - OH DOT.GDT - 2/18/14 15:37 - J:\DEPT5\2008-2011 PROJECT - PROPOSAL FOLDERS\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GPJ

LOG OF BORING

Date Started 3/31/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/31/09 Casing: Length ____ Dia. 3.25"

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Water Elev. 902.6ft
Surface Elev. 931.1ft

Boring No. PS-1 Station & Offset 102+30.94, 72.13' Rt

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
931.1	0																
931.1						1.0'	Topsoil (12")										
930.1		2/3/5					Medium stiff, brown and gray SILTY CLAY, trace sand with organics, moist	1								28	VIS.
	2																
927.6		3/3/4					Medium stiff, brown and gray SILTY CLAY, little sand, trace gravel and cobbles, moist	2								28	VIS.
	4																
925.1	6	6/7/8					No recovery	3									VIS.
	8					8.5'											
922.6		6/6/8					Stiff, brown, SILT, some clay, little sand, trace gravel with cobbles, damp to moist	4								12	VIS.
	10																
920.1		9/11/14					Very stiff, brown and gray SILT, some clay, little sand, trace gravel, moist	5	9	5	9	52	25	25	8	16	A-4b
	12																
917.6		15/16/16					No recovery	6									
	14																
915.1	16	7/11/11				16.0'	Very stiff, gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	7								12	VIS.
	18																
912.6		8/11/14					Very stiff, gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	8								12	VIS.
	20																
	22																
907.6		7/9/15					Very stiff, gray SILT AND CLAY, some sand, trace gravel with cobbles and wet sand seams, till, damp	9	4	7	16	43	30	28	12	12	A-6a
	24																
	26																
	28					28.5'											
902.6		10/14/19					Hard, brown SANDY SILT, trace gravel with cobbles, till damp	10								14	VIS.
	30																
	32																
897.6		15/26/50-6"				34.5'	Hard, brown to gray SANDY SILT, trace gravel with cobbles, till, damp	11A								11	VIS.
896.6	34							11B								8	VIS.

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

HAYDEN RUN BOULEVARD

STRUCTURE FOUNDATION EXPLORATION

DRAWN B.R.U.
CHECKED SM

LOG OF BORING (Continued)

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. PS-1

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics								ODOT Class
									% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	
896.1																	
	36						Very dense, gray SAND, some silt, little gravel, wet										
	38																
892.6		7/9/12					Medium dense, gray SAND, some silt, little gravel, wet	12								25	VIS.
891.1	40					40.0'											
							Bottom of boring										

LOG OF BORING

Date Started 3/31/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/31/09 Casing: Length ____ Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. RB-1 Station & Offset 6370+47.30, 40.04' Lt Surface Elev. 934.0ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
934.0	0																
934.0							Topsoil (12")										
933.0						1.0'											
932.5		2/1/2				1.5'	Soft, brown SILTY CLAY, little sand, trace gravel with organics, moist	1								23	VIS.
	2	2/3/4						2	6	12	21	48	13	23	6	18	A-4a
931.0							Medium stiff, brown and gray SANDY SILT, little clay, trace gravel with organics, moist										
		5/7/8					Stiff, brown and gray SANDY SILT, some clay, trace gravel, damp	3	9	7	12	45	27	28	10	15	A-4a
	4																
929.5																	
		5/5/8					Stiff, brown and gray SANDY SILT, trace gravel, trace clay with mottling, damp	4								15	VIS.
928.0	6																
		3/5/6					Stiff, brown and gray SANDY SILT, trace gravel, trace clay with mottling, damp	5								16	VIS.
	8																
925.5																	
		10/9/8					Very stiff, brown SANDY SILT, little clay, little gravel with cobbles, damp	6								13	VIS.
	10																
	12																
920.5																	
	14	12/14/16					No recovery	7									
918.0	16					16.0'											
		6/9/10					Very stiff, gray SANDY SILT, trace gravel, trace clay with cobbles, till, damp	8								13	VIS.
916.5						17.5'											
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

NOTE:
BORING NOT SHOWN ON SOIL PROFILE

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

LOG OF BORING

Date Started 3/31/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/31/09 Casing: Length ____ Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. RB-2 Station & Offset 6374+48.60, 25.89' Lt Surface Elev. 936.9ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
936.9	0					0.3'	Gravel (3")										
936.6		2/2/2					Soft, brown and gray SILTY CLAY, little sand, little gravel with cinders, moist	1								20	VIS.
935.4	2	2/2/3					Medium stiff, brown and gray SILTY CLAY, little sand, little gravel with organics, moist	2	11	4	11	39	35	40	21	25	A-6b
933.9		3/4/4				3.0'	Medium stiff, brown SANDY SILT, some clay, trace gravel with cobbles, damp	3	8	9	14	39	30	27	10	13	A-4a
932.4	4	4/3/6					Stiff, brown and gray SANDY SILT, trace clay, trace gravel with cobbles and mottling, damp	4								14	VIS.
930.9	6	6/7/11					Very stiff, brown and gray SANDY SILT, little clay, trace gravel with cobbles and mottling, moist	5								17	VIS.
928.4	8	8/15/15					Hard, brown SANDY SILT, trace clay, trace gravel with cobbles, damp	6								14	VIS.
923.4	10					13.5'											
921.9	14	7/7/8				15.0'	Stiff, gray SANDY SILT, little gravel, trace clay with cobbles, till, damp	7								12	VIS.
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

NOTE:
BORING NOT SHOWN ON SOIL PROFILE

LOG OF BORING

Date Started 3/30/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/30/09 Casing: Length ____ Dia. 3.25"

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Water Elev. Dry
Boring No. RB-3 Station & Offset 6382+62.49, 26.07' Lt Surface Elev. 932.6ft

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
932.6	0					0.2'	Topsoil (2")										
932.6		1/1/1					Soft, brown and gray SILTY CLAY, trace sand with cinders, moist	1	0	2	6	51	41	40	19	25	VIS. A-6b
932.5						1.5'											
931.1	2	3/3/3					Medium stiff, brown and gray CLAY and silt, some sand, trace gravel with cinders, moist	2	0	1	6	47	46	43	22	24	A-7-6
929.6	4	3/4/4					Medium stiff, brown and gray CLAY and silt, some sand, trace gravel with cinders, moist	3								21	VIS.
928.1		3/4/6				4.5'	Stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, till, moist	4	4	9	14	41	32	28	11	17	A-6a
926.1	6	5/6/8					Stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	5								16	VIS.
924.1	8	6/6/9					Stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	6								12	VIS.
919.1	10 12 14	7/7/7					Stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	7								16	VIS.
917.6						15.0'	Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

NOTE:
BORING NOT SHOWN ON SOIL PROFILE

HAYDEN RUN BOULEVARD

STRUCTURE FOUNDATION EXPLORATION

DRAWN B.R.U.
CHECKED SM

LOG OF BORING

Date Started 3/30/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/30/09 Casing: Length ____ Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. RB-4 Station & Offset 6386+63.24, 23.83' Lt Surface Elev. 935.6ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
935.6	0																
935.6		1/2/2				0.2'	Topsoil (2")	1	3	3	13	40	41	37	17	22	VIS. A-6b
935.4							Soft brown SILTY CLAY, little sand, trace gravel, moist										
934.1						1.5'											
	2	1/2/4					Medium stiff, brown SILT AND CLAY, little sand, trace gravel, moist	2	8	5	12	41	34	32	12	21	A-6a
932.6																	
		4/6/10					Very stiff, brown SILT AND CLAY, little sand, trace gravel, moist	3								23	VIS.
	4																
931.1																	
		8/11/13					Very stiff, brown SILT AND CLAY, some sand, trace gravel, damp	4	2	8	16	44	30	28	12	13	A-6a
	6																
929.1																	
		8/8/12					Very stiff, brown SILT AND CLAY, some sand, trace gravel, damp	5								13	VIS.
	8																
927.1																	
		6/7/11					Very stiff, brown SILT AND CLAY, some sand, trace gravel, damp	6								15	VIS.
	10																
	12																
922.1						13.5'											
	14	11/13/19					Hard, gray SANDY SILT, little gravel with cobbles, till, damp	7								9	VIS.
920.6						15.0'											
							bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

NOTE:
BORING NOT SHOWN ON SOIL PROFILE

LOG OF BORING

Date Started 3/24/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/24/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. SB-1 Station & Offset 89+91.17, 14.95' Rt Surface Elev. 937.0ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
937.0	0																
937.0						0.4'	TOPSOIL (5")										
936.6		2/3/5					Medium stiff, brown CLAY and silt, trace sand, trace gravel, damp	1								26	VIS.
935.5	2	3/3/4					Medium stiff, brown CLAY and silt, trace sand, trace gravel, damp	2	1	1	6	43	49	51	28	24	A-7-6
934.0	4	4/3/4					Medium stiff, brown CLAY and silt, little sand, trace gravel, damp	3	1	3	12	40	44	43	22	24	A-7-6
932.5		4/5/5				4.5'	Stiff, brown SILT, little sand, trace gravel, dry	4								15	VIS.
931.0	6	5/6/9					Stiff, brown SILT, little sand, trace gravel, dry	5								13	VIS.
928.5	8	10/17/14					Hard, brown SILT, little sand, trace gravel with cobbles, dry	6								11	VIS.
927.0	10					10.0'	Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

LOG OF BORING

Date Started 3/24/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/24/09 Casing: Length ____ Dia. 3.25"

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Water Elev. 897.0ft
Surface Elev. 935.5ft

Boring No. SB-2 Station & Offset 93+93.91, 10.27' Lt

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
935.5	0																
935.5						0.8'	TOPSOIL (9")										
934.5	2	3/6/7					Stiff, brown CLAY, some silt, little sand, fill, damp	1	0	1	12	34	53	62	37	25	A-7-6
932.0	4	6/3/7				3.5'	Stiff, brown SANDY SILT, little clay with sand seams, little gravel, moist	2								16	VIS.
929.5	6	6/6/9					Stiff, brown SANDY SILT, little clay, little gravel, damp	3								14	VIS.
927.0	8	7/9/11					Very stiff, brown SANDY SILT, some clay, little gravel, damp	4	10	12	18	39	21	22	8	11	A-4a
924.5	10	18/20/20					Hard, brown SANDY SILT, some clay, little gravel, damp	5								12	VIS.
922.0	12	7/8/10				13.5'	Stiff, gray SILT AND CLAY, little sand, trace gravel, till, damp	6								11	VIS.
919.5	14	5/7/10					Stiff, gray SILT AND CLAY, little sand, trace gravel, till, damp	7	7	5	15	43	30	25	11	13	A-6a
917.5	16					18.0'											
917.0	18	4/7/10					Stiff, gray SANDY SILT, little clay, little gravel, till, damp	8								12	VIS.
	20																
	22																
912.0	24	7/11/14					Very stiff, gray SANDY SILT, little clay, little gravel, till, damp	9								12	VIS.
	26																
	28																
907.0		15/20/34					Hard, gray SANDY SILT, little clay, little gravel, till, damp	10								8	VIS.
	30																
	32																
902.0	34	19/33/43					Hard, gray SANDY SILT, little clay, trace gravel, damp	11	10	14	22	36	18	19	7	7	A-4a

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

LOG OF BORING (Continued)

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. SB-2

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
900.5																	
	36																
	38																
897.0		18/41/40				38.5'	Very dense, gray SAND AND GRAVEL, moist	12								12	VIS.
	40																
	42																
892.0						43.5'											
	44	9/20/29					Hard, gray SANDY SILT, little clay, trace gravel, damp	13								8	VIS.
	46																
	48																
887.0						48.5'											
		25/50-6"			FS		Very dense, gray SAND, some silt, little gravel, trace clay, moist	14								15	VIS.
885.5	50					50.0'											
							Bottom of boring										

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

LOG OF BORING

Date Started 3/31/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/31/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. 892.9ft
Boring No. SB-3 Station & Offset 101+24.78, 12.07' Lt Surface Elev. 931.4ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
931.4	0					0.6'	Topsoil (7")										
930.8		2/3/4					Stiff, brown and gray SILT AND CLAY, some sand, little gravel, moist	1								28	VIS.
929.9	2	3/5/4					Stiff, brown and gray SILT AND CLAY, some sand, little gravel, moist	2	16	9	14	42	19	30	12	21	A-6a
928.4	4	7/6/8					Stiff, brown and gray SILT AND CLAY, some sand, little gravel, moist	3								13	VIS.
926.9	6	6/6/7				6.0'	Stiff, brown and gray SILT AND CLAY, some sand, little gravel, moist	4								15	VIS.
925.4	8	6/7/8					Stiff, brown and gray SANDY SILT, little gravel, little clay with cobbles, damp	5								13	VIS.
922.9	10	6/7/9					Very stiff, brown and gray SANDY SILT, little gravel, little clay with cobbles, damp	6	17	13	16	41	13	22	7	11	A-4a
920.4	12	17/17/17						7									
917.9	14	7/9/13				13.5'	Very stiff, gray SILT, some sand, little clay, trace gravel with cobbles, damp	8								11	VIS.
915.4	16	6/11/16					Very stiff, gray SILT, some sand, little clay, trace gravel with cobbles, damp	9	1	3	25	56	15	18	4	12	A-4b
912.9	18	10/12/14					Very stiff, gray SILT, some sand, little clay, trace gravel with cobbles, damp	10								12	VIS.
907.9	22	7/11/17					Very stiff, gray SILT, some sand, little clay, trace gravel with cobbles, damp	11								13	VIS.
905.4	26					26.0'											
902.9	28	11/14/23					Hard, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, damp	12	8	8	14	44	26	30	12	11	A-6a
897.9	34	9/14/19					Hard, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, damp	13								12	VIS.

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

CTL OH DOT 2 OLD ODOT.GLB 09050029COL.GPJ 2/18/14 CTL OH DOT.GDT

LOG OF BORING (Continued)

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. SB-3

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
896.4																	
	36																
	38																
892.9		11/17/21				38.5'	Dense, gray SAND AND GRAVEL, some silt, wet	14								21	VIS.
	40																
	42																
887.9																	
	44	12/23/18					Dense, gray SAND AND GRAVEL, some silt, wet	15								14	VIS.
	46																
	48																
882.9		11/16/17					Dense, gray SAND AND GRAVEL, some silt, wet	16								13	VIS.
881.4	50					50.0'	Bottom of boring										

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

HAYDEN RUN BOULEVARD

STRUCTURE FOUNDATION EXPLORATION

DRAWN B.R.U.
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LOG OF BORING

Date Started 3/31/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/31/09 Casing: Length ____ Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. SB-4 Station & Offset 105+27.31, 8.91' Lt Surface Elev. 929.8ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
929.8	0																
929.8							Topsoil (12")										
928.8						1.0'											
928.3		1/1/2				1.5'	Soft, brown SANDY SILT, some clay, trace gravel, moist	1								24	VIS.
	2	2/4/7						2	10	7	15	47	21	26	9	13	A-4a
926.8							Stiff, brown and gray SANDY SILT, little clay, little gravel, damp										
		8/9/10					Very stiff, brown and gray SANDY SILT, trace gravel, trace clay with mottling, damp	3	13	8	16	44	19	23	7	15	A-4a
	4																
925.3		7/6/9					Stiff, brown and gray SANDY SILT, trace gravel, trace clay with mottling, damp	4								15	VIS.
923.8	6																
		6/7/11					Very stiff, brown and gray SANDY SILT, little gravel, trace clay with mottling, damp	5								12	VIS.
	8																
921.3		6/11/12					Very stiff, brown SANDY SILT, little gravel with rock fragments, damp	6								10	VIS.
919.8	10					10.0'											
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

LOG OF BORING

Date Started 4/24/09 Sampler: Type SS Dia. 1.375"
Date Completed 4/24/09 Casing: Length ____ Dia. 3.25"

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Water Elev. 909.2ft
Surface Elev. 921.2ft

Boring No. SB-5 Station & Offset 53+44.80, 1439.74' Rt

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
921.2	0																
921.2						0.8'	Topsoil (9")										
920.5		2/4/5					Stiff, gray and brown CLAY and silt, little sand, trace gravel, moist	1								35	VIS.
919.2	2	2/3/4					Medium stiff, gray and brown CLAY and silt, little sand, trace gravel, moist	2	7	3	8	44	38	51	29	26	A-7-6
917.7	4	2/2/2					Soft, brown and gray CLAY and silt, little sand, trace gravel, moist	3								27	VIS.
916.2		7/11/13				5.0'	Very stiff, brown SANDY SILT, little clay, little gravel, till, damp	4	12	13	18	39	18	20	6	10	A-4a
	6																
	8																
912.7		9/8/10					Very stiff, brown SANDY SILT, little clay, little gravel with cobbles, till, moist	5								14	VIS.
	10																
909.2	12					12.0'											
907.7		50-3"					Hard, gray SANDY SILT, trace gravel with cobbles and wet sand seams, till	6									VIS.
	14																
906.2						15.0'	Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 4/17/09 Sampler: Type SS Dia. 1.375"
Date Completed 4/17/09 Casing: Length ____ Dia. 3.25"

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Water Elev. 920.6ft
Surface Elev. 927.1ft

Boring No. SB-6 Station & Offset 111+81.22, 42.17' Rt

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
927.1	0																
927.1						0.5'	Topsoil (6")										
926.6																	
926.1		2/2/3					Medium stiff, brown and gray CLAY and silt, trace sand, trace gravel, moist	1	2	1	5	50	42	49	27	27	A-7-6
	2																
924.6		3/2/4					Medium stiff, brown and gray CLAY and silt, little sand, trace gravel, moist	2	1	2	4	45	48	49	25	19	A-7-6
923.1	4					4.0'											
		4/5/6					Stiff, brown and gray SANDY SILT, little clay, trace gravel with cobbles, moist	3								16	VIS.
921.6																	
	6	8/10/12					Very stiff, brown and gray SANDY SILT, little clay, little gravel with cobbles, moist	4	13	9	18	44	16	23	8	10	A-4a
	8																
918.6						8.5'											
		7/31/41					Very dense, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, wet	5								13	VIS.
	10																
	12																
913.6						13.5'											
	14	11/20/22					Hard, brown SANDY SILT, little gravel with cobbles, moist	6								10	VIS.
912.1						15.0'											
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

LOG OF BORING

Date Started 4/15/09 Sampler: Type SS Dia. 1.375"
Date Completed 4/15/09 Casing: Length ____ Dia. 3.25"

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Water Elev. Dry
Boring No. SB-7 Station & Offset 50+91.38, 19.35' Rt Surface Elev. 925.9ft

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
925.9	0					0.3'	Topsoil (3")										
925.9 925.6 924.9		1/2/2					Soft, gray ELASTIC CLAY and silt, little sand, trace gravel, moist	1	1	7	11	47	34	55	23	32	A-7-5
923.4	2	2/3/4				2.5'	Medium stiff, brown and gray CLAY and silt, trace sand, trace gravel, moist	2	1	2	10	44	43	46	23	25	A-7-6
921.9	4	3/3/5				4.0'	Medium stiff, brown and gray SANDY SILT, some clay, trace gravel, moist	3	7	12	19	41	21	21	6	13	A-4a
920.4	6	4/4/5				5.5'	Stiff, brown SANDY SILT, little clay, trace to little gravel with cobbles, moist	4								13	VIS.
917.4	8 10	4/4/11					Stiff, brown SANDY SILT, trace clay, little gravel with cobbles, moist	5								11	VIS.
912.4	12 14	5/7/10				13.5'	Very stiff, gray SANDY SILT, little clay, trace gravel, till, damp	6								14	VIS.
910.9						15.0'	Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

LOG OF BORING

Date Started 4/15/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 4/15/09 Casing: Length ____ Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. SB-8 Station & Offset 55+85.97, 30.01' Lt Surface Elev. 925.8ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
925.8	0																
925.8						0.6'	Topsoil (8")										
925.1																	
924.8		1/2/2					Soft to medium stiff, brown and gray CLAY and silt, trace sand, trace gravel with organics, moist	1	1	2	8	53	36	44	23	27	A-7-6
	2																
923.3		2/3/4					Medium stiff, brown and gray CLAY and silt, little sand, trace gravel with sandstone fragments, moist	2	1	3	10	43	43	48	25	24	A-7-6
921.8	4					4.0'											
		5/5/7					Stiff, brown and gray SANDY SILT, trace clay, trace to little gravel with sandstone fragments, moist	3								19	VIS.
920.3																	
	6	5/8/9					Very stiff, brown SANDY SILT, little gravel, trace clay with sandstone fragments, moist	4								16	VIS.
	8																
917.3																	
		12/6/8					Stiff, gray SANDY SILT, trace gravel, till, damp	5								14	VIS.
	10																
	12																
912.3																	
	14	3/5/7					Stiff, gray SANDY SILT, trace gravel, till, damp	6								15	VIS.
910.8						15.0'											
							Bottom of boring										

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 4/15/09 Sampler: Type SS Dia. 1.375"
Date Completed 4/15/09 Casing: Length ____ Dia. 3.25"

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Water Elev. 925.5ft
Surface Elev. 927.0ft

Boring No. SB-9 Station & Offset 46+63.72, 25.66' Rt

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
927.0	0														
927.0		4/6/7			Medium dense, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, possible fill, wet	1	54	18	12	13	3			9	VIS.
925.5	2	3/2/2			Loose, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, possible fill, wet	2								11	VIS.
924.0	4	2/2/2			Loose, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, possible fill, wet	3								15	VIS.
922.5	6	2/1/1			Very loose, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, possible fill, wet	4									
921.0					6.0'										
920.5	8	2/2/3			Medium stiff, brown SILT, some clay, some sand, trace gravel, moist	5	2	6	17	50	25	25	8	16	A-4b
918.5	10	3/4/8			Stiff, brown SILT, some clay, some sand, trace gravel, moist	6								15	VIS.
917.0					10.0'										
					Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 2/18/14

APPENDIX B
TEST BORING RECORDS

SOIL DESCRIPTION

Descriptors for soil consistency used in this report are based upon the Standard Penetration Test (SPT), ASTM D 1587, with the penetration (N) values corrected to N_{60} , based upon the efficiency of the SPT Hammer used for the soil sampling.

Descriptors for both non-cohesive and cohesive soils are presented below, with the corresponding range of corrected penetration values.

NON-COHESIVE SOIL DESCRIPTION	CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)
Very Loose	0 – 4
Loose	5 – 10
Medium Dense	11- 30
Dense	31 – 50
Very Dense	Over 50

COHESIVE SOIL DESCRIPTION	CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)
Very Soft	0 – 1
Soft	2 – 4
Medium Stiff	5 – 8
Stiff	9 – 15
Very Stiff	16 –30
Hard	Over 30

Moisture term descriptors for both non-cohesive and cohesive soils are presented below.

NON-COHESIVE SOIL DESCRIPTION	MOISTURE TERMS	COHESIVE SOIL DESCRIPTION
Powdery	Dry	Powdery
Some Moisture	Damp	Below Plastic Limit
Damp to the Touch	Moist	Above Plastic, Below Liquid Limit
Free Water	Wet	Above Liquid Limit

SOIL DESCRIPTION

Descriptors for soil consistency used in this report are based upon the Standard Penetration Test (SPT), ASTM D 1587, with the penetration (N) values corrected to N_{60} , based upon the efficiency of the SPT Hammer used for the soil sampling.

Descriptors for both non-cohesive and cohesive soils are presented below, with the corresponding range of corrected penetration values.

NON-COHESIVE SOIL DESCRIPTION	CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)
Very Loose	0 – 4
Loose	5 – 10
Medium Dense	11- 30
Dense	31 – 50
Very Dense	Over 50

COHESIVE SOIL DESCRIPTION	CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)
Very Soft	0 – 1
Soft	2 – 4
Medium Stiff	5 – 8
Stiff	9 – 15
Very Stiff	16 –30
Hard	Over 30

Moisture term descriptors for both non-cohesive and cohesive soils are presented below.

NON-COHESIVE SOIL DESCRIPTION	MOISTURE TERMS	COHESIVE SOIL DESCRIPTION
Powdery	Dry	Powdery
Some Moisture	Damp	Below Plastic Limit
Damp to the Touch	Moist	Above Plastic, Below Liquid Limit
Free Water	Wet	Above Liquid Limit

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/19/13 09:44 - J:\DEPT5\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GP

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / JP	DRILL RIG: 0305R333-11	STATION / OFFSET: 95+21.4, 94.1 LT	EXPLORATION ID B-003-0-12	
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / JP	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.		
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/4/11	ELEVATION: 933.8 (MSL) EOB: 40.0 ft.	PAGE 1 OF 2	
START: 10/25/12 END: 10/25/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.1	COORD: 10.000 N, 10.000 E		

MATERIAL DESCRIPTION AND NOTES	ELEV. 933.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (7")	933.2																	
VERY STIFF, BROWN, **CLAY**, AND SILT, LITTLE SAND, DAMP	930.8		2 3 5	11	94	SS-1	2.50	0	2	9	52	37	44	22	22	19	A-7-6 (14)	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP Shelby Tube (ST-3) Obtained in Offset Hole from Depths of 5.0' to 7.0'			9 8 6	19	100	SS-2	2.25	-	-	-	-	-	-	-	-	19	A-6a (V)	
@6.0'; STIFF					-	ST-3	-	5	7	15	42	31	32	18	14	-	A-6a (9)	
	925.3		8 12 22	45	100	SS-4	1.25	-	-	-	-	-	-	-	-	9	A-6a (V)	
VERY DENSE, BROWN TO GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, DRY			6 45 50/1"	-	15	SS-5	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
			50/5"	-	120	SS-6	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
	917.8		13 20 25	60	6	SS-7	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
VERY STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP	915.3		13 6 9	20	83	SS-8	4.00	3	4	17	49	27	25	14	11	11	A-6a (8)	
DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, DRY	912.8		9 11 14	33	6	SS-9	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
STIFF, GRAY, **SILT AND CLAY**, SOME SAND, MOIST			6 10 14	32	100	SS-10	1.00	-	-	-	-	-	-	-	-	11	A-6a (V)	
@23.5'; VERY STIFF	909.8	W	21 17 24	55	100	SS-11	2.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
VERY STIFF, GRAY, **SANDY SILT**, LITTLE CLAY, SOME GRAVEL, DAMP							-	-	-	-	-	-	-	-	-	17	A-4a (V)	
			6 11 17	37	78	SS-12	3.25	28	15	15	28	14	21	12	9	10	A-4a (1)	

PID:	BR ID:	PROJECT: HAYDEN RUN BLVD, PART II	STATION / OFFSET: 95+21.4, 94.1 LT	START: 10/25/12	END: 10/25/12	PG 2 OF 2	B-003-0-12

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
VERY STIFF, GRAY, **SANDY SILT**, LITTLE CLAY, SOME GRAVEL, DAMP *(continued)*	903.8	31																
		32																
		33																
		34	17 45 50/5"	-	88	SS-13	4.00	-	-	-	-	-	-	-	-	7	A-4a (V)	
		35																
		36																
		37																
		38																
		39	21 41 45	115	83	SS-14	3.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
	893.8	EOB 40																

NOTES: CAVED AT 17.2'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/19/13 09:44 - J:\DEPT5\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GP

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / MF	DRILL RIG: 03050TKR349-11	STATION / OFFSET: 99+24.9, 75.7 LT	EXPLORATION ID B-004-0-12
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / MF	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.	
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/17/11	ELEVATION: 932.8 (MSL) EOB: 50.0 ft.	PAGE 1 OF 2
START: 10/25/12 END: 10/25/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.7	COORD: 20.000 N, 20.000 E	

MATERIAL DESCRIPTION AND NOTES	ELEV. 932.8	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (9")	932.1																	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, SOME GRAVEL, DAMP		1–5	6 12 16	38	44	SS-1	-	26	7	12	38	17	30	17	13	9	A-6a (5)	
			16 20 19	52	94	SS-2	1.00	-	-	-	-	-	-	-	-	10	A-6a (V)	
	927.3																	
STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP		6–10	14 18 22	54	50	SS-3	-	-	-	-	-	-	-	-	-	11	A-4a (V)	
			16 22 28	67	56	SS-4	1.00	12	12	17	41	18	23	14	9	8	A-4a (5)	
	921.8																	
DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, DRY		11–13	50/1"	-	100	SS-5	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
	919.3																	
STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP		14–15	45 17 11	38	67	SS-6	1.75	-	-	-	-	-	-	-	-	13	A-6a (V)	
@16.0'; VERY STIFF		16–17	6 8 14	30	56	SS-7	2.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
		19–20	8 10 9	26	56	SS-8	2.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
		21–22	10 14 16	40	0	SS-9	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
@23.5'; STIFF		24–25	5 7 10	23	94	SS-10	1.75	6	6	16	45	27	29	16	13	13	A-6a (9)	
@28.5'; VERY STIFF		29	36 50/5"	-	64	SS-11	3.50	-	-	-	-	-	-	-	-	9	A-6a (V)	

PID:	BR ID:	PROJECT: HAYDEN RUN BLVD, PART II	STATION / OFFSET: 99+24.9, 75.7 LT	START: 10/25/12	END: 10/25/12	PG 2 OF 2	B-004-0-12

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP *(continued)*	902.8	31 32 33																
	899.3	W																
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, DAMP		34 35 36 37 38	50	-	50	SS-12	-	-	-	-	-	-	-	-	-	11	A-1-b (V)	
	894.3																	
MEDIUM STIFF, GRAY, **SILT AND CLAY**, MOIST		39 40 41 42 43	36 38 34	97	44	SS-13	0.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
		44 45 46 47 48	30 50	-	50	SS-14	0.75	-	-	-	-	-	-	-	-	13	A-6a (V)	
@48.5'; STIFF		49	12 33 50/5"	-	71	SS-15	1.25	-	-	-	-	-	-	-	-	10	A-6a (V)	
	882.8	EOB 50																

NOTES: CAVED AT 30'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/19/13 09:44 - J:\DEPT5\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GP

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / MF	DRILL RIG: 03050TKR349-11	STATION / OFFSET: 102+19.9, 74.5 LT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / MF	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/17/11	ELEVATION: 932.0 (MSL) EOB: 40.0 ft.
START: 10/25/12 END: 10/25/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.7	COORD: 30.000 N, 30.000 E

EXPLORATION ID B-005-0-12

PAGE 1 OF 2

MATERIAL DESCRIPTION AND NOTES	ELEV. 932.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (8")	931.3																	
VERY STIFF, BROWN, **SILT**, SOME CLAY, LITTLE SAND, DAMP	929.5	1	5															
		2	5 10	20	94	SS-1	2.00	0	2	9	64	25	27	17	10	11	A-4b (8)	
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP Shelby Tube (ST-2) Obtained in Offset Hole from Depths of 3.0' to 5.0'		3																
		4	12 20 24	59	- 67	ST-2 SS-3	- 2.25	5 -	8 -	12 -	44 -	31 -	34 -	19 -	15 -	- 11	A-6a (10) A-6a (V)	
		5																
		6																
@6.5'; STIFF		7	12 20 50/4"	-	75	SS-4	1.50	-	-	-	-	-	-	-	-	11	A-6a (V)	
		8																
@8.5'; VERY STIFF		9	18 19 19	51	56	SS-5	3.00	-	-	-	-	-	-	-	-	9	A-6a (V)	
		10																
@11.0'; GRAY, SOME SAND		11																
		12	15 18 18	48	50	SS-6	3.50	8	5	16	47	24	26	14	12	10	A-6a (8)	
		13																
		14	2 5 6	15	67	SS-7	2.50	-	-	-	-	-	-	-	-	12	A-6a (V)	
		15																
		16																
		17	9 12 16	38	0	SS-8	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		18																
@18.5'; HARD		19	7 10 13	31	17	SS-9	4.50	-	-	-	-	-	-	-	-	20	A-6a (V)	
		20																
@21.0'; VERY STIFF		21																
		22	8 9 12	28	44	SS-10	2.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
		23																
		24	6 10 13	31	0	SS-11	-	-	-	-	-	-	-	-	-	-	A-6a (V)	
		25																
		26																
		27																
		28																
		29	8 12 18	40	94	SS-12	3.00	8	5	21	39	27	23	12	11	8	A-6a (7)	

PID:	BR ID:	PROJECT: HAYDEN RUN BLVD, PART II	STATION / OFFSET: 102+19.9, 74.5 LT	START: 10/25/12	END: 10/25/12	PG 2 OF 2	B-005-0-12

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
VERY STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP Shelby Tube (ST-2) Obtained in Offset Hole from Depths of 3.0' to 5.0' *(continued)*	902.0	31 32 33																
@33.5'; STIFF	897.5	W 34	39 32 27	79	56	SS-13	1.00	-	-	-	-	-	-	-	-	8	A-6a (V)	
VERY DENSE, GRAY, **FINE SAND**, MOIST		35 36 37 38					-	-	-	-	-	-	-	-	-	19	A-3 (V)	
@38.5'; COBBLES	892.0	39 EOB 40	22 35 46	109	56	SS-14	-	-	-	-	-	-	-	-	-	8	A-3 (V)	

NOTES: CAVED AT 26.6'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/19/13 09:44 - J:\DEPT5\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GP

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / MF	DRILL RIG: 03050TKR349-11	STATION / OFFSET: 103+70.8, 76.9 LT
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / JP	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/17/11	ELEVATION: 929.9 (MSL) EOB: 45.0 ft.
START: 11/16/12 END: 11/16/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.7	COORD: 40.000 N, 40.000 E

EXPLORATION ID B-006-0-12

MATERIAL DESCRIPTION AND NOTES	ELEV. 929.9	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (11")	929.0																	
HARD, BROWN, **SILTY CLAY**, LITTLE SAND, LITTLE GRAVEL, DAMP Shelby Tube (ST-2) Obtained in Offset Hole from Depths of 2.0' to 4.0'		1	5 10 11	28	56	SS-1	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	
		2																
		3			-	ST-2	-	13	4	10	39	34	36	19	17	-	A-6b (10)	
		4	4 16 16	43	94	SS-3	4.00	-	-	-	-	-	-	-	-	11	A-6b (V)	
	924.4	5																
HARD, BROWN, **SANDY SILT**, AND GRAVEL, LITTLE CLAY, DAMP		6																
		7	16 17 16	44	89	SS-4	4.50	-	-	-	-	-	-	-	-	9	A-4a (V)	
		8																
		9	15 18 20	51	94	SS-5	4.00	41	9	12	27	11	23	17	6	12	A-4a (1)	
		10																
		11																
		12	19 16 16	43	72	SS-6	4.50	-	-	-	-	-	-	-	-	10	A-4a (V)	
		13																
		14	13 16 15	42	0	SS-7	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
	913.9	15																
VERY STIFF, GRAY, **CLAY**, DAMP		16																
		17	8 8 6	19	0	SS-8	3.00	-	-	-	-	-	-	-	-	14	A-7-6 (V)	
		18																
		19	5 6 7	17	0	SS-9	3.00	-	-	-	-	-	-	-	-	15	A-7-6 (V)	
		20																
		21																
		22																
		23																
@23.5'; HARD		24	8 9 16	34	0	SS-10	4.50	-	-	-	-	-	-	-	-	9	A-7-6 (V)	
		25																
		26																
		27																
	901.9	28																
STIFF, BROWN, **SILT**, LITTLE GRAVEL, TRACE CLAY, DAMP		29	26 50	-	83	SS-11	1.00	19	13	31	33	4	NP	NP	NP	13	A-4a (0)	

PID:	BR ID:	PROJECT: HAYDEN RUN BLVD, PART II	STATION / OFFSET: 103+70.8, 76.9 LT	START: 11/16/12	END: 11/16/12	PG 2 OF 2	B-006-0-12

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
STIFF, BROWN, **SILT**, LITTLE GRAVEL, TRACE CLAY, DAMP *(continued)*	899.9	31 32 33																
	896.4																	
DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, WET		34 35 36 37 38	37 50/3"	-	0	SS-12	-	-	-	-	-	-	-	-	-	17	A-2-6 (V)	
		39 40 41 42 43	50	-	0	SS-13	-	-	-	-	-	-	-	-	-	-	A-2-6 (V)	
	886.4																	
HARD, GRAY, **CLAY**, DAMP		44	22 36 50	116	94	SS-14	4.50	-	-	-	-	-	-	-	-	7	A-7-6 (V)	
	884.9	EOB 45																

NOTES: GROUNDWATER ENCOUNTERD 33.5', CAVED AT 27.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/19/13 09:44 - J:\DEPT5\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GP

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / MF	DRILL RIG: 03050TKR349-11	STATION / OFFSET: 105+20.8, 80.1 LT	EXPLORATION ID B-007-0-12
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / JP	HAMMER: CME AUTOMATIC	ALIGNMENT: HAYDEN RUN RD.	
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/17/11	ELEVATION: 929.2 (MSL) EOB: 45.0 ft.	PAGE 1 OF 2
START: 11/16/12 END: 11/16/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.7	COORD: 50.000 N, 50.000 E	

MATERIAL DESCRIPTION AND NOTES	ELEV. 929.2	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (15")	928.0																	
HARD, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP		1	6 6 9	20	78	SS-1	4.50	9	3	10	45	33	39	22	17	13	A-6b (11)	
		2																
		3																
		4	11 12 13	34	94	SS-2	4.50	-	-	-	-	-	-	-	-	11	A-6b (V)	
		5																
		6																
		7	21 14 14	38	6	SS-3	-	-	-	-	-	-	-	-	-	-	A-6b (V)	
		8																
	920.7																	
VERY STIFF, BROWN, **SANDY SILT**, DAMP		9	7 10 15	34	94	SS-4	4.00	-	-	-	-	-	-	-	-	10	A-4a (V)	
		10																
		11																
		12	12 12 12	32	0	SS-5	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
		13																
		14	10 16 16	43	0	SS-6	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
		15																
	913.2																	
HARD, BROWN, **SILT AND CLAY**, TRACE SAND, MOIST		16	6 8 11	26	83	SS-7	4.00	0	0	3	61	36	31	23	8	18	A-4b (8)	
		17																
		18																
		19	6 9 11	27	89	SS-8	4.50	-	-	-	-	-	-	-	-	12	A-4b (V)	
		20																
		21																
		22																
	907.2	23																
VERY STIFF, BROWN, **SANDY SILT**, SOME GRAVEL, TRACE CLAY, MOIST		24	16 26 40	89	6	SS-9	-	-	-	-	-	-	-	-	-	-	A-4a (V)	
		25																
		26																
		27	8 16 20	48	72	SS-10	3.00	-	-	-	-	-	-	-	-	16	A-4a (V)	
		28																
		29	18 22 25	63	94	SS-11	2.00	35	13	10	39	3	22	18	4	11	A-4a (1)	

PID:	BR ID:	PROJECT: HAYDEN RUN BLVD, PART II	STATION / OFFSET: 105+20.8, 80.1 LT	START: 11/16/12	END: 11/16/12	PG 2 OF 2	B-007-0-12

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
VERY STIFF, BROWN, **SANDY SILT**, SOME GRAVEL, TRACE CLAY, MOIST *(continued)*	899.2	31 32 33																
	895.7																	
DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, WET		34 35 36 37 38	16 12 15	36	44	SS-12	-	-	-	-	-	-	-	-	-	14	A-2-4 (V)	
@38.5'; VERY DENSE		39 40 41 42 43	30 32 38	94	78	SS-13	-	-	-	-	-	-	-	-	-	8	A-2-4 (V)	
	885.7																	
HARD, GRAY, **SANDY SILT**, DAMP	884.2	44 45 EOB	36 40 50/5"	-	41	SS-14	4.50	-	-	-	-	-	-	-	-	9	A-4a (V)	

NOTES: GROUNDWATER ENCOUNTERED 33.5'' CAVED AT 27.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 7/19/13 09:44 - J:\DEPT5\09 PROJECTS\09050029COL_EMHT-HAYDEN RUN BLVD-PT II\REPORTS\LOGS\09050029COL-2012.GP

PROJECT: HAYDEN RUN BLVD, PART II	DRILLING FIRM / OPERATOR: CTL / JP	DRILL RIG: 0305R333-11	STATION / OFFSET: 28+32, 243.1 RT	EXPLORATION ID B-008-0-12
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: CTL / JP	HAMMER: CME AUTOMATIC	ALIGNMENT: AVERY ROAD	
PID: BR ID:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 10/4/11	ELEVATION: 926.0 (MSL) EOB: 30.0 ft.	PAGE 1 OF 1
START: 10/25/12 END: 10/25/12	SAMPLING METHOD: SPT	ENERGY RATIO (%): 80.1	COORD: 60.000 N, 60.000 E	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	INST.
Topsoil (3")	926.0																	
	925.8																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP		1	1 3 5	11	78	SS-1	2.00	-	-	-	-	-	-	-	-	28	A-6a (V)	
		2																
		3																
		4	3 2 7	12	78	SS-2	1.62	11	11	18	38	22	29	17	12	12	A-6a (6)	
		5																
@6.0'; SOME GRAVEL		6	5 7 9	21	100	SS-3	2.50	-	-	-	-	-	-	-	-	12	A-6a (V)	
		7																
	917.5	8																
VERY DENSE, GRAY, **GRAVEL AND/OR STONE FRAGMENTS**, DRY		9	8 50/2"	-	13	SS-4	-	-	-	-	-	-	-	-	-	-	A-1-a (V)	
	915.0	10																
MEDIUM STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, SOME GRAVEL, DAMP		11	14 24 19	57	67	SS-5	0.50	35	8	12	30	15	23	14	9	10	A-4a (2)	
		12																
		13																
@13.5'; VERY STIFF, SOME CLAY, TRACE GRAVEL		14	2 5 6	15	78	SS-6	3.00	6	5	15	43	31	26	16	10	12	A-4a (8)	
		15																
		16																
		17	5 8 11	25	83	SS-7	2.50	-	-	-	-	-	-	-	-	12	A-4a (V)	
	908.0	18																
VERY STIFF, GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP		19	2 3 7	13	100	SS-8	2.00	5	7	16	43	29	28	16	12	14	A-6a (8)	
		20																
		21					3.00	-	-	-	-	-	-	-	-	11	A-6a (V)	
		22	11 10 17	36	100	SS-9	-	-	-	-	-	-	-	-	-	-		
		23																
@23.5'; HARD		24	13 15 20	47	100	SS-10	4.50	6	8	16	37	33	27	14	13	9	A-6a (8)	
		25																
		26																
		27	15 20 41	81	100	SS-11	4.50	-	-	-	-	-	-	-	-	7	A-6a (V)	
		28																
@28.5'; VERY STIFF		29	50	-	100	SS-12	2.00	-	-	-	-	-	-	-	-	7	A-6a (V)	
	896.0																	
		EOB																

NOTES: CAVED AT 14.9'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: NOT RECORDED

LOG OF BORING

Date Started 3/25/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/25/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. 895.3ft
Boring No. B-1 Station & Offset 97+92.23, 34.85' Lt Surface Elev. 933.8ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
933.8	0					0.6'	Topsoil (7")										
932.8	2	3/3/4					Medium stiff, brown and gray SILT, some clay, little sand, fill, moist	1	1	3	9	66	21	26	7	23	A-4b
930.3	4	5/6/7					Stiff, brown and gray SILT, some clay, little sand, fill, damp	2								18	VIS.
927.8	6	8/7/7				6.0'	Stiff, brown and gray SANDY SILT, little clay, little gravel with weathered clay-stone fragments, damp	3								10	VIS.
925.3	8	4/12/13					Very stiff, brown and gray SANDY SILT, little clay, little gravel with cobbles, damp	4	14	12	14	41	19	22	7	10	A-4a
922.8	10	15/18/18					Hard, brown and gray SANDY SILT, little clay, little gravel with cobbles, damp	5								11	VIS.
920.3	12	12/13/13					Very stiff, brown and gray SANDY SILT, little clay, little gravel with cobbles, damp	6								11	VIS.
917.8	14	5/8/11					No recovery	7									VIS.
915.3	16	10/11/13					Very stiff, brown and gray SANDY SILT, little clay, little gravel with cobbles, damp	8								12	VIS.
910.3	18	6/7/10				23.5'	Very stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, damp to moist	9	5	5	15	48	27	27	12	15	A-6a
905.3	28	12/18/24				28.5'	Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	10	8	7	21	44	20	21	8	9	A-4a
900.3	34	17/50-6"					Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	11								7	VIS.

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 7/19/13

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. B-1

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
898.8																	
	36																
	38																
895.3		42/50-6"					Hard, gray SANDY SILT, little gravel, trace clay with cobbles and wet sand seams, till, damp	12								8	VIS.
	40																
	42																
890.3																	
	44	15/20/26					Hard, gray SANDY SILT, little gravel, trace clay with cobbles, till, damp	13								8	VIS.
	46																
	48																
885.3		16/25/34					Hard, gray SANDY SILT, little gravel, trace clay with cobbles, till, damp	14								9	VIS.
	50																
	52																
880.3																	
	54	9/17/19					Hard, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	15	8	10	21	41	20	21	7	11	A-4a
	56																
	58																
875.3		9/18/25					Hard, gray SANDY SILT, little gravel, little clay with cobbles, till, damp	16								11	VIS.
873.8	60					60.0'											
							Bottom of boring										

LOG OF BORING

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Date Started 3/30/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/30/09 Casing: Length ____ Dia. 3.25"

Water Elev. 909.1ft
Boring No. B-2 Station & Offset 99+11.42, 47.38' Rt Surface Elev. 932.6ft

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
932.6	0																
932.6							Topsoil (11")										VIS.
931.7						0.9'											
931.6		5/3/5					Medium stiff, brown CLAY and silt, trace sand, trace gravel, fill, moist	1	1	2	7	51	39	53	29	26	A-7-6
	2																
929.1																	
	4	4/3/3					Medium stiff, brown and gray CLAY and silt, trace sand, trace gravel, fill, moist	2								33	VIS.
927.6						5.0'											
926.6	6																
		3/4/6					Stiff, brown and gray SANDY SILT, some gravel, little clay, damp	3	24	11	15	33	17	23	8	14	A-4a
	8																
924.1		15/18/30					No recovery	4									
	10																
921.6																	
	12	5/9/10					Very stiff, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	5	2	5	16	48	29	25	10	12	A-4a
919.1																	
	14	6/8/12					Very stiff, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	6								13	VIS.
916.6	16																
		4/6/10					Very stiff, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	7								13	VIS.
	18																
914.1		5/8/13					Very stiff, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	8	3	7	17	49	24	25	10	12	A-4a
	20																
	22																
909.1																	
	24	12/12/21					Hard, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	9								17	VIS.
	26																
	28																
904.1																	
		14/21/36					Hard, gray SANDY SILT, some clay, trace gravel with cobbles, till, damp	10								16	VIS.
	30																
	32																
899.1																	
	34	26/36/40					Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	11	8	11	22	43	16	21	8	9	A-4a

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. B-2

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
897.6																	
	36																
	38																
894.1		20/34/39					Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	12								8	VIS.
	40																
	42																
889.1																	
	44	11/23/30					Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	13								9	VIS.
	46																
	48																
884.1		16/23/30					Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	14	9	10	21	42	18	21	8	9	A-4a
	50																
	52																
879.1																	
	54	13/24/36					Hard, gray SANDY SILT, little clay, trace gravel with cobbles, till, damp	15								8	VIS.
877.6						55.0'											
							Bottom of boring										

LOG OF BORING

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Date Started 3/31/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/31/09 Casing: Length ____ Dia. 3.25"

Water Elev. 902.6ft

Boring No. PS-1 Station & Offset 102+30.94, 72.13' Rt Surface Elev. 931.1ft

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
931.1	0																
931.1							Topsoil (12")										
930.1						1.0'											
		2/3/5					Medium stiff, brown and gray SILTY CLAY, trace sand with organics, moist	1								28	VIS.
	2																
927.6																	
	4	3/3/4					Medium stiff, brown and gray SILTY CLAY, little sand, trace gravel and cobbles, moist	2								28	VIS.
925.1	6																
		6/7/8					No recovery	3									VIS.
	8																
922.6						8.5'											
		6/6/8					Stiff, brown, SILT, some clay, little sand, trace gravel with cobbles, damp to moist	4								12	VIS.
	10																
920.1																	
		9/11/14					Very stiff, brown and gray SILT, some clay, little sand, trace gravel, moist	5	9	5	9	52	25	25	8	16	A-4b
	12																
917.6																	
	14	15/16/16					No recovery	6									
915.1	16					16.0'											
		7/11/11					Very stiff, gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	7								12	VIS.
	18																
912.6																	
		8/11/14					Very stiff, gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	8								12	VIS.
	20																
	22																
907.6																	
	24	7/9/15					Very stiff, gray SILT AND CLAY, some sand, trace gravel with cobbles and wet sand seams, till, damp	9	4	7	16	43	30	28	12	12	A-6a
	26																
	28																
902.6						28.5'											
		10/14/19					Hard, brown SANDY SILT, trace gravel with cobbles, till damp	10								14	VIS.
	30																
	32																
897.6																	
	34	15/26/50-6"					Hard, brown to gray SANDY SILT, trace gravel with cobbles, till, damp	11A								11	VIS.
896.6						34.5'											
								11B								8	VIS.

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

OH DOT 2 CTL OH DOT.GDT OLD ODOT.GLB 09050029COL.GPJ 7/19/13

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. PS-1

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics								ODOT Class
									% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	
896.1																	
	36						Very dense, gray SAND, some silt, little gravel, wet										
	38																
892.6		7/9/12					Medium dense, gray SAND, some silt, little gravel, wet	12								25	VIS.
891.1	40					40.0'											
							Bottom of boring										

LOG OF BORING

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Date Started 3/31/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/31/09 Casing: Length Dia. 3.25"
Water Elev. Dry

Boring No. RB-1 Station & Offset 6370+47.30, 40.04' Lt Surface Elev. 934.0ft
CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics								ODOT Class
									% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	
934.0	0						Topsoil (12")										
933.0						1.0'											
932.5		2/1/2				1.5'	Soft, brown SILTY CLAY, little sand, trace gravel with organics, moist	1								23	VIS.
	2	2/3/4						2	6	12	21	48	13	23	6	18	A-4a
931.0							Medium stiff, brown and gray SANDY SILT, little clay, trace gravel with organics, moist	3	9	7	12	45	27	28	10	15	A-4a
	4	5/7/8					Stiff, brown and gray SANDY SILT, some clay, trace gravel, damp										
929.5		5/5/8					Stiff, brown and gray SANDY SILT, trace gravel, trace clay with mottling, damp	4								15	VIS.
928.0	6																
		3/5/6					Stiff, brown and gray SANDY SILT, trace gravel, trace clay with mottling, damp	5								16	VIS.
	8																
925.5		10/9/8					Very stiff, brown SANDY SILT, little clay, little gravel with cobbles, damp	6								13	VIS.
	10																
	12																
920.5																	
	14	12/14/16					No recovery	7									
918.0	16					16.0'											
		6/9/10					Very stiff, gray SANDY SILT, trace gravel, trace clay with cobbles, till, damp	8								13	VIS.
916.5						17.5'											
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 3/31/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/31/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. RB-2 Station & Offset 6374+48.60, 25.89' Lt Surface Elev. 936.9ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
936.9	0					0.3'	Gravel (3")										
936.6		2/2/2					Soft, brown and gray SILTY CLAY, little sand, little gravel with cinders, moist	1								20	VIS.
935.4	2	2/2/3					Medium stiff, brown and gray SILTY CLAY, little sand, little gravel with organics, moist	2	11	4	11	39	35	40	21	25	A-6b
933.9		3/4/4				3.0'	Medium stiff, brown SANDY SILT, some clay, trace gravel with cobbles, damp	3	8	9	14	39	30	27	10	13	A-4a
	4																
932.4		4/3/6					Stiff, brown and gray SANDY SILT, trace clay, trace gravel with cobbles and mottling, damp	4								14	VIS.
930.9	6	6/7/11					Very stiff, brown and gray SANDY SILT, little clay, trace gravel with cobbles and mottling, moist	5								17	VIS.
	8																
928.4		8/15/15					Hard, brown SANDY SILT, trace clay, trace gravel with cobbles, damp	6								14	VIS.
	10																
	12																
923.4	14	7/7/8				13.5'	Stiff, gray SANDY SILT, little gravel, trace clay with cobbles, till, damp	7								12	VIS.
921.9						15.0'	Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 3/30/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/30/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. RB-3 Station & Offset 6382+62.49, 26.07' Lt Surface Elev. 932.6ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)	Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
932.6	0				0.2'										
932.6		1/1/1			Topsoil (2")	1	0	2	6	51	41	40	19	25	VIS.
932.5					Soft, brown and gray SILTY CLAY, trace sand with cinders, moist										A-6b
931.1					1.5'										
	2	3/3/3			Medium stiff, brown and gray CLAY and silt, some sand, trace gravel with cinders, moist	2	0	1	6	47	46	43	22	24	A-7-6
929.6															
		3/4/4			Medium stiff, brown and gray CLAY and silt, some sand, trace gravel with cinders, moist	3								21	VIS.
	4														
928.1					4.5'										
		3/4/6			Stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, till, moist	4	4	9	14	41	32	28	11	17	A-6a
	6														
926.1															
		5/6/8			Stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	5								16	VIS.
	8														
924.1															
		6/6/9			Stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	6								12	VIS.
	10														
	12														
919.1															
	14	7/7/7			Stiff, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, till, damp	7								16	VIS.
917.6					15.0'										
					Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 3/30/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/30/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. RB-4 Station & Offset 6386+63.24, 23.83' Lt Surface Elev. 935.6ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
935.6	0					0.2'											
935.6		1/2/2					Topsoil (2")	1	3	3	13	40	41	37	17	22	VIS.
935.4							Soft brown SILTY CLAY, little sand, trace gravel, moist										A-6b
934.1						1.5'											
	2	1/2/4					Medium stiff, brown SILT AND CLAY, little sand, trace gravel, moist	2	8	5	12	41	34	32	12	21	A-6a
932.6																	
		4/6/10					Very stiff, brown SILT AND CLAY, little sand, trace gravel, moist	3								23	VIS.
	4																
931.1																	
		8/11/13					Very stiff, brown SILT AND CLAY, some sand, trace gravel, damp	4	2	8	16	44	30	28	12	13	A-6a
	6																
929.1																	
		8/8/12					Very stiff, brown SILT AND CLAY, some sand, trace gravel, damp	5								13	VIS.
	8																
927.1																	
		6/7/11					Very stiff, brown SILT AND CLAY, some sand, trace gravel, damp	6								15	VIS.
	10																
	12																
922.1						13.5'											
	14	11/13/19					Hard, gray SANDY SILT, little gravel with cobbles, till, damp	7								9	VIS.
920.6						15.0'											
							bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 3/24/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/24/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. SB-1 Station & Offset 89+91.17, 14.95' Rt Surface Elev. 937.0ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
937.0	0																
937.0						0.4'	TOPSOIL (5")										
936.6		2/3/5					Medium stiff, brown CLAY and silt, trace sand, trace gravel, damp	1								26	VIS.
935.5	2	3/3/4					Medium stiff, brown CLAY and silt, trace sand, trace gravel, damp	2	1	1	6	43	49	51	28	24	A-7-6
934.0	4	4/3/4					Medium stiff, brown CLAY and silt, little sand, trace gravel, damp	3	1	3	12	40	44	43	22	24	A-7-6
932.5		4/5/5				4.5'	Stiff, brown SILT, little sand, trace gravel, dry	4								15	VIS.
931.0	6	5/6/9					Stiff, brown SILT, little sand, trace gravel, dry	5								13	VIS.
928.5	8	10/17/14					Hard, brown SILT, little sand, trace gravel with cobbles, dry	6								11	VIS.
927.0	10					10.0'	Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 3/24/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 3/24/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. 897.0ft
Boring No. SB-2 Station & Offset 93+93.91, 10.27' Lt Surface Elev. 935.5ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
935.5	0						TOPSOIL (9")										
934.5		3/6/7				0.8'	Stiff, brown CLAY, some silt, little sand, fill, damp	1	0	1	12	34	53	62	37	25	A-7-6
	2																
932.0	4	6/3/7				3.5'	Stiff, brown SANDY SILT, little clay with sand seams, little gravel, moist	2								16	VIS.
929.5	6	6/6/9					Stiff, brown SANDY SILT, little clay, little gravel, damp	3								14	VIS.
	8																
927.0	10	7/9/11					Very stiff, brown SANDY SILT, some clay, little gravel, damp	4	10	12	18	39	21	22	8	11	A-4a
924.5	12	18/20/20					Hard, brown SANDY SILT, some clay, little gravel, damp	5								12	VIS.
922.0	14	7/8/10				13.5'	Stiff, gray SILT AND CLAY, little sand, trace gravel, till, damp	6								11	VIS.
919.5	16	5/7/10					Stiff, gray SILT AND CLAY, little sand, trace gravel, till, damp	7	7	5	15	43	30	25	11	13	A-6a
917.5	18					18.0'											
917.0	20	4/7/10					Stiff, gray SANDY SILT, little clay, little gravel, till, damp	8								12	VIS.
	22																
912.0	24	7/11/14					Very stiff, gray SANDY SILT, little clay, little gravel, till, damp	9								12	VIS.
	26																
	28																
907.0	30	15/20/34					Hard, gray SANDY SILT, little clay, little gravel, till, damp	10								8	VIS.
	32																
902.0	34	19/33/43					Hard, gray SANDY SILT, little clay, trace gravel, damp	11	10	14	22	36	18	19	7	7	A-4a

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. SB-2

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics								ODOT Class
									% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	
900.5																	
	36																
	38																
897.0						38.5'											
		18/41/40					Very dense, gray SAND AND GRAVEL, moist	12								12	VIS.
	40																
	42																
892.0						43.5'											
	44	9/20/29					Hard, gray SANDY SILT, little clay, trace gravel, damp	13								8	VIS.
	46																
	48																
887.0						48.5'											
		25/50-6"			FS		Very dense, gray SAND, some silt, little gravel, trace clay, moist	14								15	VIS.
885.5	50					50.0'											
							Bottom of boring										

LOG OF BORING

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Date Started 3/31/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/31/09 Casing: Length ____ Dia. 3.25"

Water Elev. 892.9ft
Boring No. SB-3 Station & Offset 101+24.78, 12.07' Lt Surface Elev. 931.4ft

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
931.4	0					0.6'	Topsoil (7")										
930.8		2/3/4					Stiff, brown and gray SILT AND CLAY, some sand, little gravel, moist	1								28	VIS.
929.9	2	3/5/4					Stiff, brown and gray SILT AND CLAY, some sand, little gravel, moist	2	16	9	14	42	19	30	12	21	A-6a
928.4	4	7/6/8					Stiff, brown and gray SILT AND CLAY, some sand, little gravel, moist	3								13	VIS.
926.9	6	6/6/7					Stiff, brown and gray SILT AND CLAY, some sand, little gravel, moist	4								15	VIS.
925.4	8	6/7/8				6.0'	Stiff, brown and gray SANDY SILT, little gravel, little clay with cobbles, damp	5								13	VIS.
922.9	10	6/7/9					Very stiff, brown and gray SANDY SILT, little gravel, little clay with cobbles, damp	6	17	13	16	41	13	22	7	11	A-4a
920.4	12	17/17/17						7									
917.9	14	7/9/13				13.5'	Very stiff, gray SILT, some sand, little clay, trace gravel with cobbles, damp	8								11	VIS.
915.4	16	6/11/16					Very stiff, gray SILT, some sand, little clay, trace gravel with cobbles, damp	9	1	3	25	56	15	18	4	12	A-4b
912.9	18	10/12/14					Very stiff, gray SILT, some sand, little clay, trace gravel with cobbles, damp	10								12	VIS.
907.9	20	7/11/17					Very stiff, gray SILT, some sand, little clay, trace gravel with cobbles, damp	11								13	VIS.
905.4	26					26.0'											
902.9	28	11/14/23					Hard, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, damp	12	8	8	14	44	26	30	12	11	A-6a
897.9	34	9/14/19					Hard, brown and gray SILT AND CLAY, some sand, trace gravel with cobbles, damp	13								12	VIS.

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Boring No. SB-3

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics								ODOT Class
									% Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	
896.4																	
	36																
	38																
892.9						38.5'											
		11/17/21					Dense, gray SAND AND GRAVEL, some silt, wet	14								21	VIS.
	40																
	42																
887.9																	
	44	12/23/18					Dense, gray SAND AND GRAVEL, some silt, wet	15								14	VIS.
	46																
	48																
882.9																	
		11/16/17					Dense, gray SAND AND GRAVEL, some silt, wet	16								13	VIS.
881.4	50					50.0'											
							Bottom of boring										

LOG OF BORING

Project Identification: EMH&T
Hayden Run Blvd, Columbus, Ohio

Date Started 3/31/09 Sampler: Type SS Dia. 1.375"
Date Completed 3/31/09 Casing: Length ____ Dia. 3.25"

Water Elev. Dry

Boring No. SB-4 Station & Offset 105+27.31, 8.91' Lt Surface Elev. 929.8ft

CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
929.8	0						Topsoil (12")										
928.8						1.0'											
928.3		1/1/2				1.5'	Soft, brown SANDY SILT, some clay, trace gravel, moist	1								24	VIS.
	2	2/4/7					Stiff, brown and gray SANDY SILT, little clay, little gravel, damp	2	10	7	15	47	21	26	9	13	A-4a
926.8		8/9/10					Very stiff, brown and gray SANDY SILT, trace gravel, trace clay with mottling, damp	3	13	8	16	44	19	23	7	15	A-4a
	4																
925.3		7/6/9					Stiff, brown and gray SANDY SILT, trace gravel, trace clay with mottling, damp	4								15	VIS.
923.8	6																
		6/7/11					Very stiff, brown and gray SANDY SILT, little gravel, trace clay with mottling, damp	5								12	VIS.
	8																
921.3		6/11/12					Very stiff, brown SANDY SILT, little gravel with rock fragments, damp	6								10	VIS.
919.8	10					10.0'											
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 4/24/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 4/24/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. 909.2ft
Boring No. SB-5 Station & Offset 53+44.80, 1439.74' Rt Surface Elev. 921.2ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
921.2	0						Topsoil (9")										
920.5		2/4/5				0.8'	Stiff, gray and brown CLAY and silt, little sand, trace gravel, moist	1								35	VIS.
919.2	2	2/3/4					Medium stiff, gray and brown CLAY and silt, little sand, trace gravel, moist	2	7	3	8	44	38	51	29	26	A-7-6
917.7	4	2/2/2					Soft, brown and gray CLAY and silt, little sand, trace gravel, moist	3								27	VIS.
916.2		7/11/13				5.0'	Very stiff, brown SANDY SILT, little clay, little gravel, till, damp	4	12	13	18	39	18	20	6	10	A-4a
	6																
	8																
912.7		9/8/10					Very stiff, brown SANDY SILT, little clay, little gravel with cobbles, till, moist	5								14	VIS.
	10																
909.2	12					12.0'											
907.7	14	50-3"					Hard, gray SANDY SILT, trace gravel with cobbles and wet sand seams, till	6									VIS.
906.2						15.0'	Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 4/17/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 4/17/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. 920.6ft
Boring No. SB-6 Station & Offset 111+81.22, 42.17' Rt Surface Elev. 927.1ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
927.1	0					0.5'	Topsoil (6")										
926.6																	
926.1		2/2/3					Medium stiff, brown and gray CLAY and silt, trace sand, trace gravel, moist	1	2	1	5	50	42	49	27	27	A-7-6
	2																
924.6		3/2/4					Medium stiff, brown and gray CLAY and silt, little sand, trace gravel, moist	2	1	2	4	45	48	49	25	19	A-7-6
923.1	4					4.0'											
		4/5/6					Stiff, brown and gray SANDY SILT, little clay, trace gravel with cobbles, moist	3								16	VIS.
921.6																	
	6	8/10/12					Very stiff, brown and gray SANDY SILT, little clay, little gravel with cobbles, moist	4	13	9	18	44	16	23	8	10	A-4a
	8																
918.6						8.5'											
		7/31/41					Very dense, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, wet	5								13	VIS.
	10																
	12																
913.6						13.5'											
	14	11/20/22					Hard, brown SANDY SILT, little gravel with cobbles, moist	6								10	VIS.
912.1						15.0'											
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 4/15/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 4/15/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. SB-7 Station & Offset 50+91.38, 19.35' Rt Surface Elev. 925.9ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
925.9	0					0.3'	Topsoil (3")										
925.6																	
924.9		1/2/2					Soft, gray ELASTIC CLAY and silt, little sand, trace gravel, moist	1	1	7	11	47	34	55	23	32	A-7-5
	2					2.5'											
923.4		2/3/4					Medium stiff, brown and gray CLAY and silt, trace sand, trace gravel, moist	2	1	2	10	44	43	46	23	25	A-7-6
921.9	4					4.0'											
		3/3/5					Medium stiff, brown and gray SANDY SILT, some clay, trace gravel, moist	3	7	12	19	41	21	21	6	13	A-4a
920.4						5.5'											
	6	4/4/5					Stiff, brown SANDY SILT, little clay, trace to little gravel with cobbles, moist	4								13	VIS.
	8																
917.4		4/4/11					Stiff, brown SANDY SILT, trace clay, little gravel with cobbles, moist	5								11	VIS.
	10																
	12																
912.4						13.5'											
	14	5/7/10					Very stiff, gray SANDY SILT, little clay, trace gravel, till, damp	6								14	VIS.
910.9						15.0'											
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

LOG OF BORING

Date Started 4/15/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 4/15/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. Dry
Boring No. SB-8 Station & Offset 55+85.97, 30.01' Lt Surface Elev. 925.8ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
925.8	0					0.6'	Topsoil (8")										
925.1																	
924.8		1/2/2					Soft to medium stiff, brown and gray CLAY and silt, trace sand, trace gravel with organics, moist	1	1	2	8	53	36	44	23	27	A-7-6
	2																
923.3		2/3/4					Medium stiff, brown and gray CLAY and silt, little sand, trace gravel with sandstone fragments, moist	2	1	3	10	43	43	48	25	24	A-7-6
921.8	4					4.0'											
		5/5/7					Stiff, brown and gray SANDY SILT, trace clay, trace to little gravel with sandstone fragments, moist	3								19	VIS.
920.3																	
	6	5/8/9					Very stiff, brown SANDY SILT, little gravel, trace clay with sandstone fragments, moist	4								16	VIS.
	8																
917.3		12/6/8					Stiff, gray SANDY SILT, trace gravel, till, damp	5								14	VIS.
	10																
	12																
912.3																	
	14	3/5/7					Stiff, gray SANDY SILT, trace gravel, till, damp	6								15	VIS.
910.8						15.0'											
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

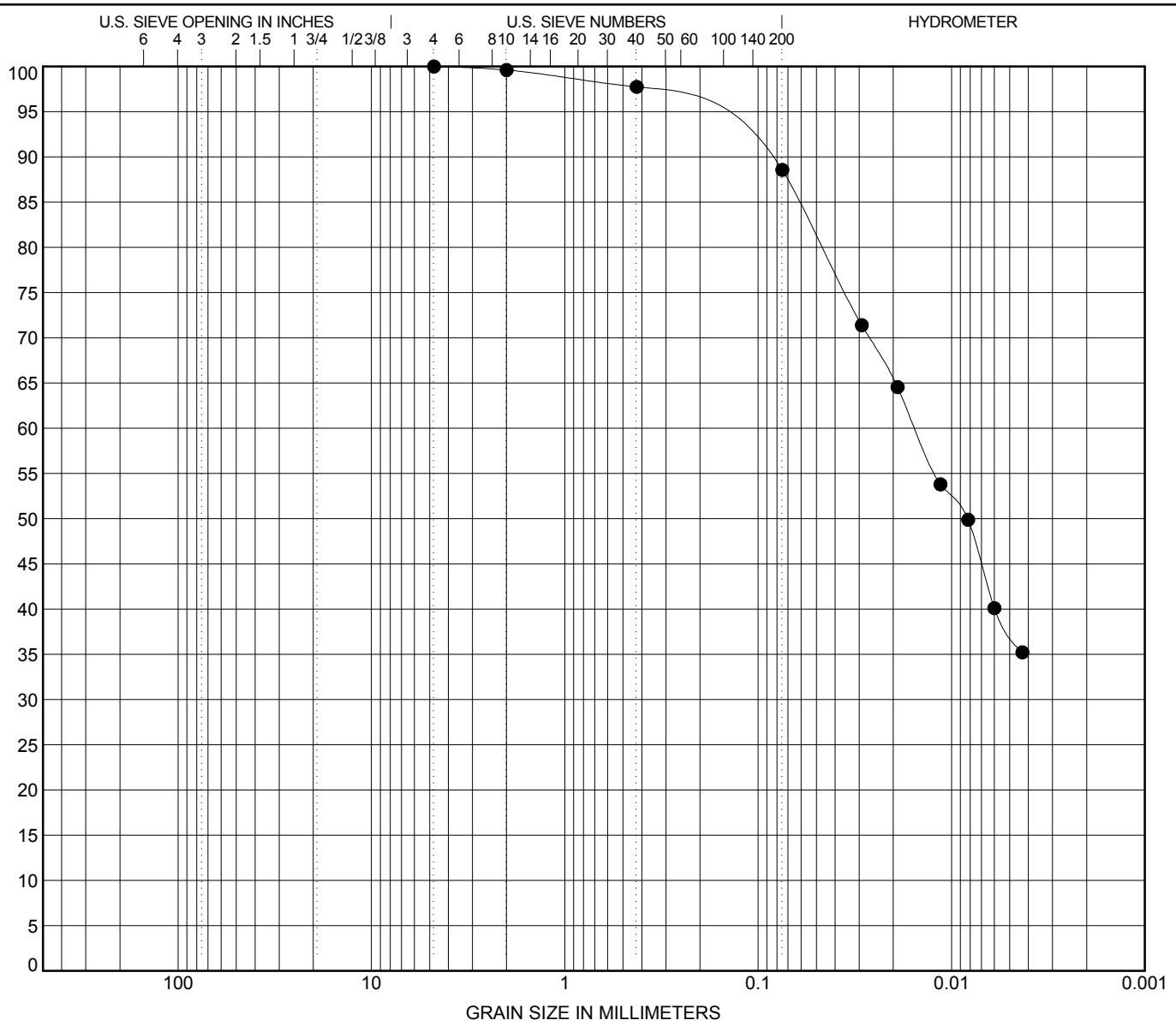
LOG OF BORING

Date Started 4/15/09 Sampler: Type SS Dia. 1.375" Project Identification: EMH&T
Date Completed 4/15/09 Casing: Length Dia. 3.25" Hayden Run Blvd, Columbus, Ohio
Water Elev. 925.5ft
Boring No. SB-9 Station & Offset 46+63.72, 25.66' Rt Surface Elev. 927.0ft CTL Project No. 09050029COL

Elev. (ft)	Depth (ft)	Std. Pen./ RQD	Rec. (ft)	Loss (ft)			Description	Sample No.	Physical Characteristics % Agg	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	ODOT Class
927.0	0	4/6/7					Medium dense, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, possible fill, wet	1	54	18	12	13	3			9	VIS.
925.5	2	3/2/2					Loose, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, possible fill, wet	2								11	VIS.
924.0	4	2/2/2					Loose, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, possible fill, wet	3								15	VIS.
922.5		2/1/1					Very loose, brown GRAVEL AND/OR STONE FRAGMENTS WITH SAND, possible fill, wet	4									
921.0	6					6.0'											
920.5	8	2/2/3					Medium stiff, brown SILT, some clay, some sand, trace gravel, moist	5	2	6	17	50	25	25	8	16	A-4b
918.5		3/4/8					Stiff, brown SILT, some clay, some sand, trace gravel, moist	6								15	VIS.
917.0	10					10.0'											
							Bottom of boring										

Particle Sizes: Agg => 2.00mm, Coarse Sand = 2.00-0.42mm, Fine Sand = 0.42-0.074mm, Silt = 0.074-0.005mm, Clay =< 0.005mm.

APPENDIX C
LABORATORY TESTING



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-003-0-12	**1.0**	**A-7-6(14)**	**19**	**44**	**22**	**22**		
		CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-003-0-12	**1.0**	**4.75**	**0.015**	**0.008**			**0**	**2**	**9**	**52**	**37**

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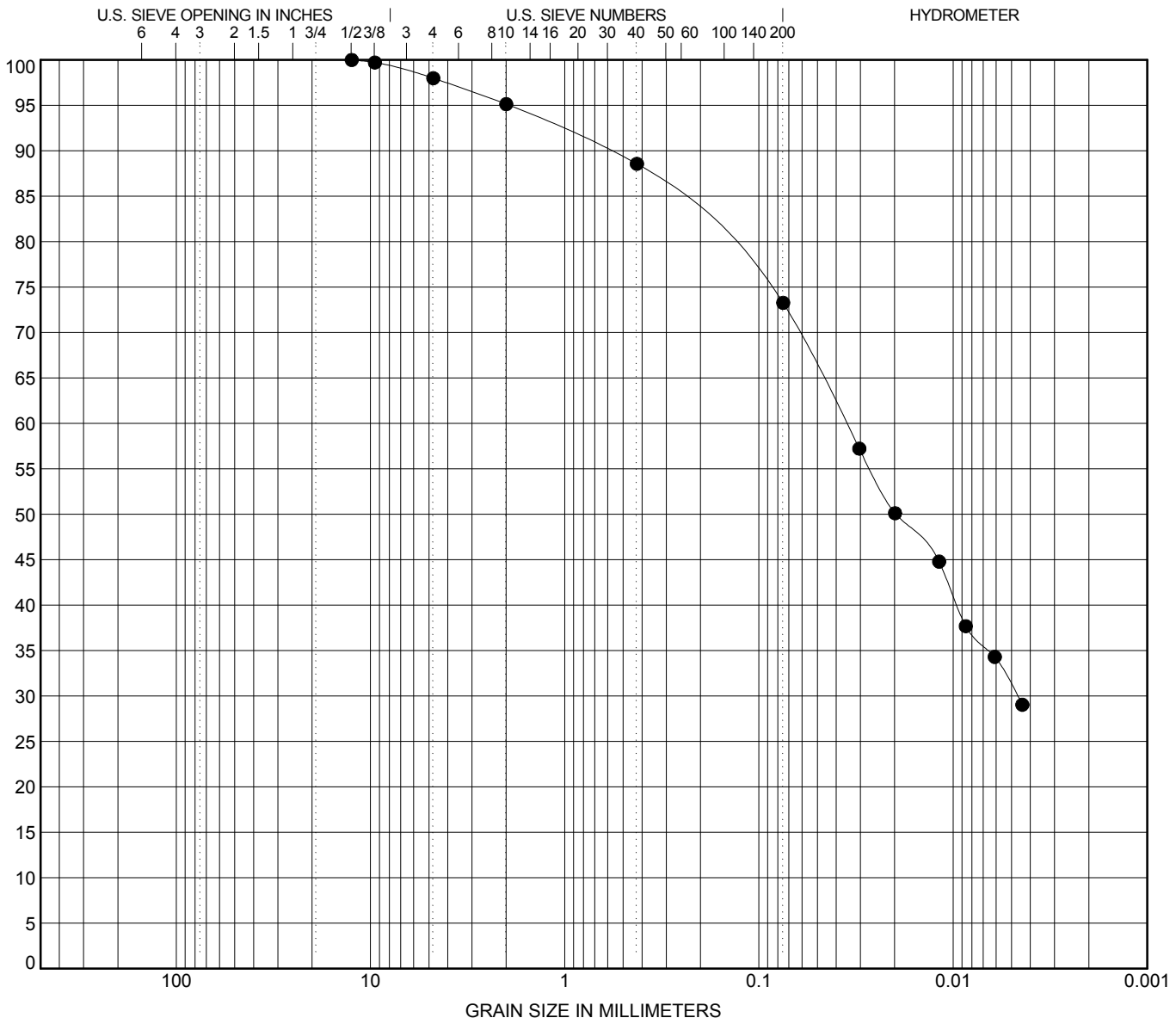
GRAIN SIZE DISTRIBUTION

Project: EMH&T
Location:FRA COUNTY
CTL Project Number:09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-003-0-12	**5.0**	**A-6a(9)**	**-**	**32**	**18**	**14**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-003-0-12	**5.0**	**12.5**	**0.036**	**0.02**	**0.005**		**5**	**7**	**15**	**42**	**31**

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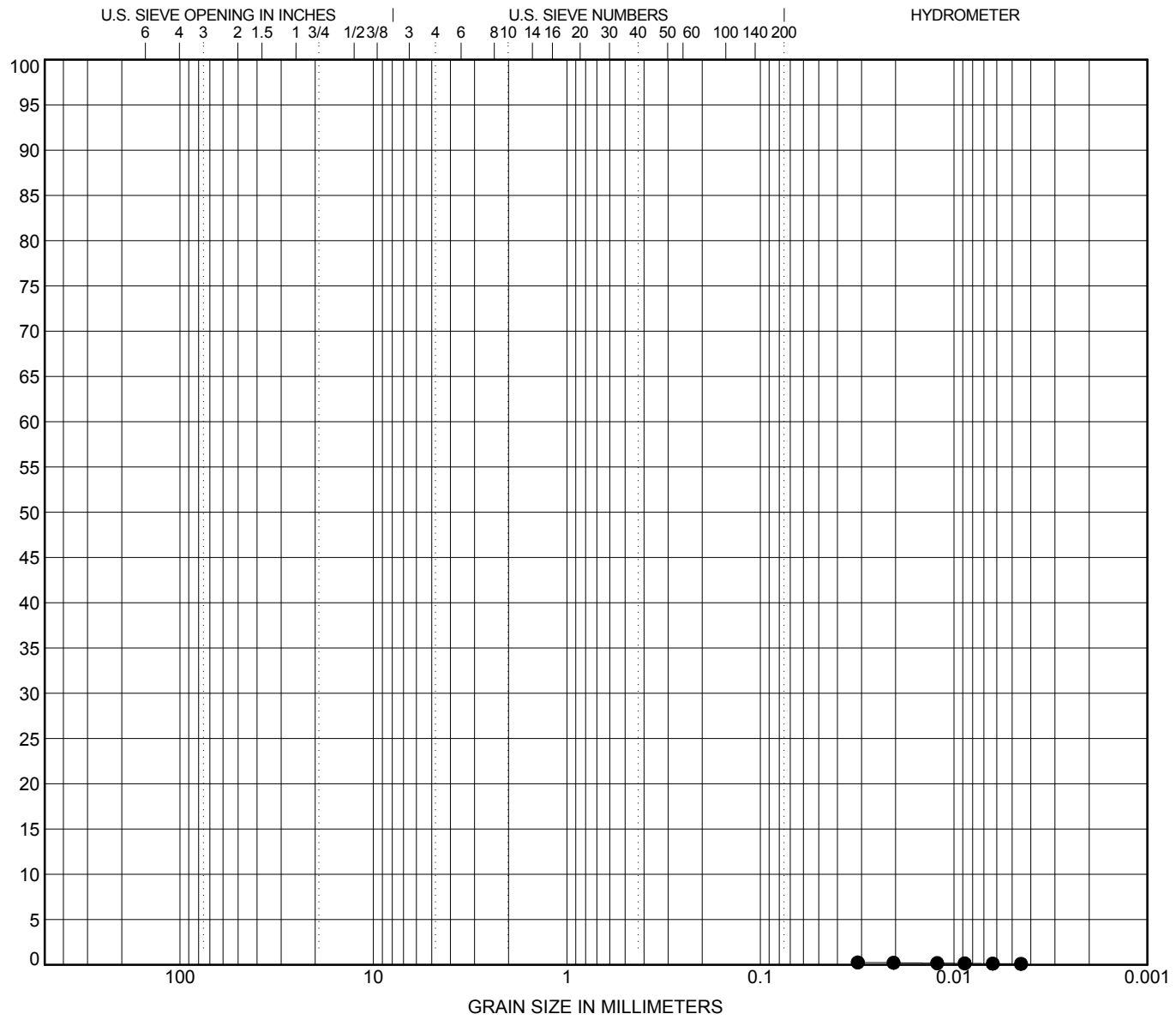

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-003-0-12	**8.5**	**()**	**-**					
		OTHER						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-003-0-12	**8.5**										

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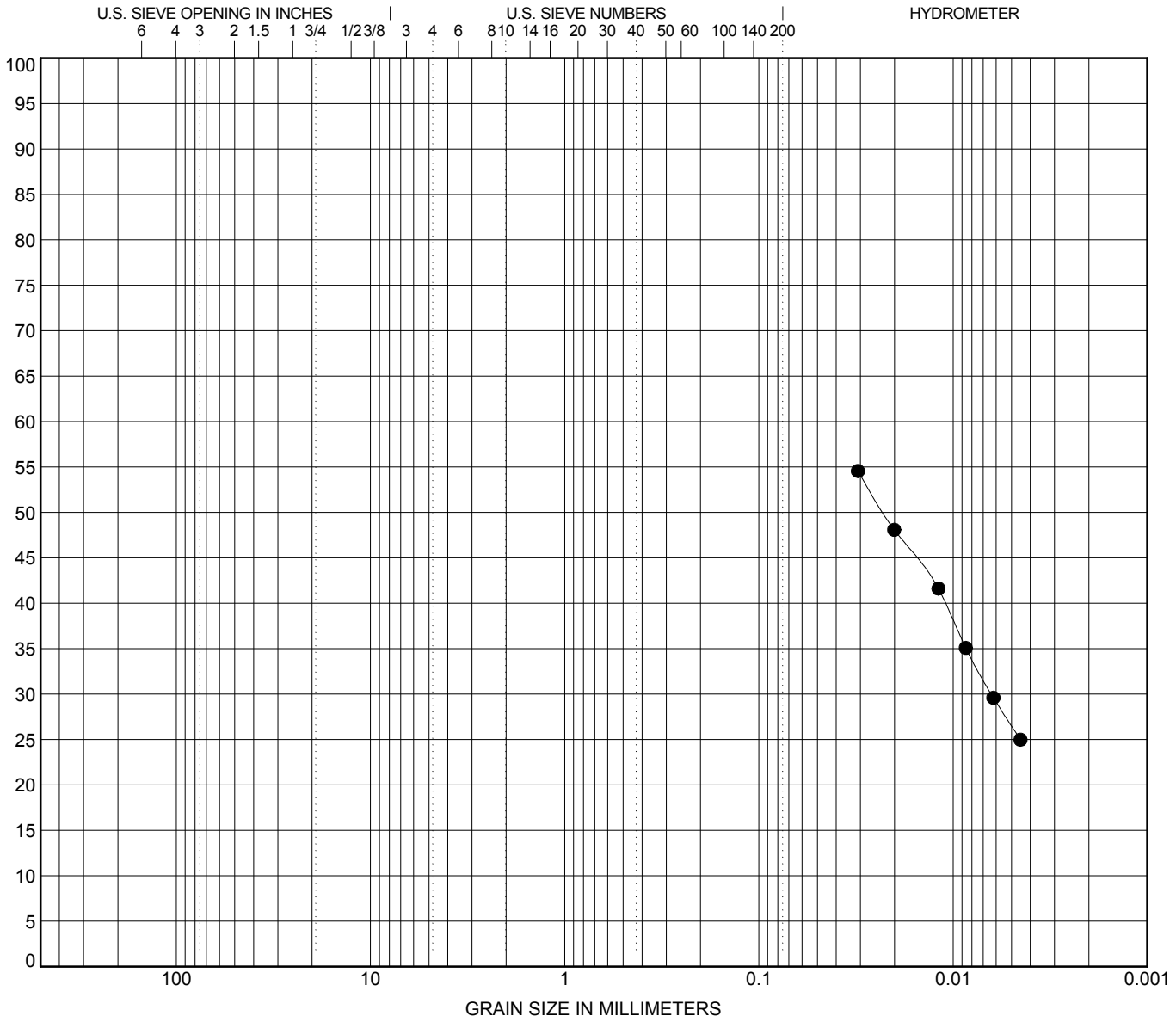

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-003-0-12	**13.5**	**()**	**-**					
		OTHER						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-003-0-12	**13.5**			**0.023**	**0.006**						

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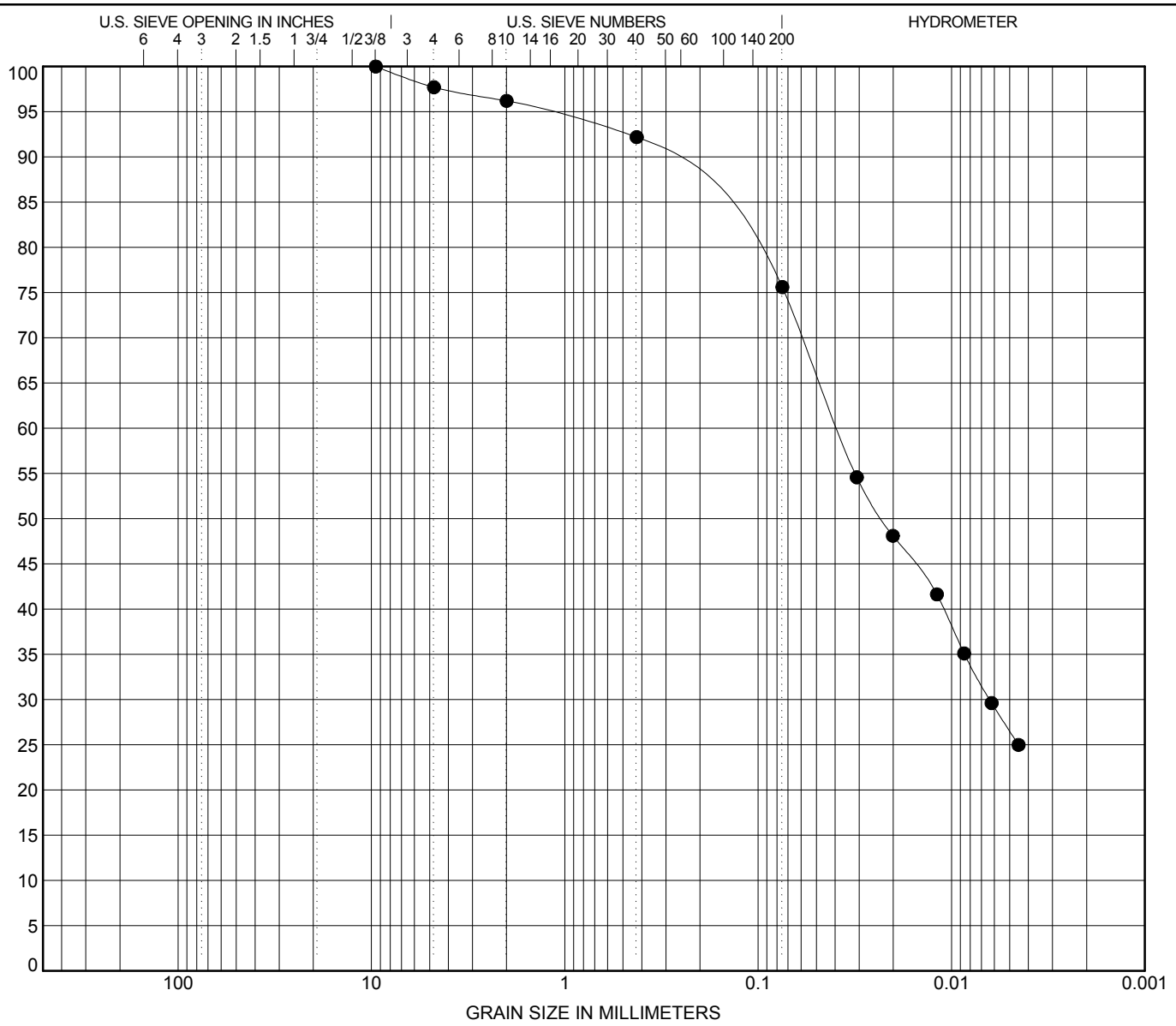

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-003-0-12	**16.0**	**A-6a(8)**	**11**	**25**	**14**	**11**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-003-0-12	**16.0**	**9.5**	**0.039**	**0.023**	**0.006**		**3**	**4**	**17**	**49**	**27**

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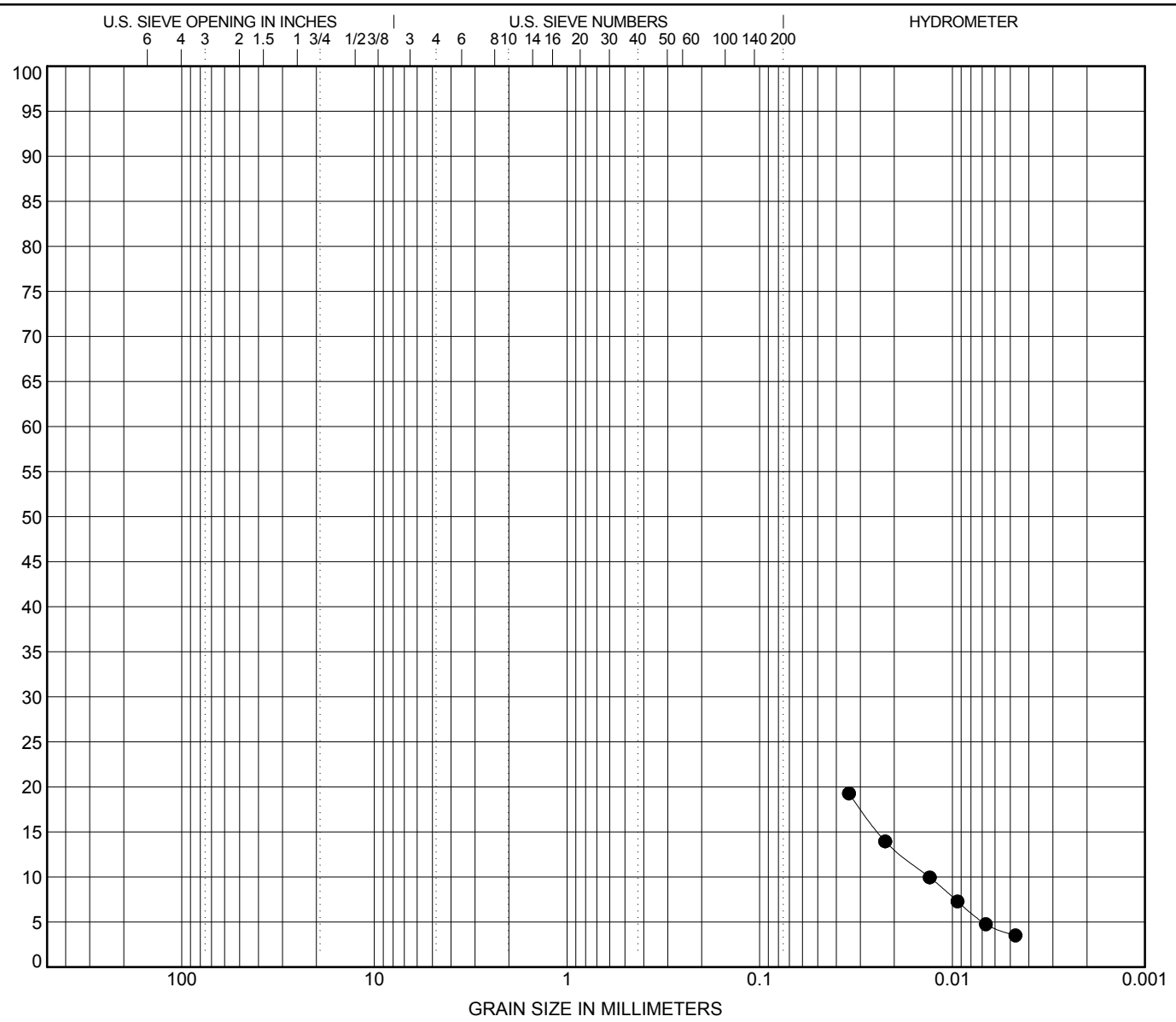

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-003-0-12	**23.5**	**()**	**13**					
		OTHER						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-003-0-12	**23.5**					**0.013**					

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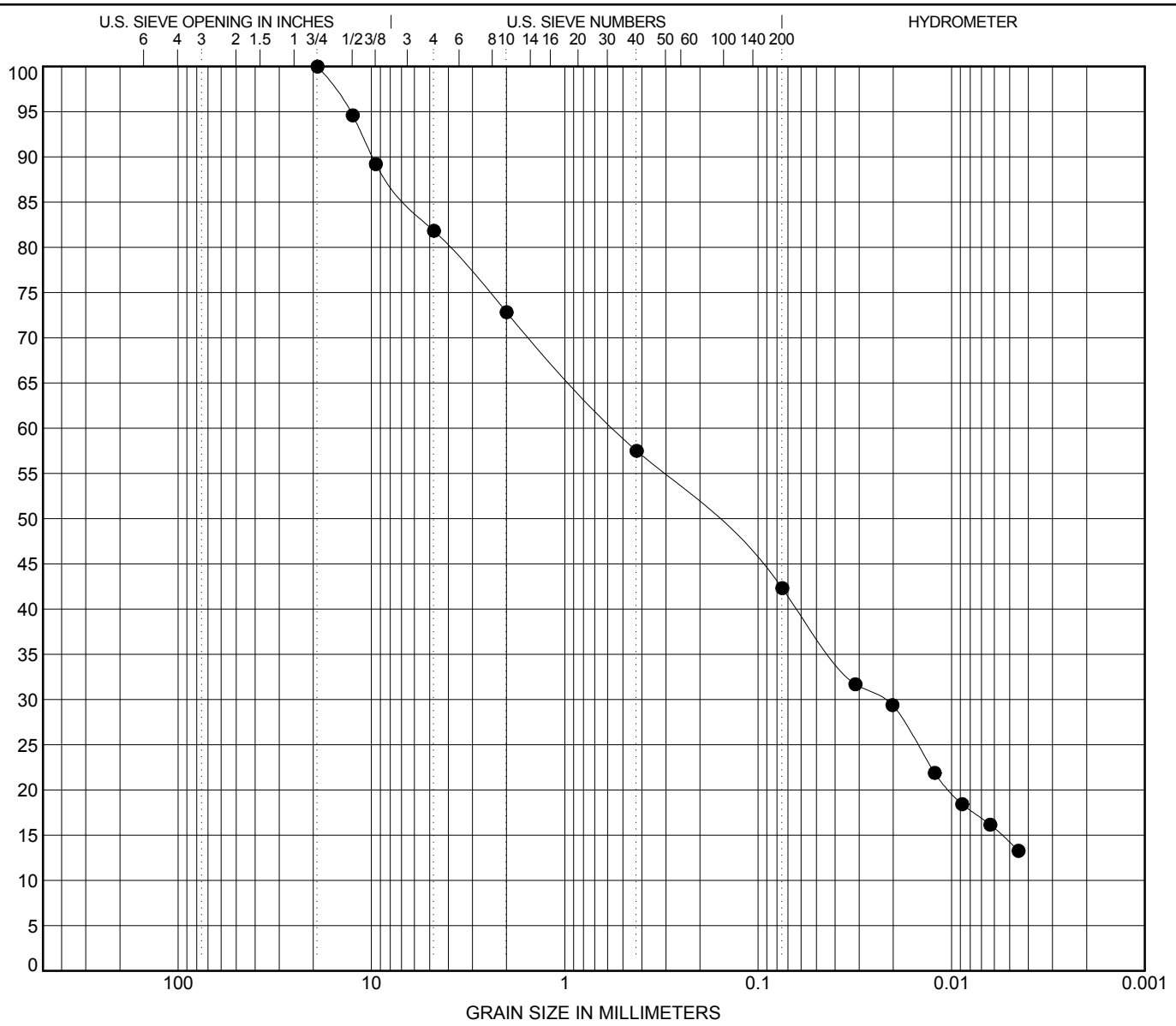

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-003-0-12	**28.5**	**A-4a(1)**	**10**	**21**	**12**	**9**		
		SANDY SILT						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-003-0-12	**28.5**	**19**	**0.547**	**0.18**	**0.023**		**28**	**15**	**15**	**28**	**14**

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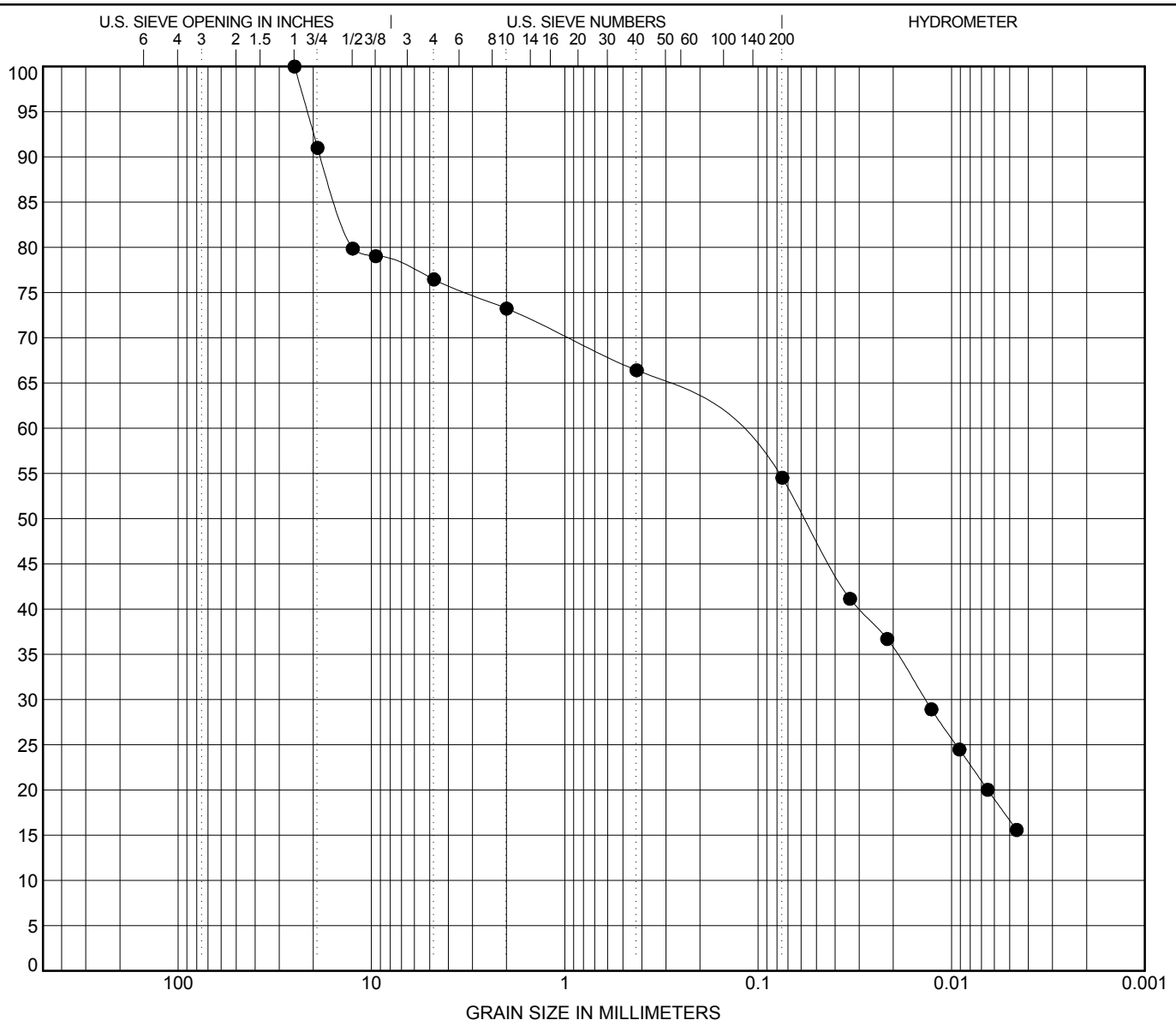

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-004-0-12	**1.0**	**A-6a(5)**	**9**	**30**	**17**	**13**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-004-0-12	**1.0**	**25**	**0.167**	**0.057**	**0.014**		**26**	**7**	**12**	**38**	**17**

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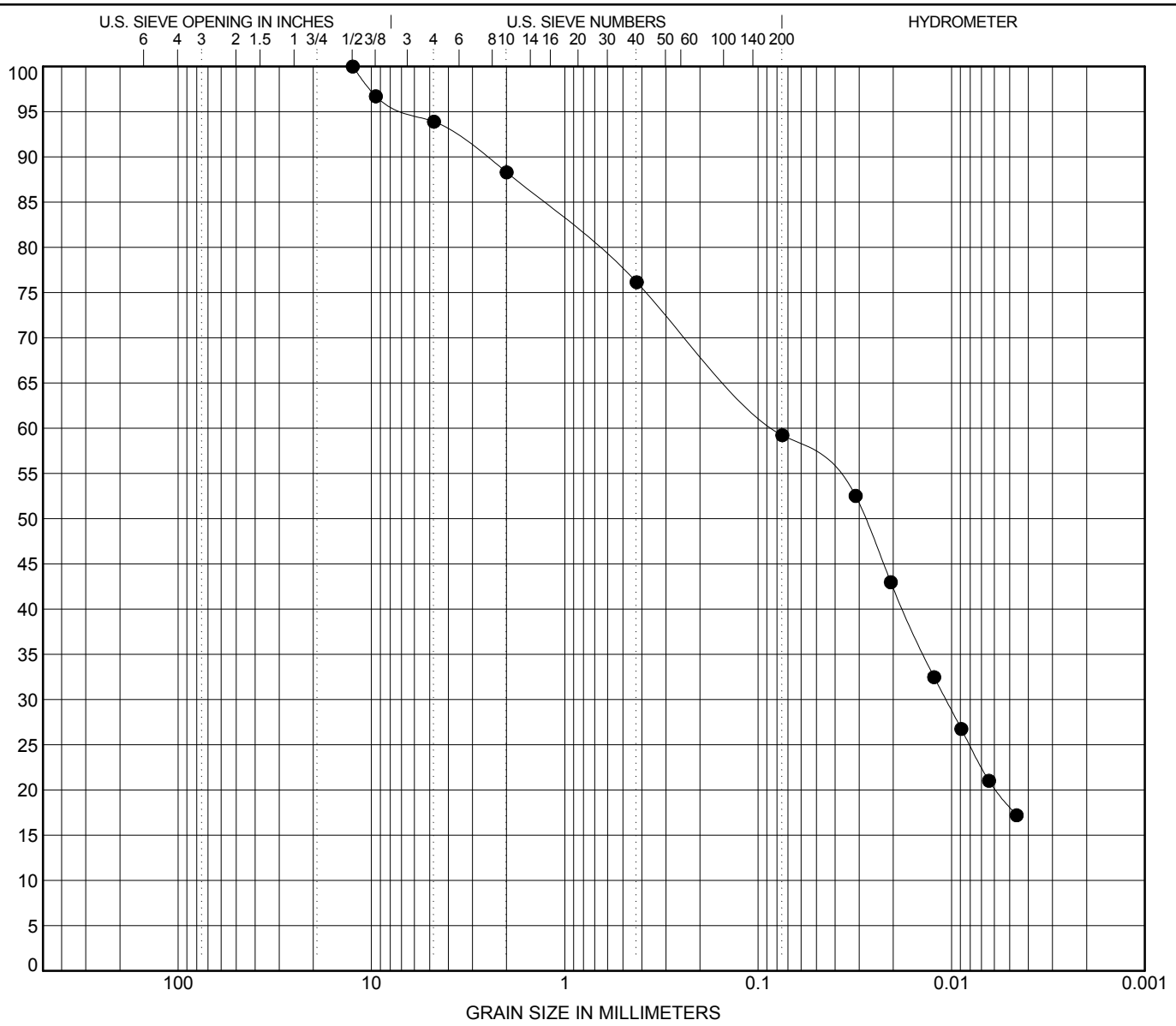

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-004-0-12	**8.5**	**A-4a(5)**	**8**	**23**	**14**	**9**		
		SANDY SILT						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-004-0-12	**8.5**	**12.5**	**0.081**	**0.028**	**0.011**		**12**	**12**	**17**	**41**	**18**

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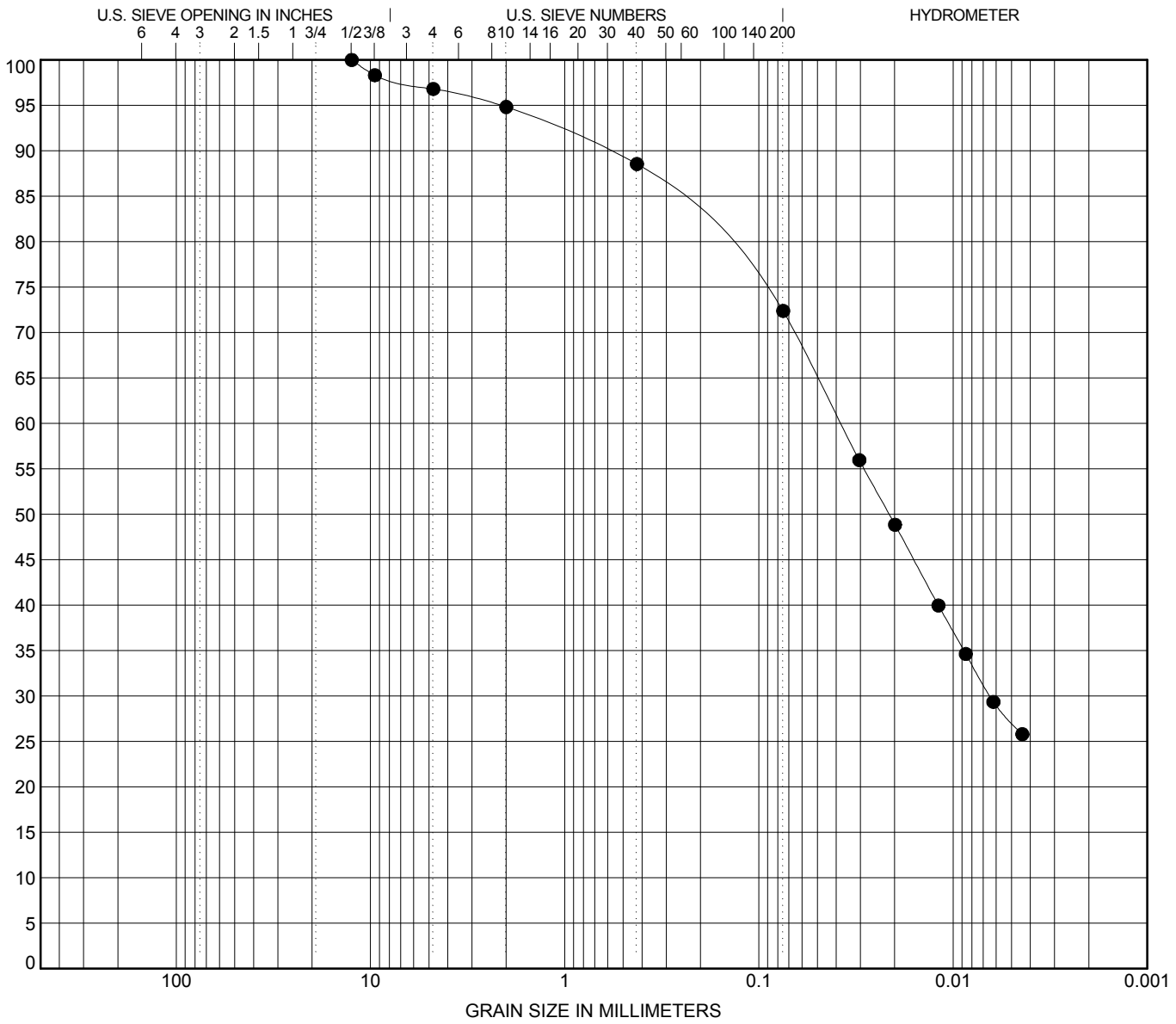

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-004-0-12	**23.5**	**A-6a(9)**	**13**	**29**	**16**	**13**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-004-0-12	**23.5**	**12.5**	**0.038**	**0.021**	**0.006**		**6**	**6**	**16**	**45**	**27**

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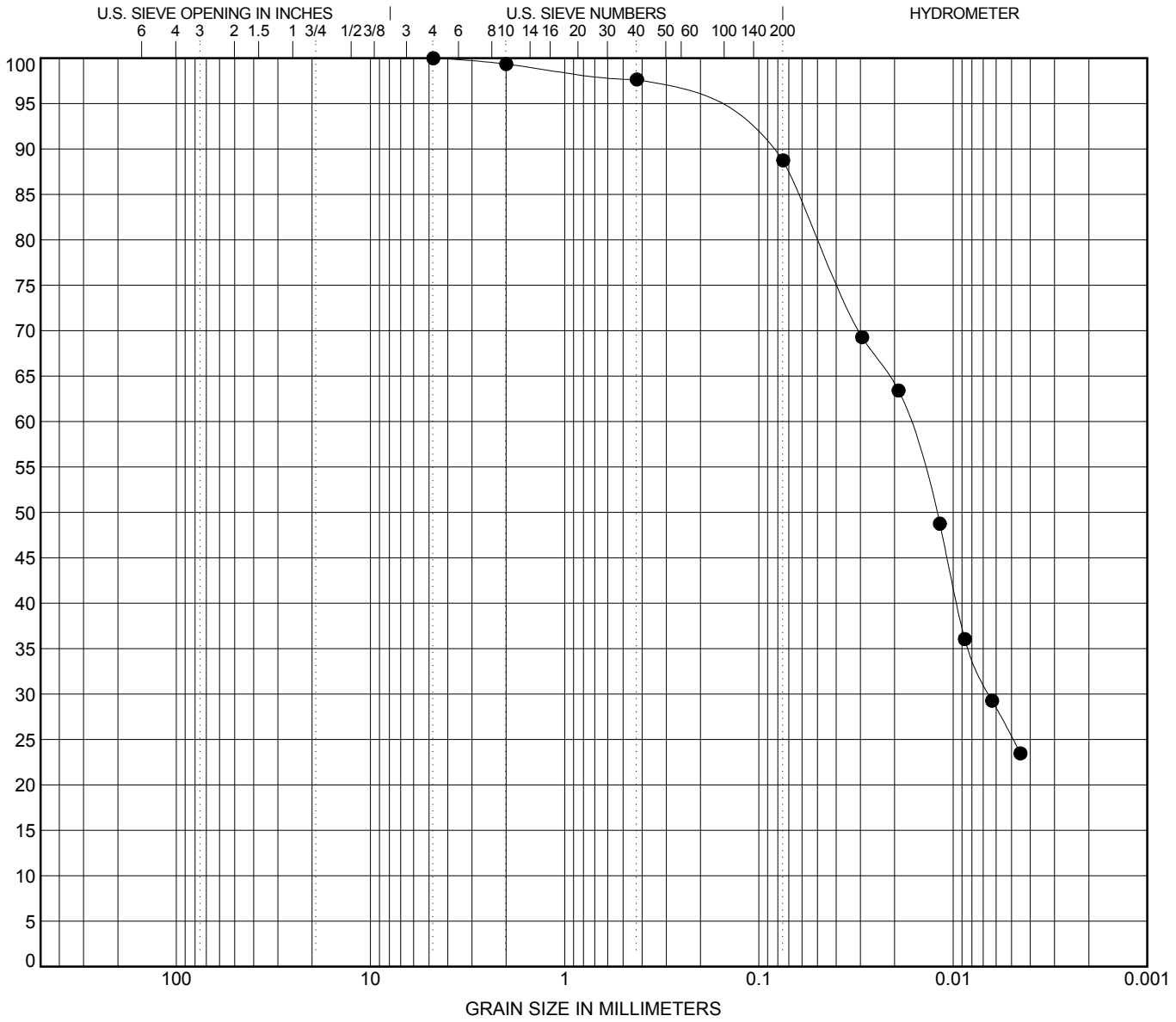

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-005-0-12	**1.0**	**A-4b(8)**	**11**	**27**	**17**	**10**		
		SILT						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-005-0-12	**1.0**	**4.75**	**0.017**	**0.012**	**0.007**		**0**	**2**	**9**	**64**	**25**

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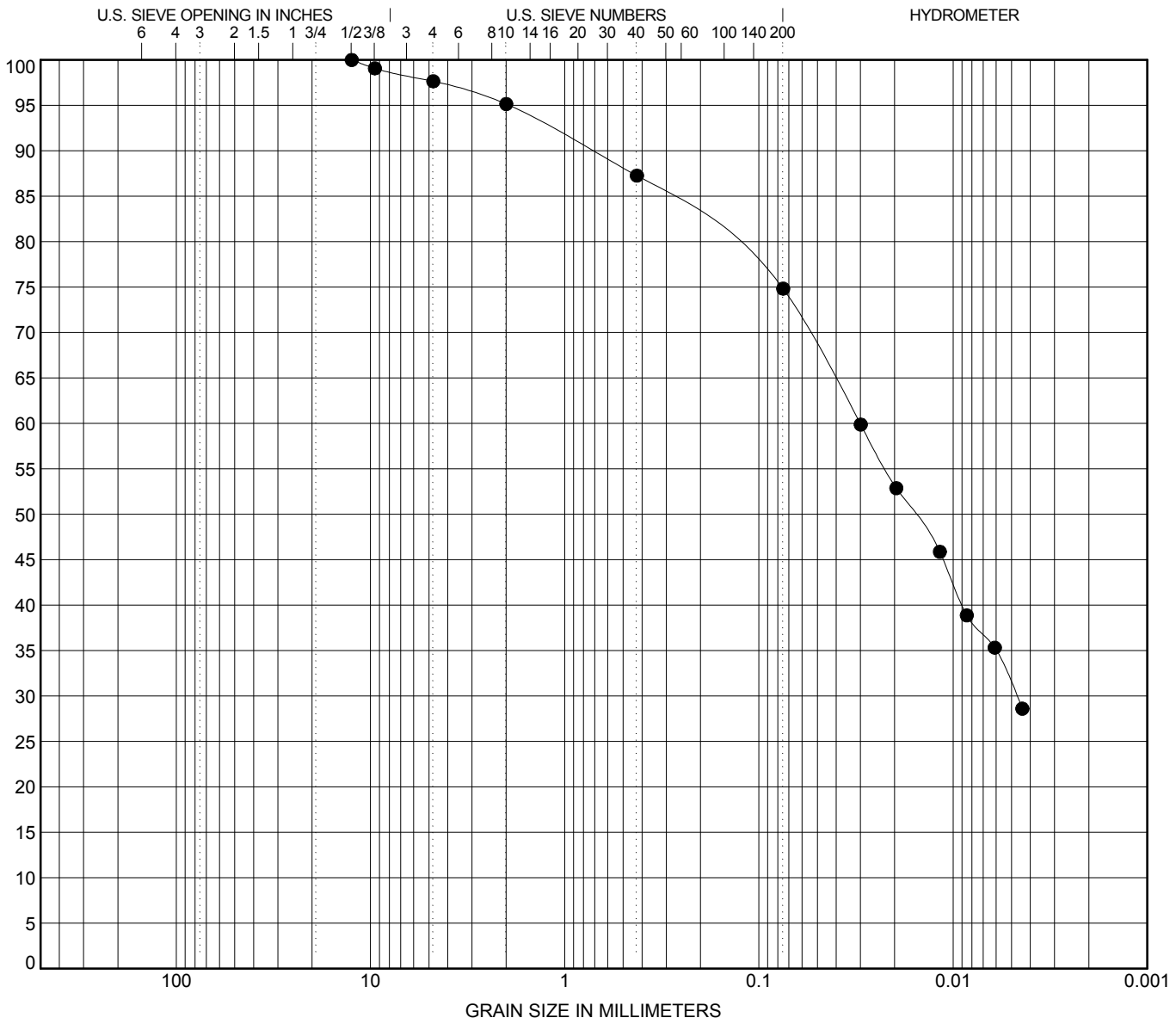
GRAIN SIZE DISTRIBUTION

Project: EMH&T
Location:FRA COUNTY
CTL Project Number:09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-005-0-12	**3.0**	**A-6a(10)**	**-**	**34**	**19**	**15**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-005-0-12	**3.0**	**12.5**	**0.03**	**0.016**	**0.005**		**5**	**8**	**12**	**44**	**31**

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GRAIN SIZE DISTRIBUTION

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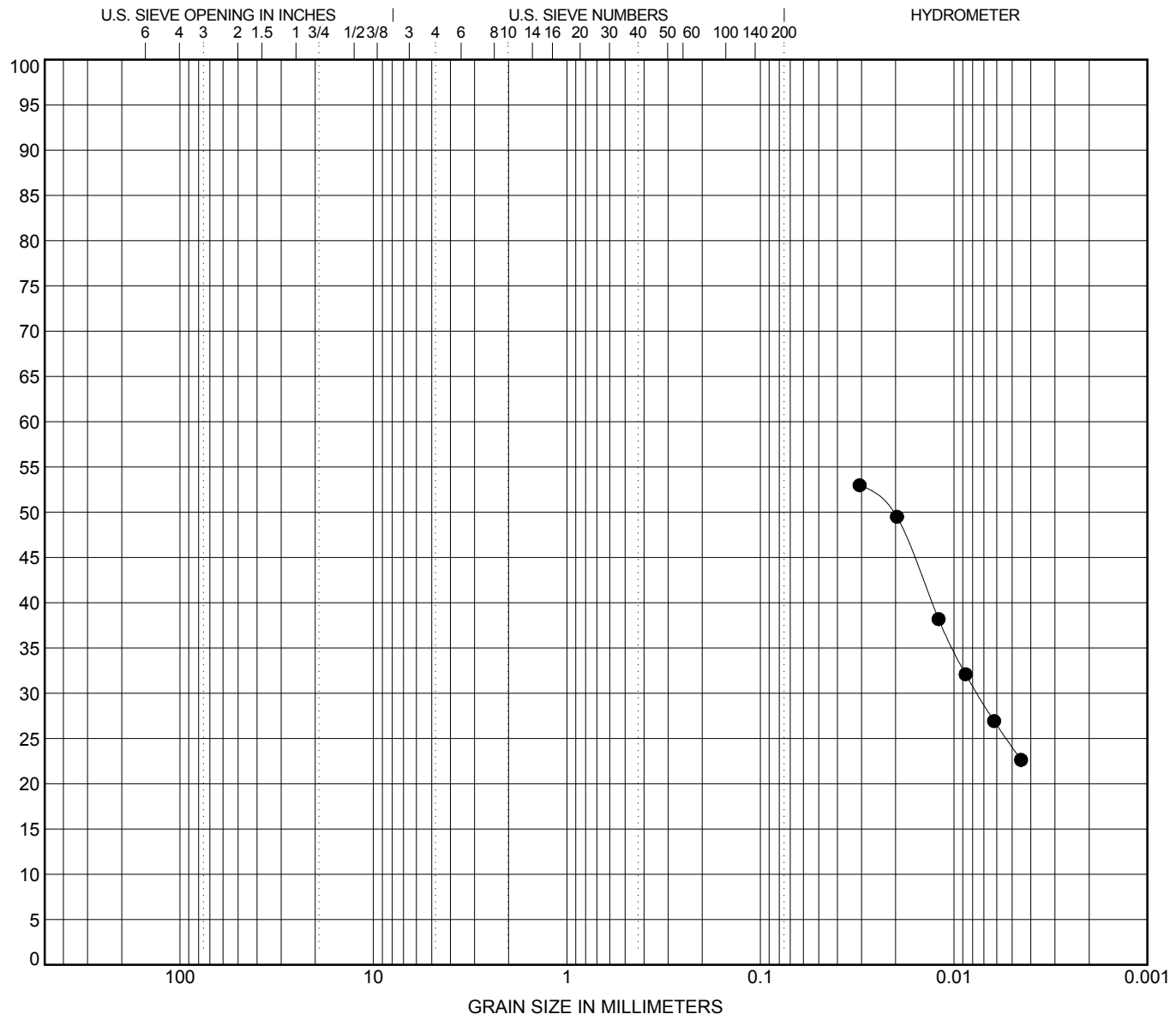
CTL Project Number:09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-005-0-12	**8.5**	**()**	**9**					
		OTHER						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-005-0-12	**8.5**			**0.021**	**0.008**						

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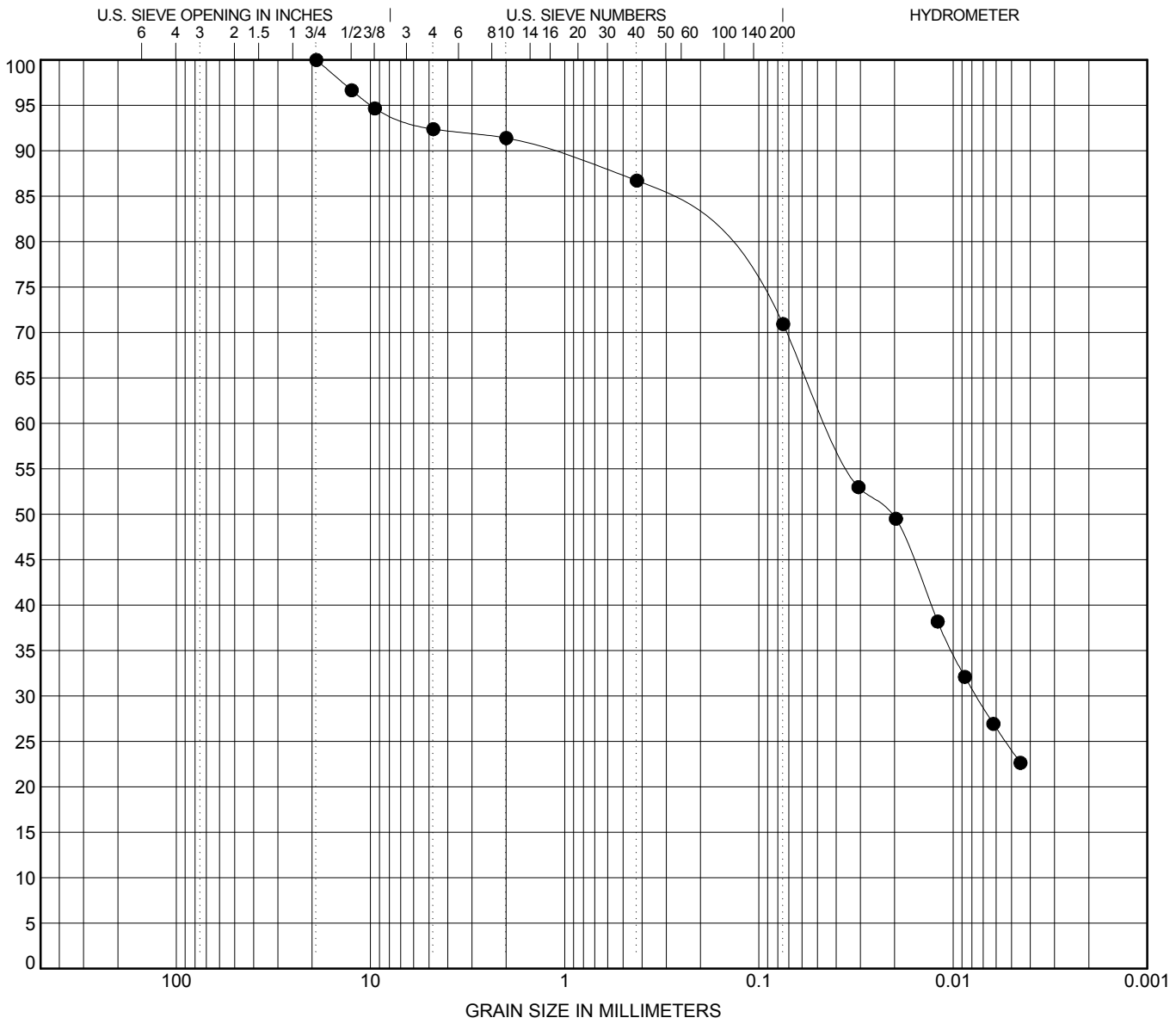
Location:FRA COUNTY
CTL Project Number:09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-005-0-12	**11.0**	**A-6a(8)**	**10**	**26**	**14**	**12**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-005-0-12	**11.0**	**19**	**0.044**	**0.021**	**0.008**		**8**	**5**	**16**	**47**	**24**

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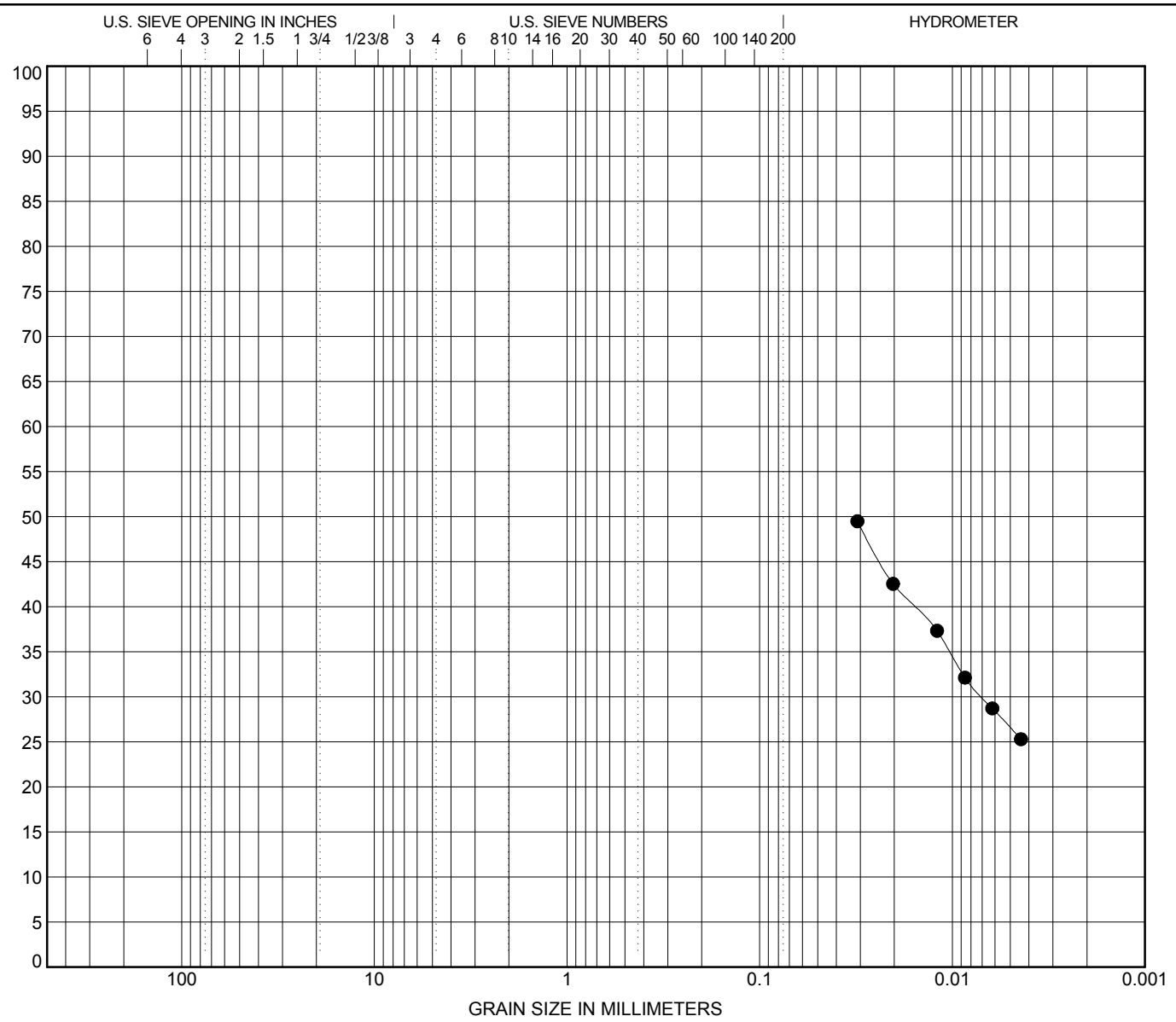
CTL Project Number:09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-005-0-12	**23.5**	**()**	**-**					
		OTHER						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-005-0-12	**23.5**				**0.007**						

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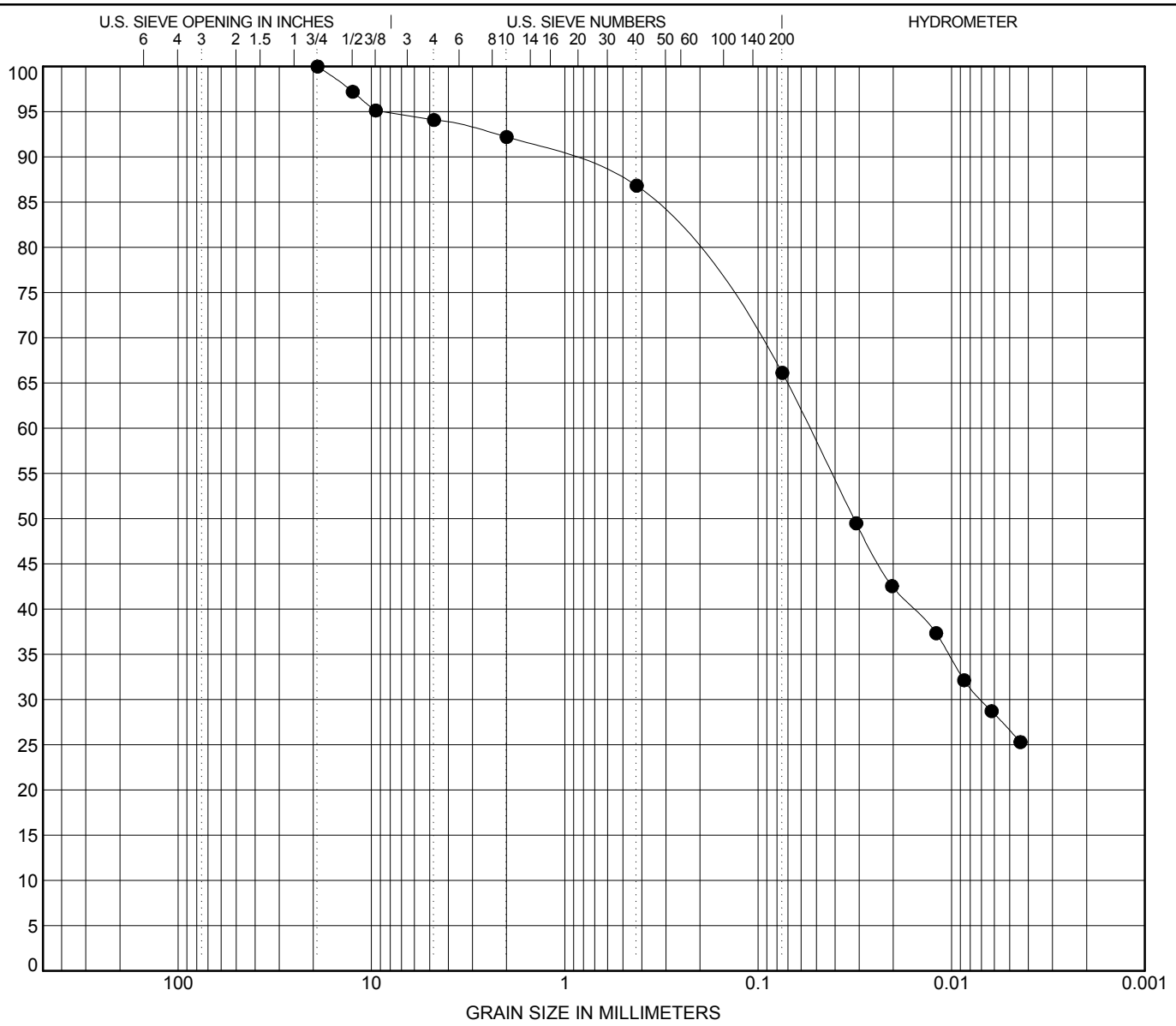
GRAIN SIZE DISTRIBUTION

Project: EMH&T
Location:FRA COUNTY
CTL Project Number:09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-005-0-12	**28.5**	**A-6a(7)**	**8**	**23**	**12**	**11**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-005-0-12	**28.5**	**19**	**0.054**	**0.032**	**0.007**		**8**	**5**	**21**	**39**	**27**

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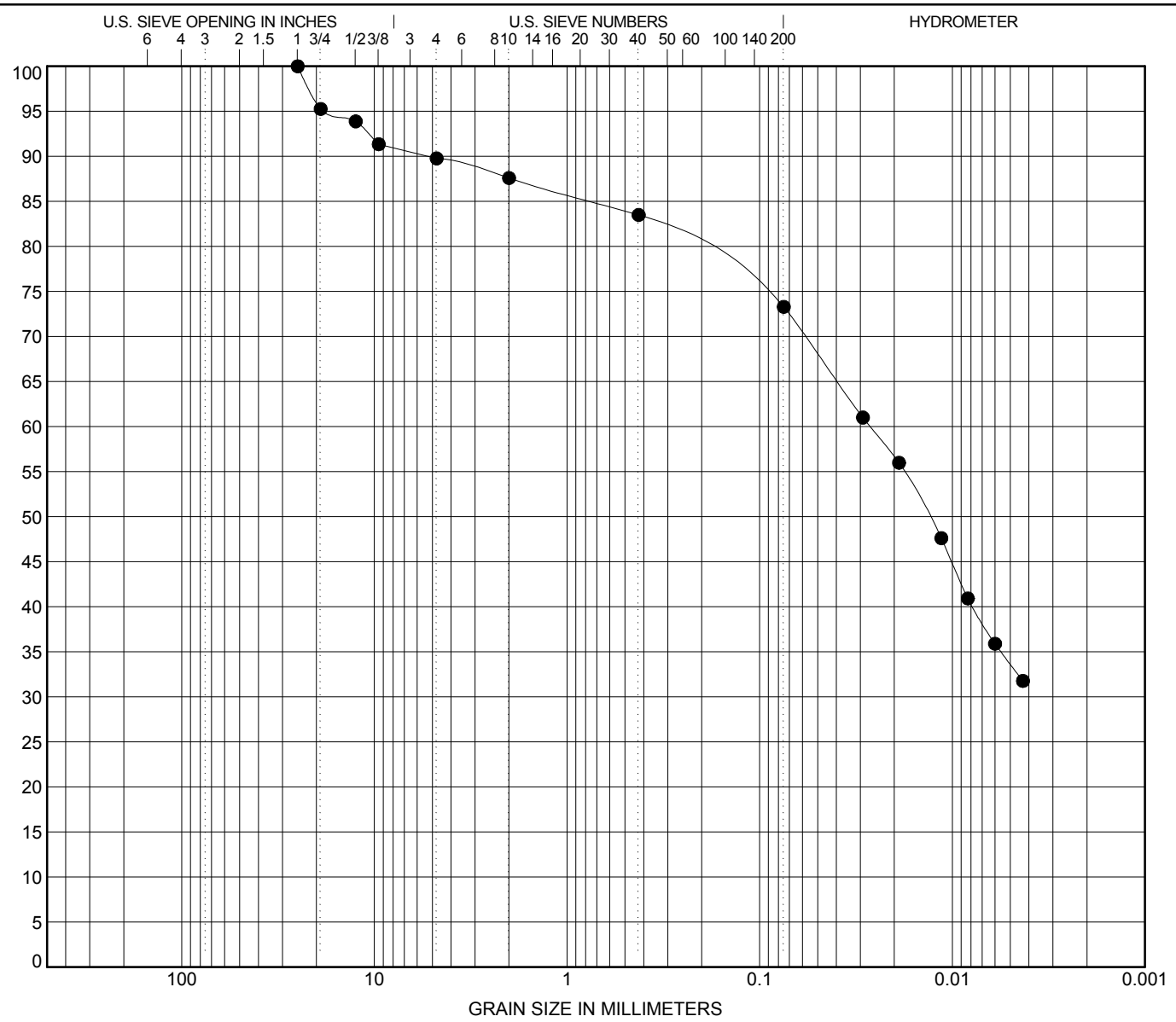

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-006-0-12	**2.0**	**A-6b(10)**	**-**	**36**	**19**	**17**		
		SILTY CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-006-0-12	**2.0**	**25**	**0.027**	**0.013**			**13**	**4**	**10**	**39**	**34**

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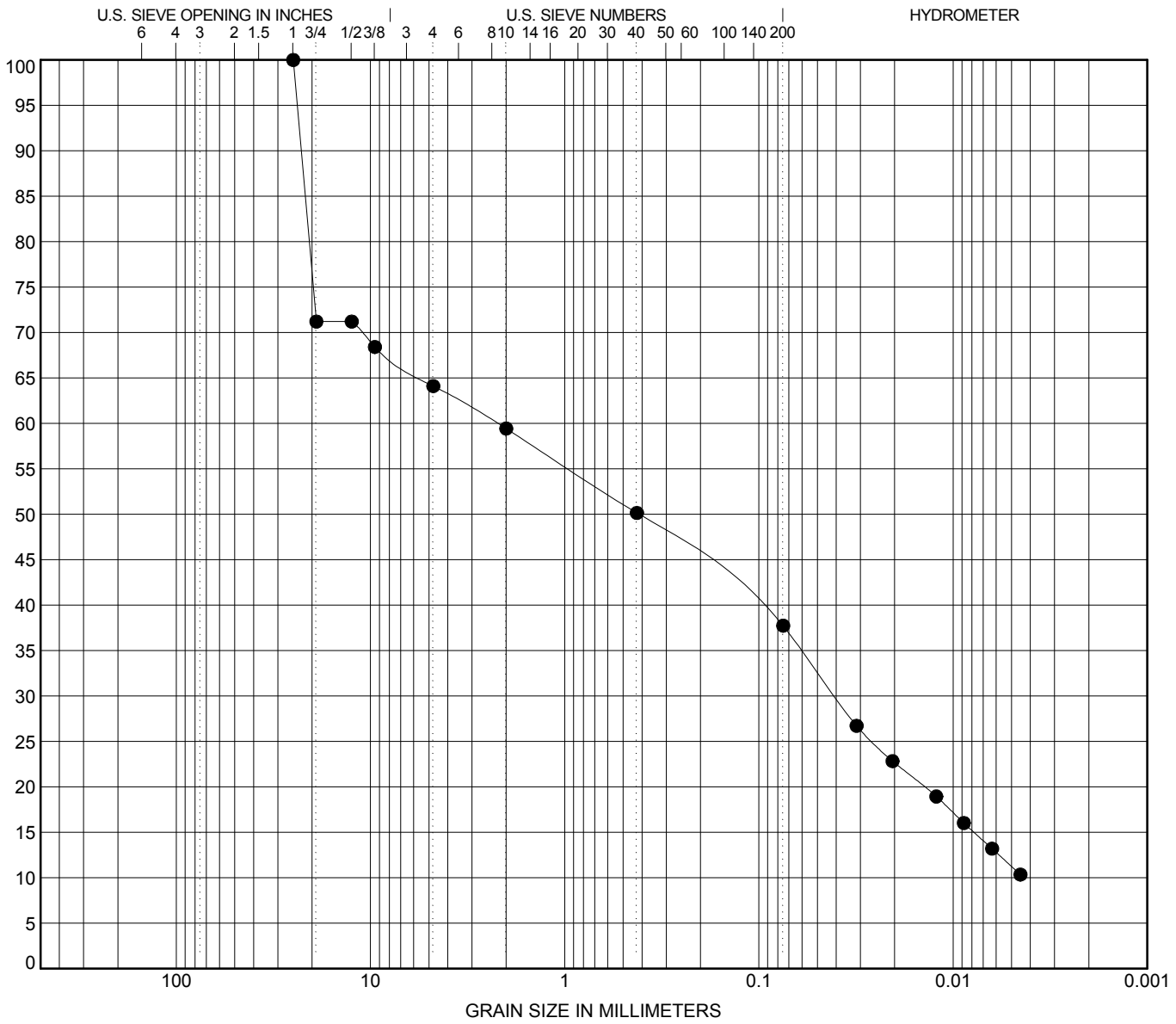
GRAIN SIZE DISTRIBUTION

Project: EMH&T
Location:FRA COUNTY
CTL Project Number:09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-006-0-12	**8.5**	**A-4a(1)**	**12**	**23**	**17**	**6**		
		SANDY SILT						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-006-0-12	**8.5**	**25**	**2.22**	**0.416**	**0.041**		**41**	**9**	**12**	**27**	**11**

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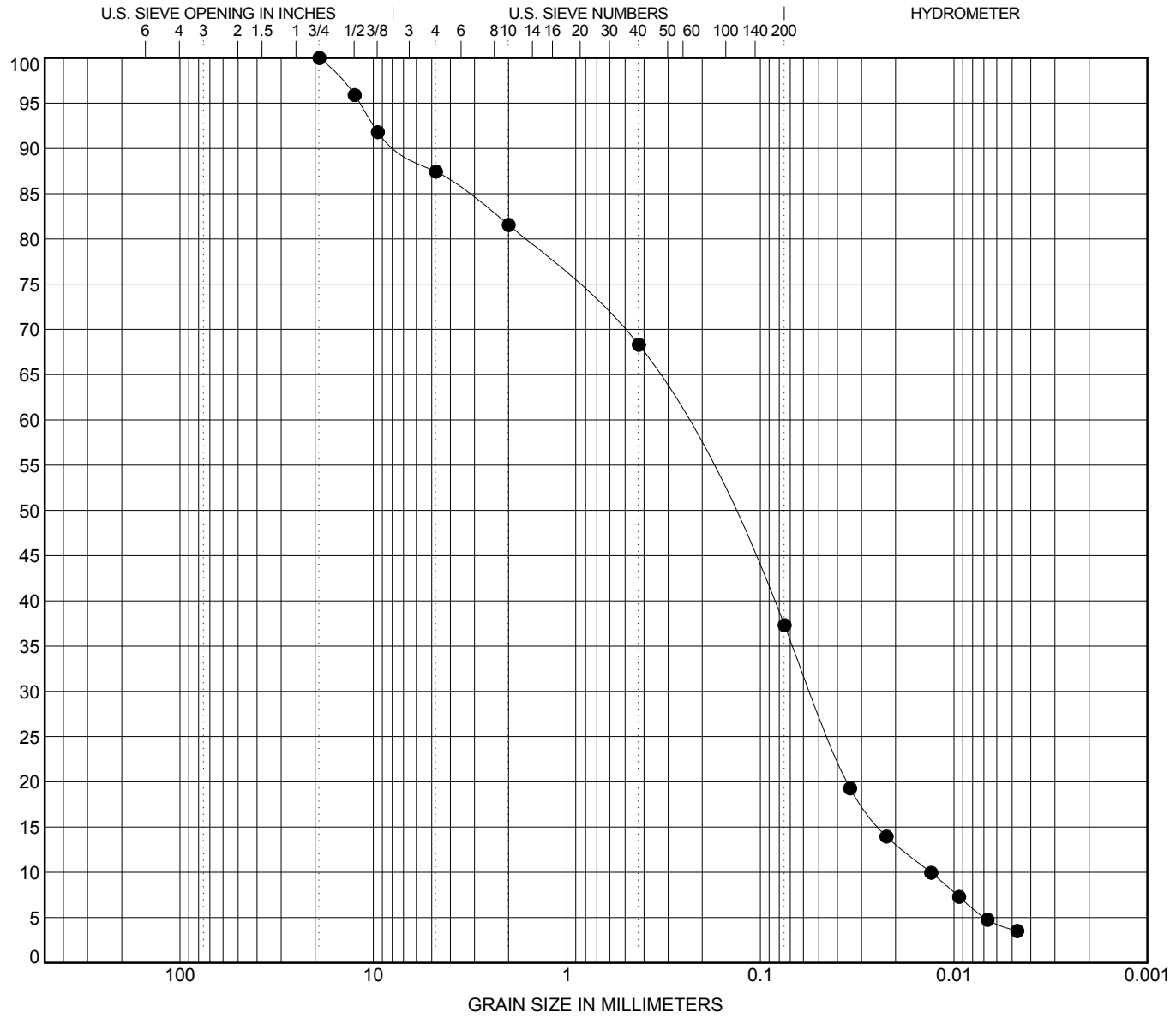

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-006-0-12	**28.0**	**A-4a(0)**	**13**	**NP**	**NP**	**NP**	**0.85**	**20.27**
		SANDY SILT						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-006-0-12	**28.0**	**19**	**0.267**	**0.153**	**0.055**	**0.013**	**19**	**13**	**31**	**33**	**4**

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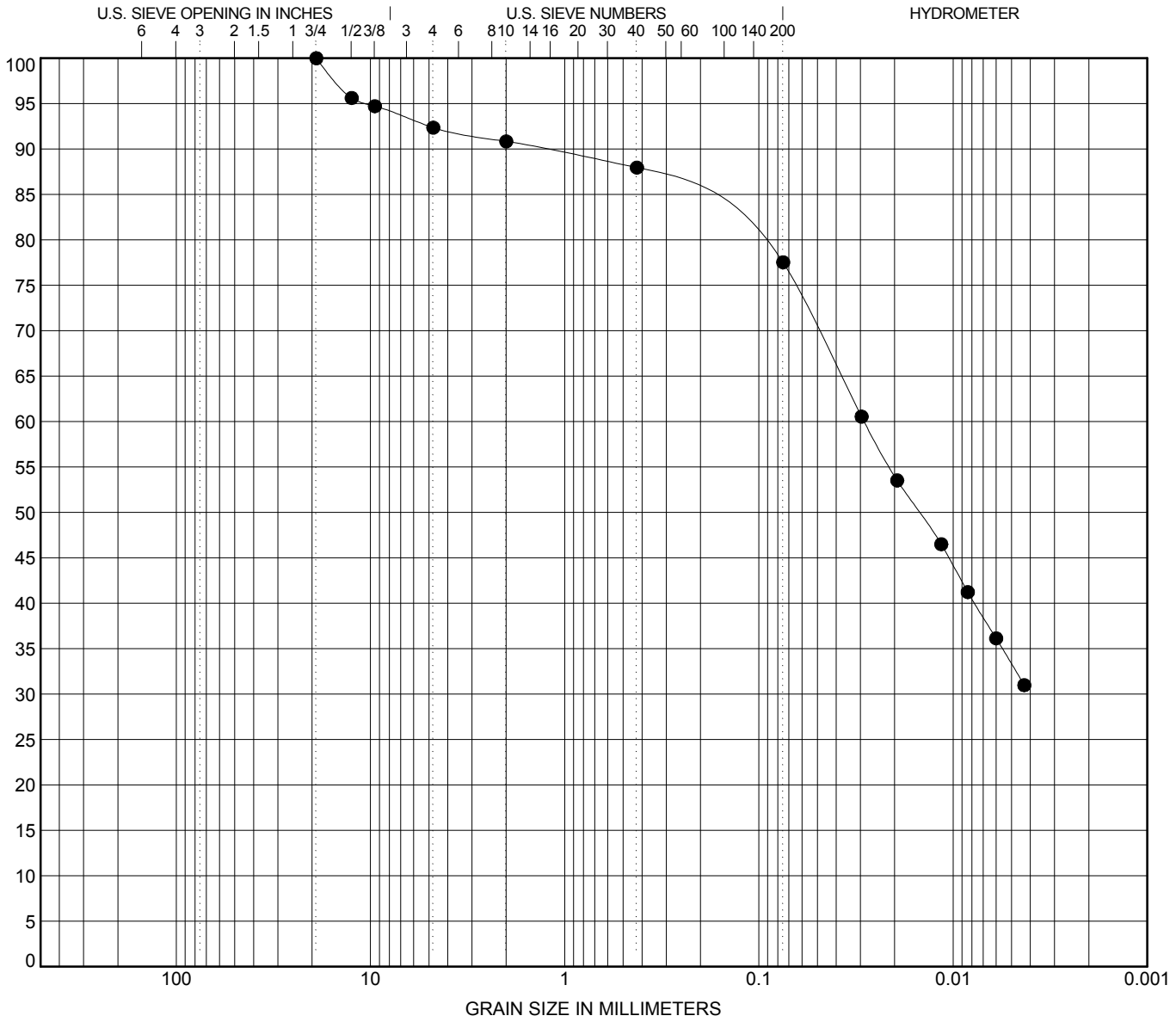

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-007-0-12	**1.0**	**A-6b(11)**	**13**	**39**	**22**	**17**		
		SILTY CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-007-0-12	**1.0**	**19**	**0.029**	**0.015**			**9**	**3**	**10**	**45**	**33**

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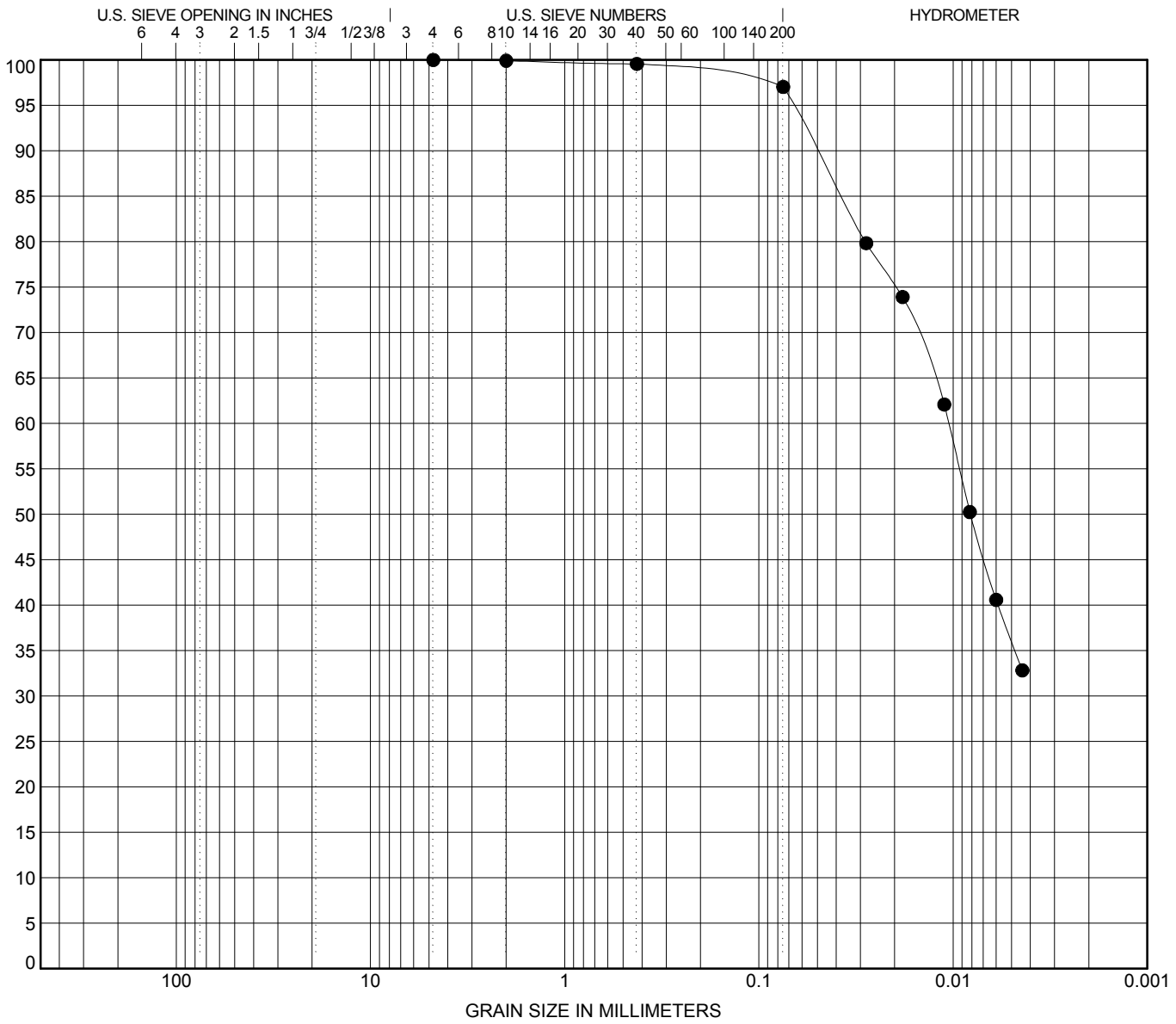

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-007-0-12	**16.0**	**A-4b(8)**	**18**	**31**	**23**	**8**		
		SILT						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-007-0-12	**16.0**	**4.75**	**0.011**	**0.008**			**0**	**0**	**3**	**61**	**36**

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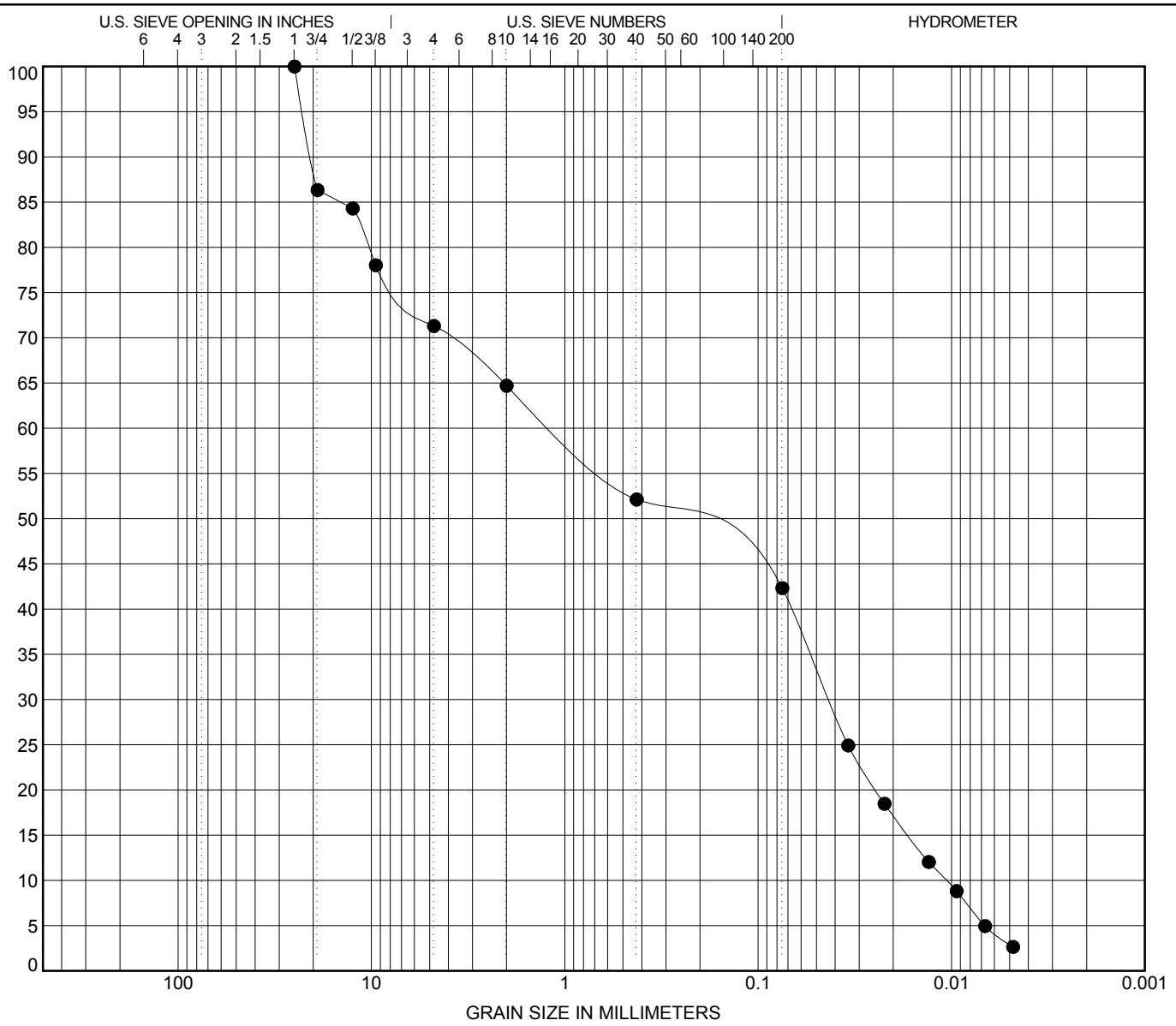

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-007-0-12	**28.5**	**A-4a(1)**	**11**	**22**	**18**	**4**	**0.16**	**105.60**
		SANDY SILT						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-007-0-12	**28.5**	**25**	**1.121**	**0.292**	**0.043**	**0.011**	**35**	**13**	**10**	**39**	**3**

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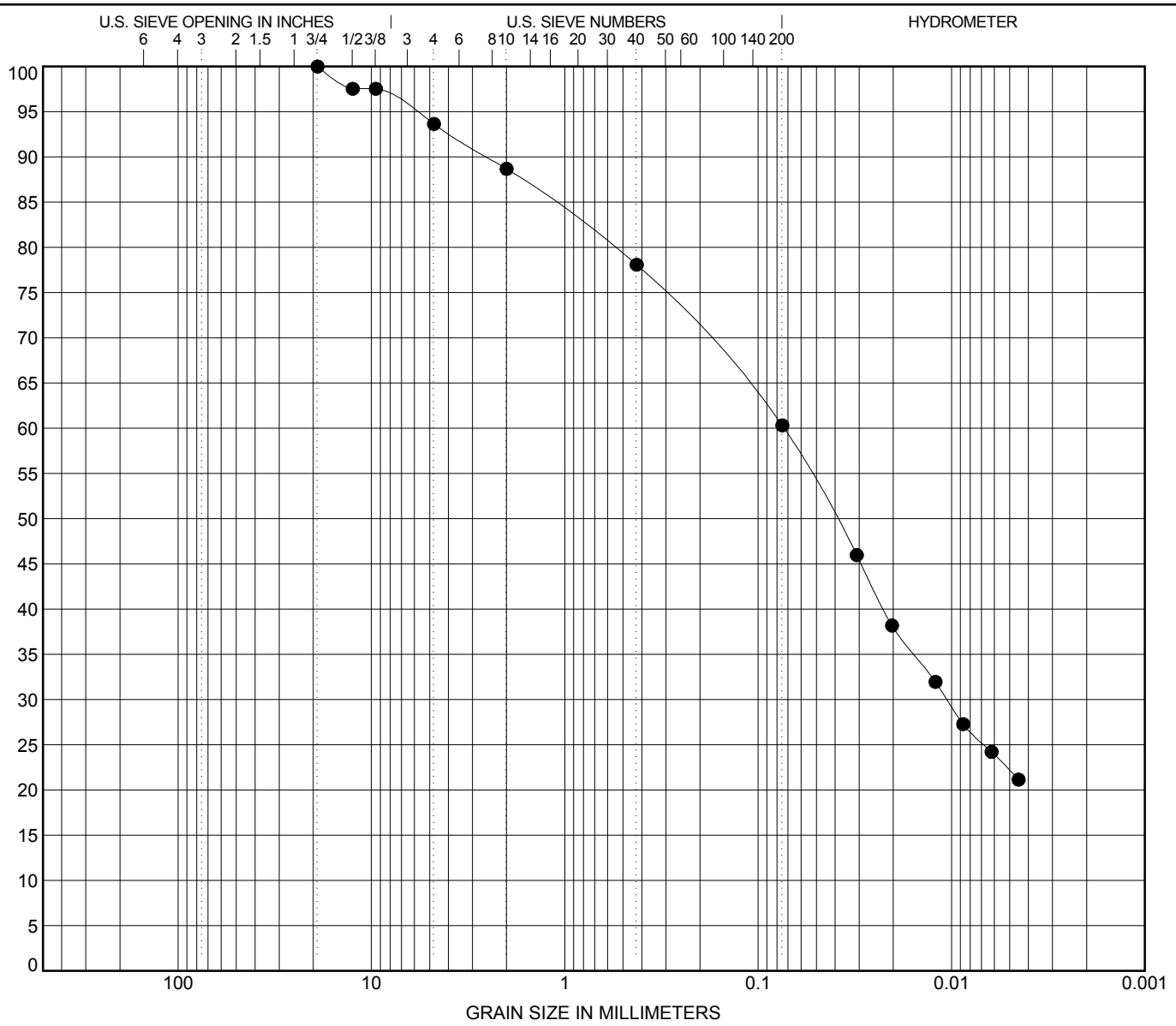

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-008-0-12	**3.5**	**A-6a(6)**	**12**	**29**	**17**	**12**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-008-0-12	**3.5**	**19**	**0.074**	**0.04**	**0.011**		**11**	**11**	**18**	**38**	**22**

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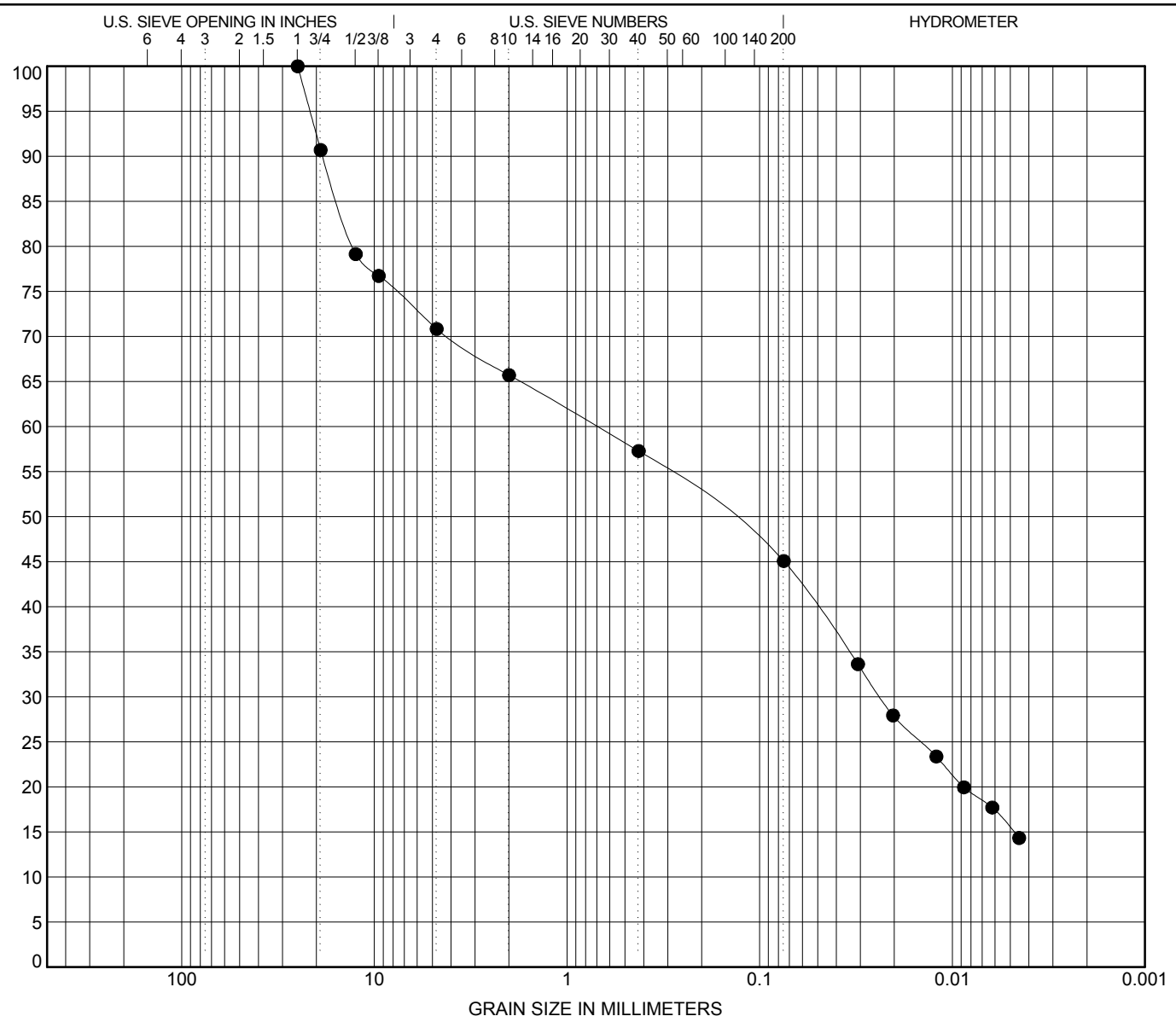

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-008-0-12	**11.0**	**A-4a(2)**	**10**	**23**	**14**	**9**		
		SANDY SILT						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-008-0-12	**11.0**	**25**	**0.7**	**0.151**	**0.024**		**35**	**8**	**12**	**30**	**15**

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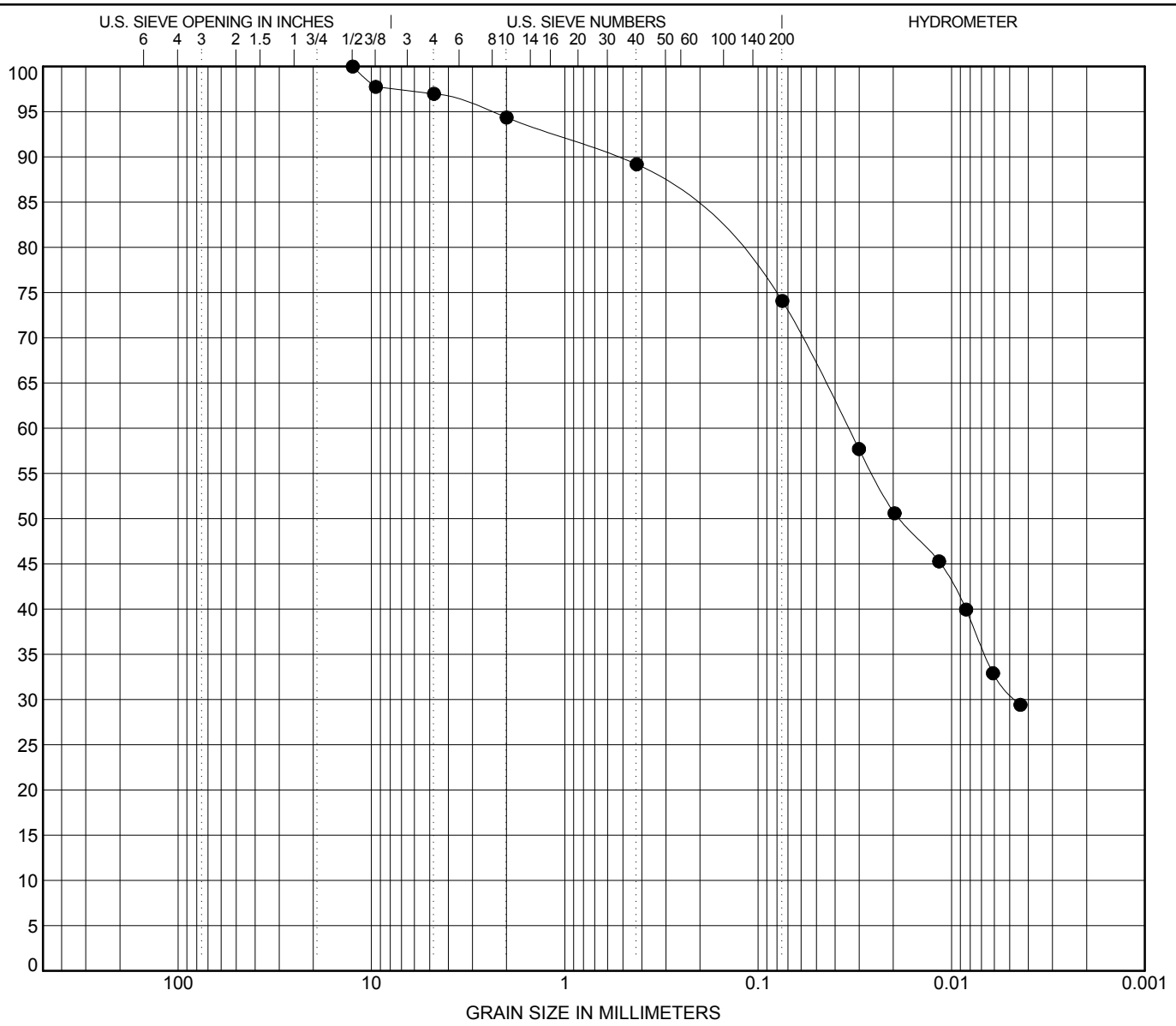

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-008-0-12	**13.5**	**A-4a(8)**	**12**	**26**	**16**	**10**		
		SANDY SILT						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-008-0-12	**13.5**	**12.5**	**0.034**	**0.019**	**0.005**		**6**	**5**	**15**	**43**	**31**

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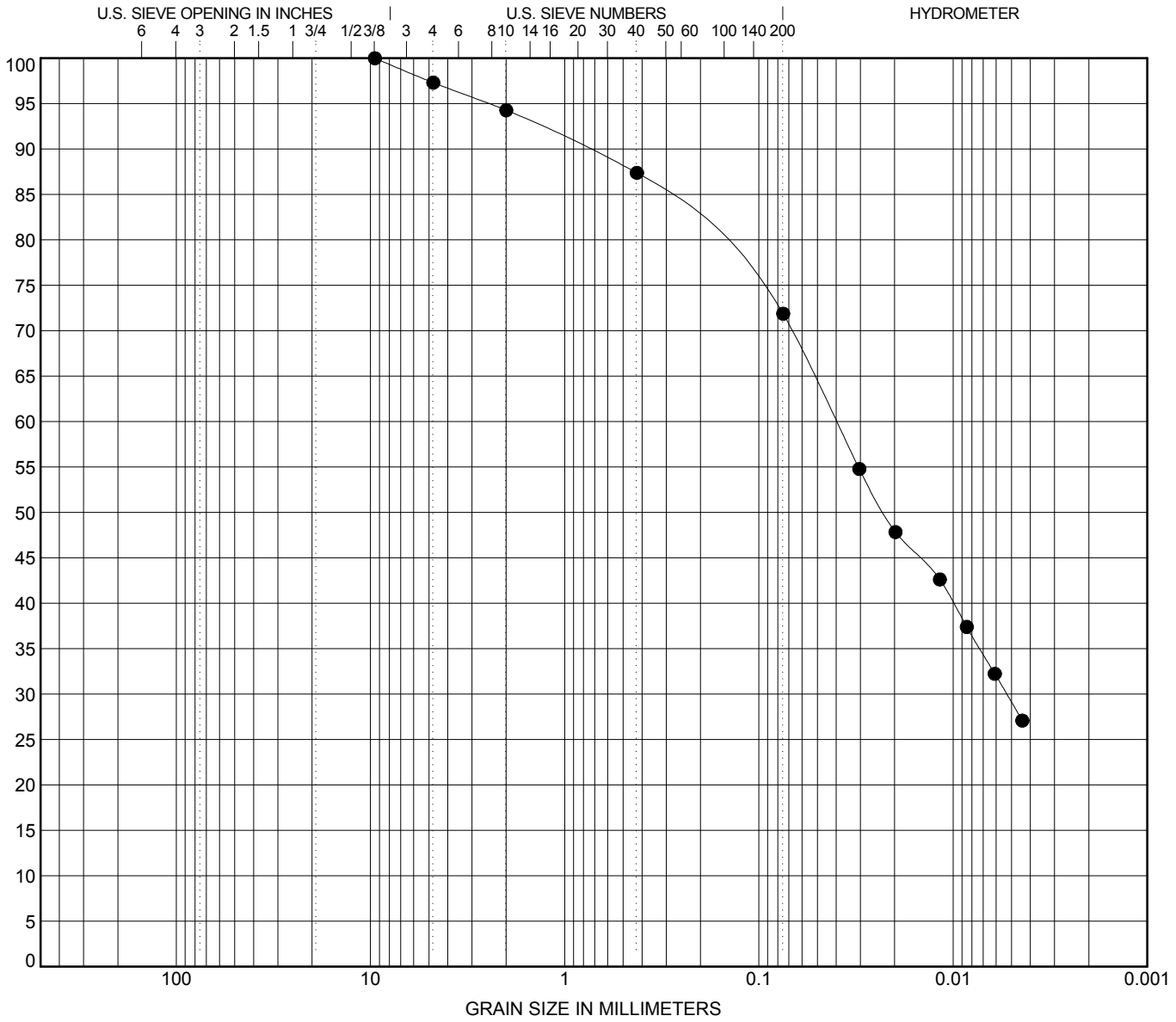

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-008-0-12	**18.5**	**A-6a(8)**	**14**	**28**	**16**	**12**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-008-0-12	**18.5**	**9.5**	**0.04**	**0.023**	**0.005**		**5**	**7**	**16**	**43**	**29**

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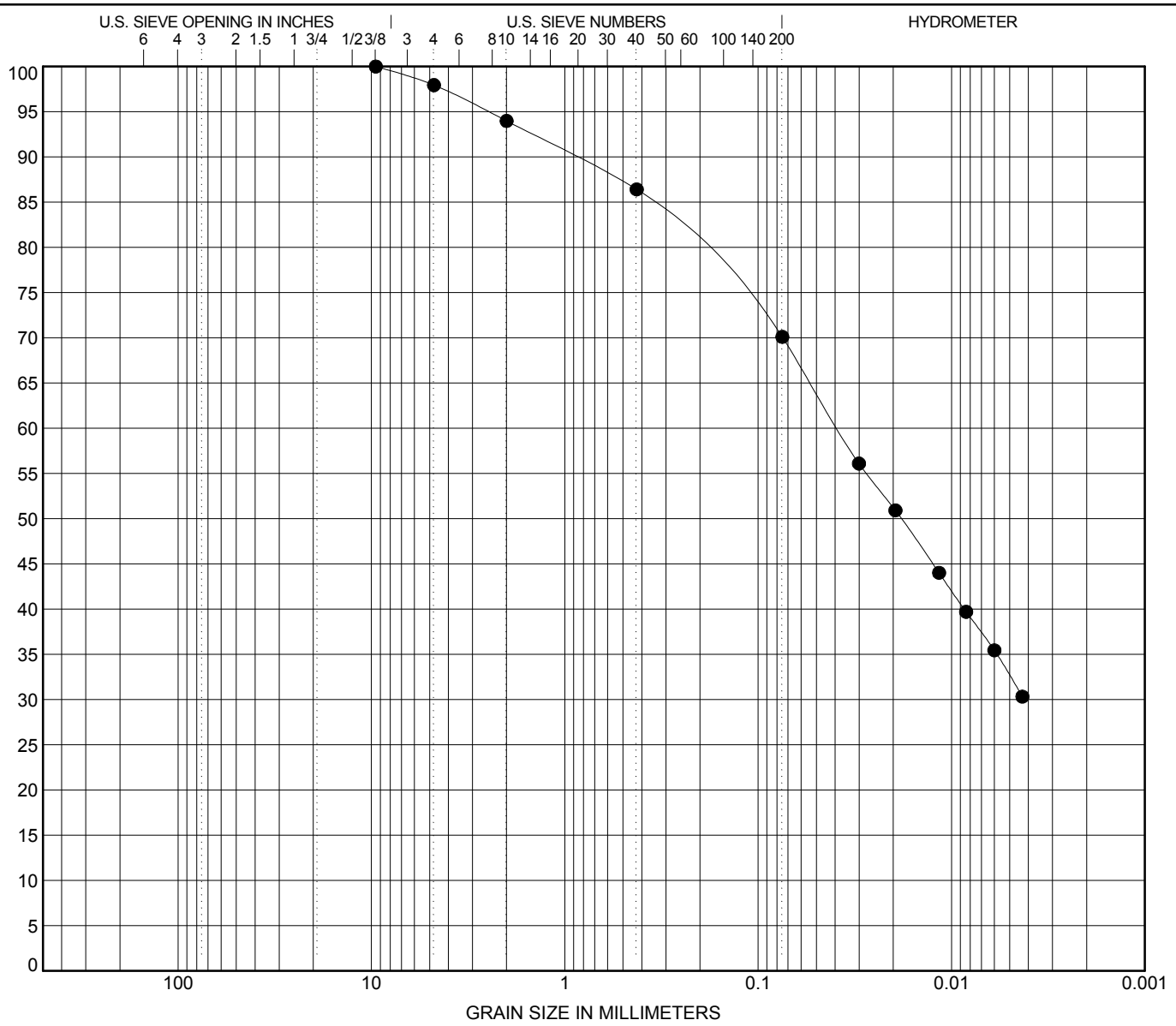

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Specimen Identification	Depth	Classification	MC	LL	PL	PI	Cc	Cu
B-008-0-12	**23.5**	**A-6a(8)**	**9**	**27**	**14**	**13**		
		SILT AND CLAY						

Specimen Identification	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
B-008-0-12	**23.5**	**9.5**	**0.039**	**0.018**			**6**	**8**	**16**	**37**	**33**

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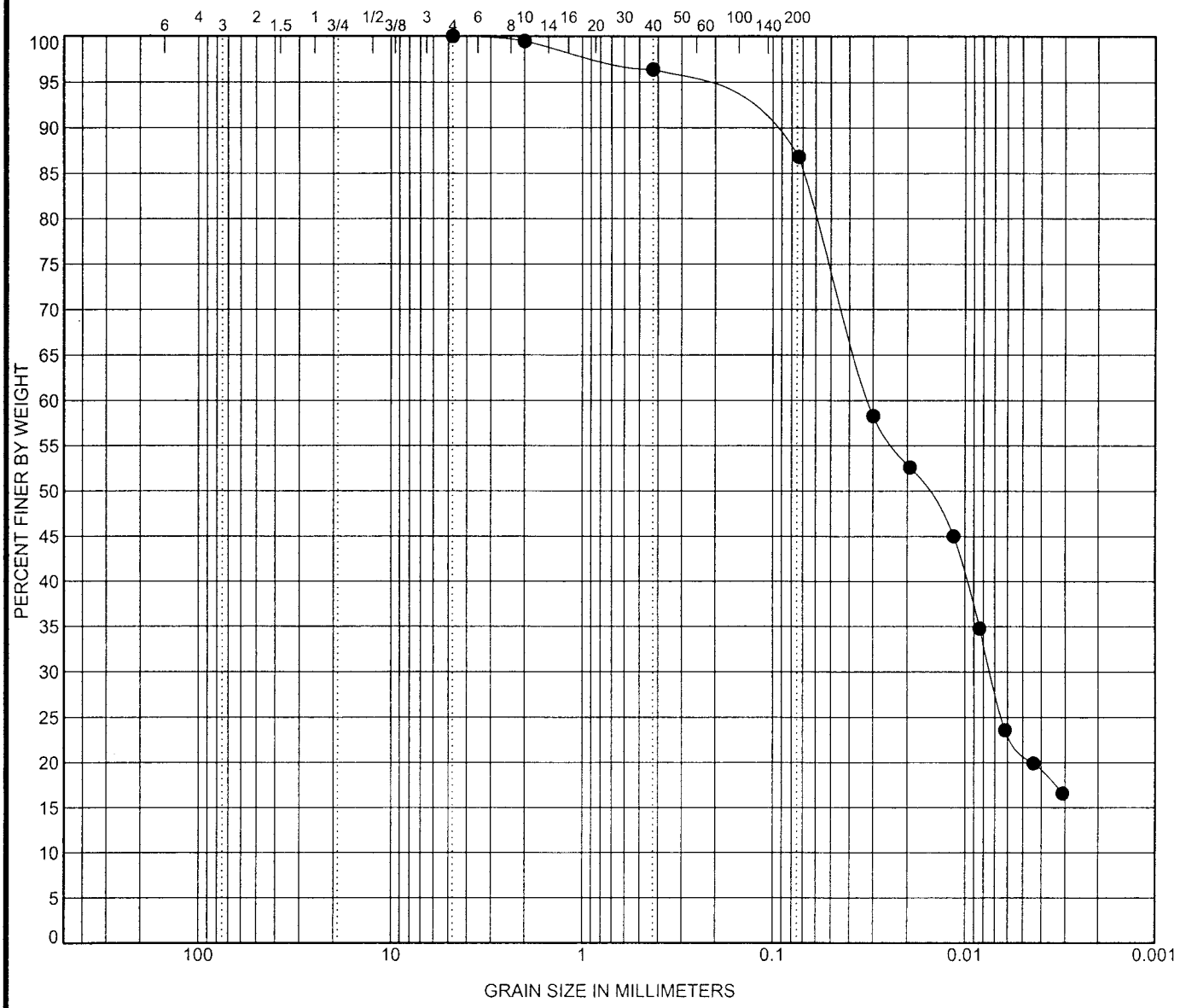

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-1	SS-1	1.0	A-4b (8)	23	26	19	7		
⊠				SILT						
▲				some clay, little sand, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-1	SS-1	1.0	4.75	0.032	0.016	0.007		1	3	10	65	21
⊠													
▲													
★													
⊙													

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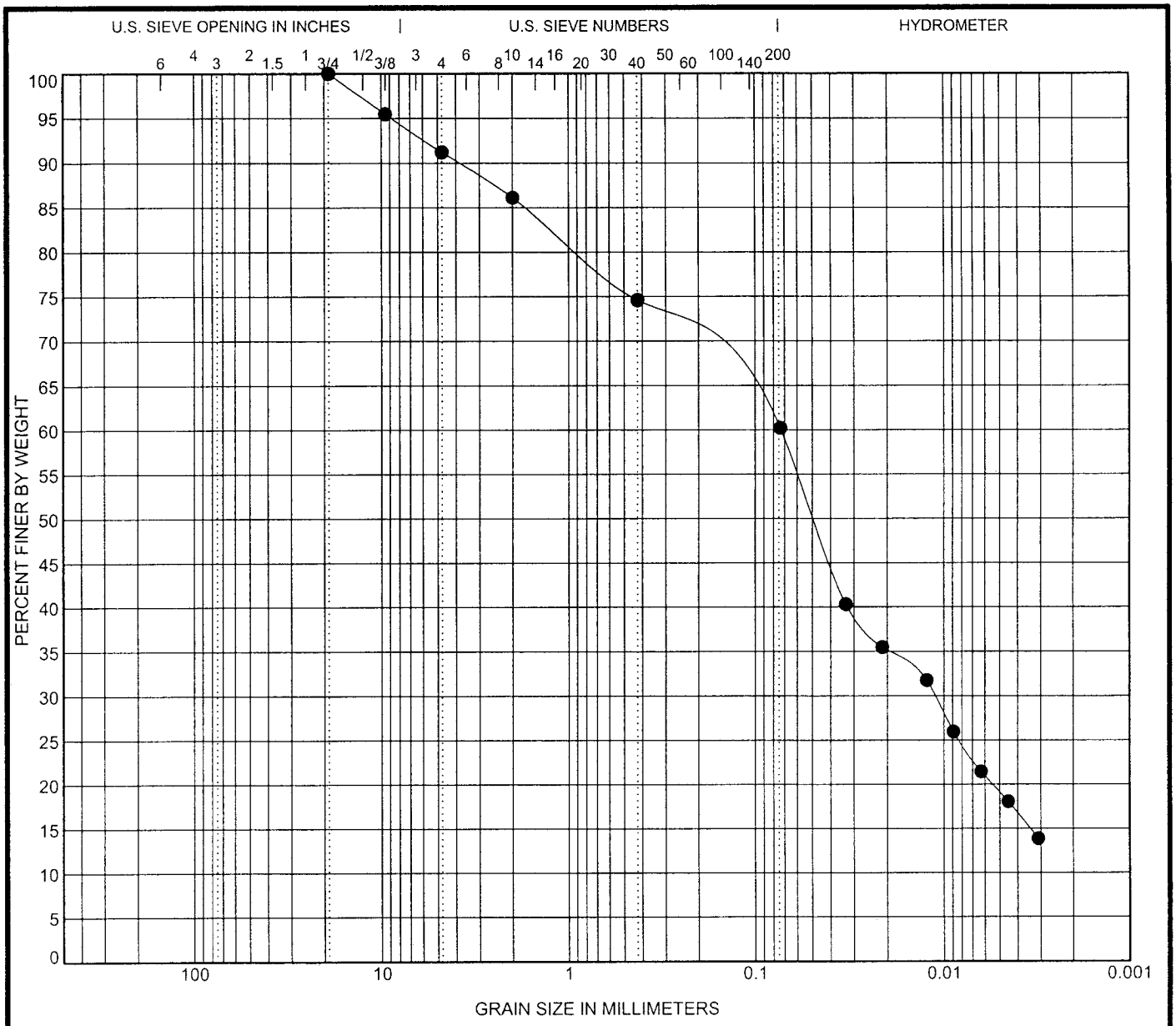

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-1	SS-4	8.5	A-4a (5)	10	22	15	7		
⊠				SANDY SILT						
▲				little gravel, little clay, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-1	SS-4	8.5	19	0.073	0.049	0.011		14	12	14	41	19
⊠													
▲													
★													
⊙													

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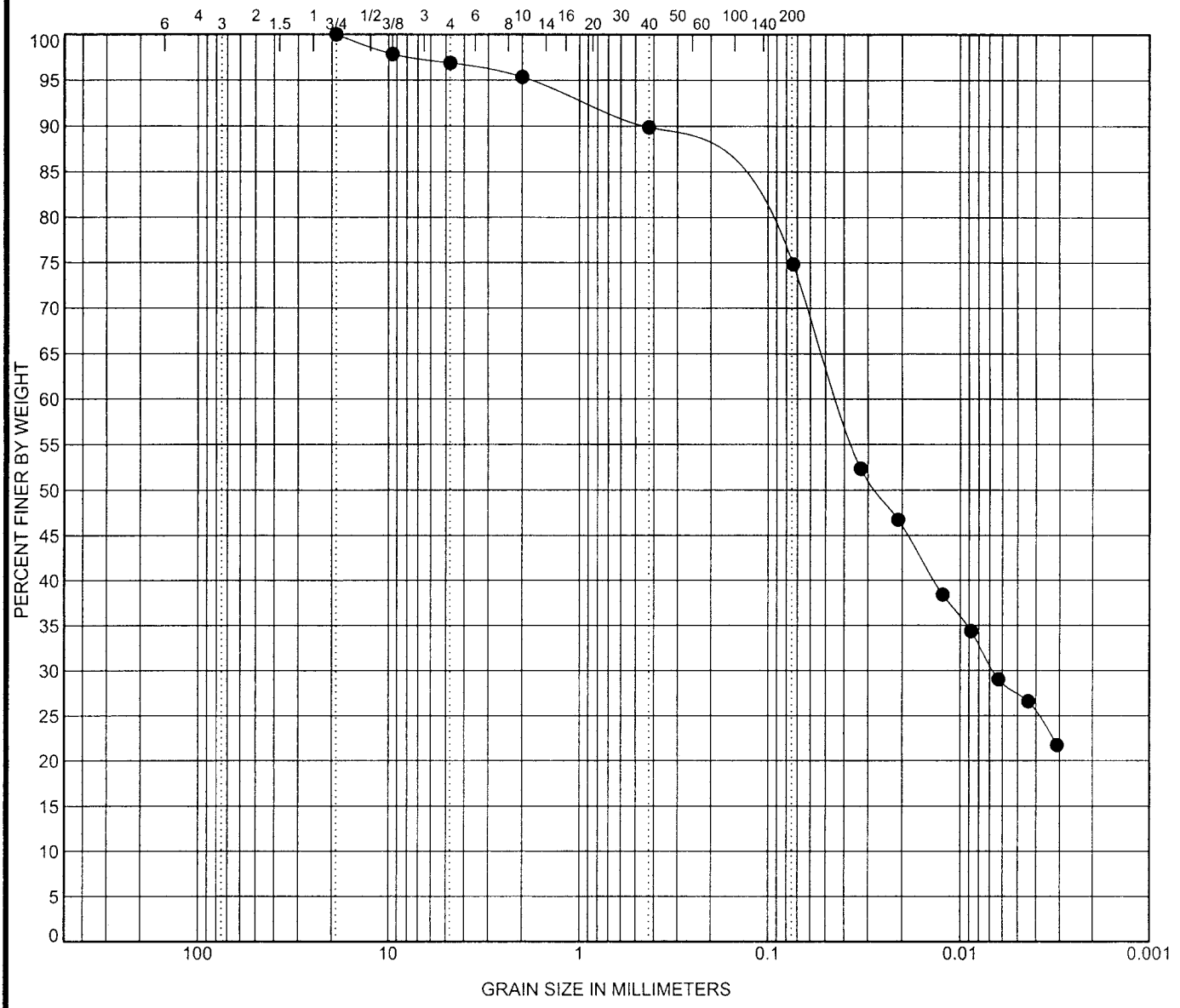

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-1	SS-9	23.5	A-6a (9)	15	27	15	12		
⊠				SILT AND CLAY						
▲				some sand, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-1	SS-9	23.5	19	0.043	0.027	0.007		5	5	15	48	27
⊠													
▲													
★													
⊙													

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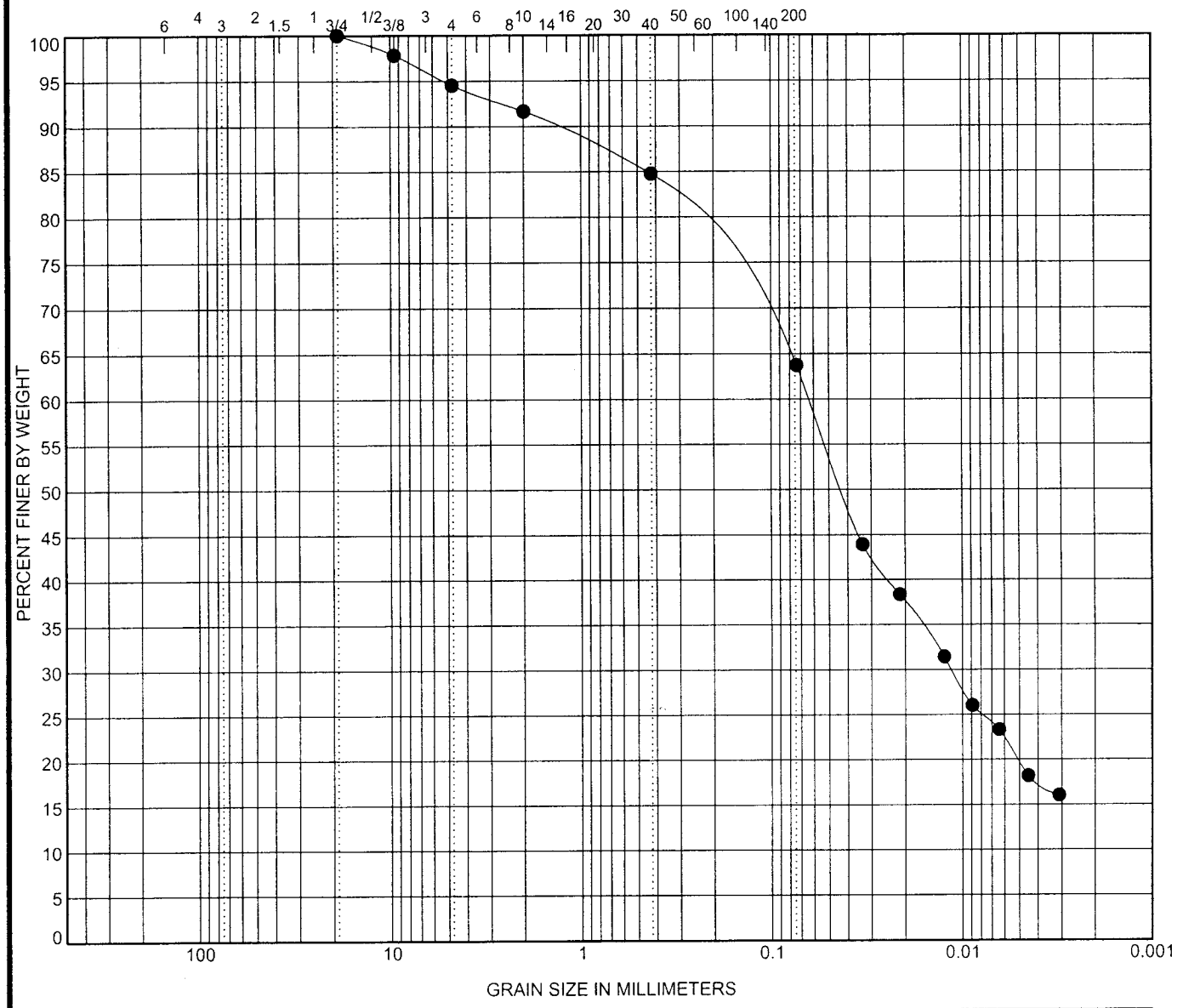

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-1	SS-10	28.5	A-4a (6)	9	21	13	8		
⊠				SANDY SILT						
▲				little clay, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-1	SS-10	28.5	19	0.063	0.043	0.011		8	7	21	44	20
⊠													
▲													
★													
⊙													

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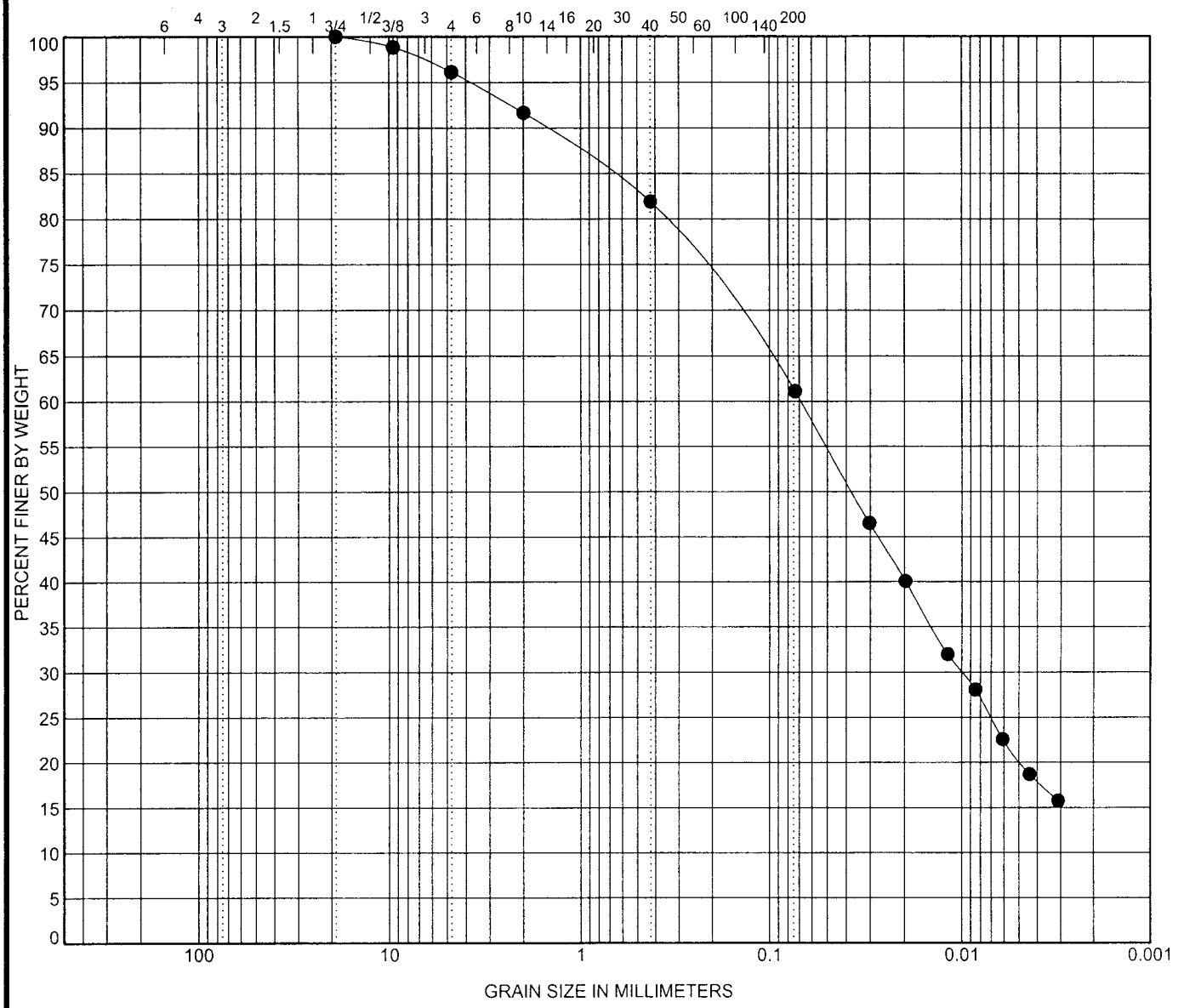

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-1	SS-15	53.5	A-4a (5)	11	21	14	7		
⊠				SANDY SILT						
▲				little clay, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-1	SS-15	53.5	19	0.069	0.038	0.01		8	10	21	41	20
⊠													
▲													
★													
⊙													

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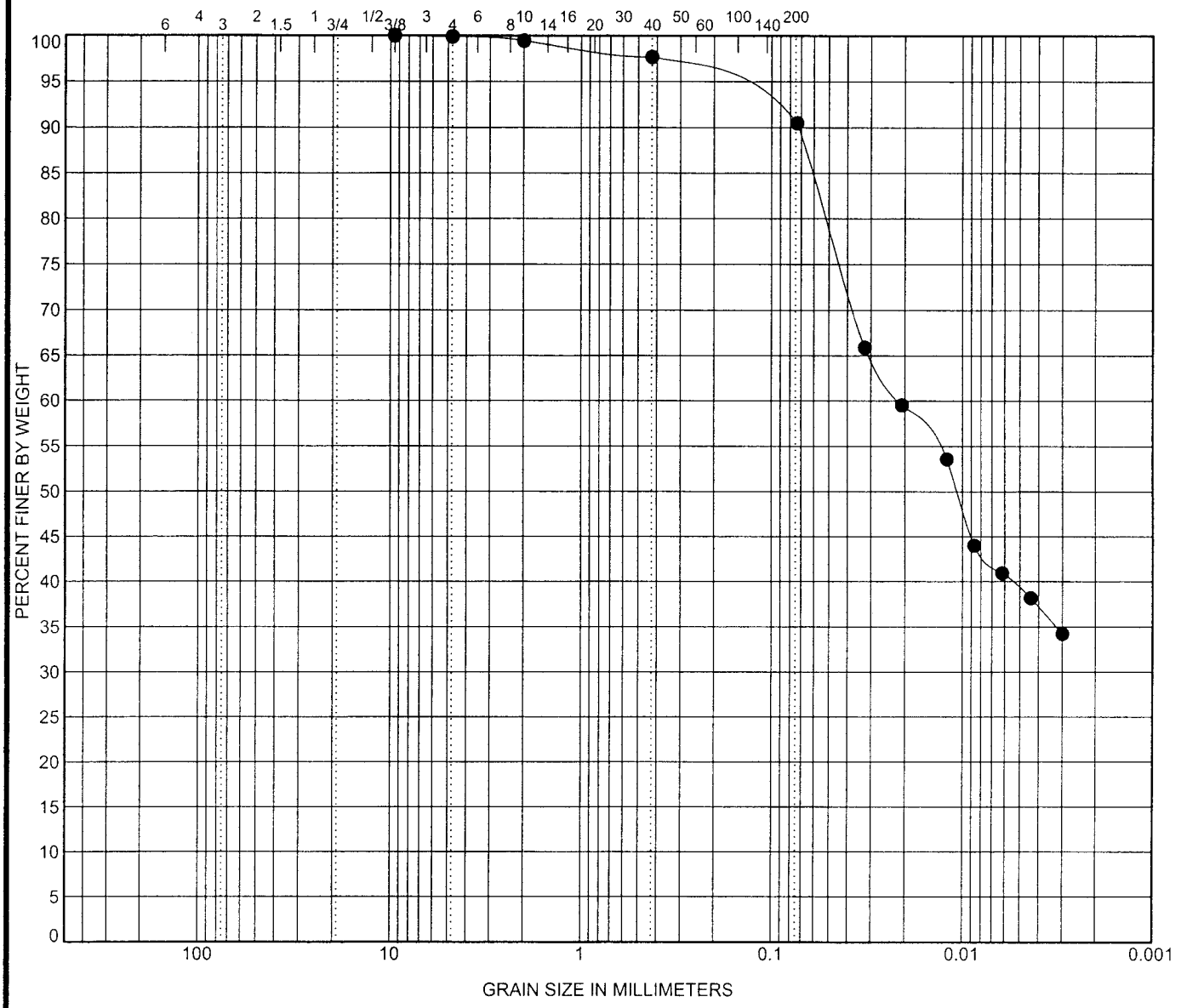

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-2	SS-1	1.0	A-7-6 (18)	26	53	24	29		
⊠				CLAY						
▲				and silt, trace sand, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-2	SS-1	1.0	9.525	0.021	0.011			1	2	7	51	39
⊠													
▲													
★													
⊙													

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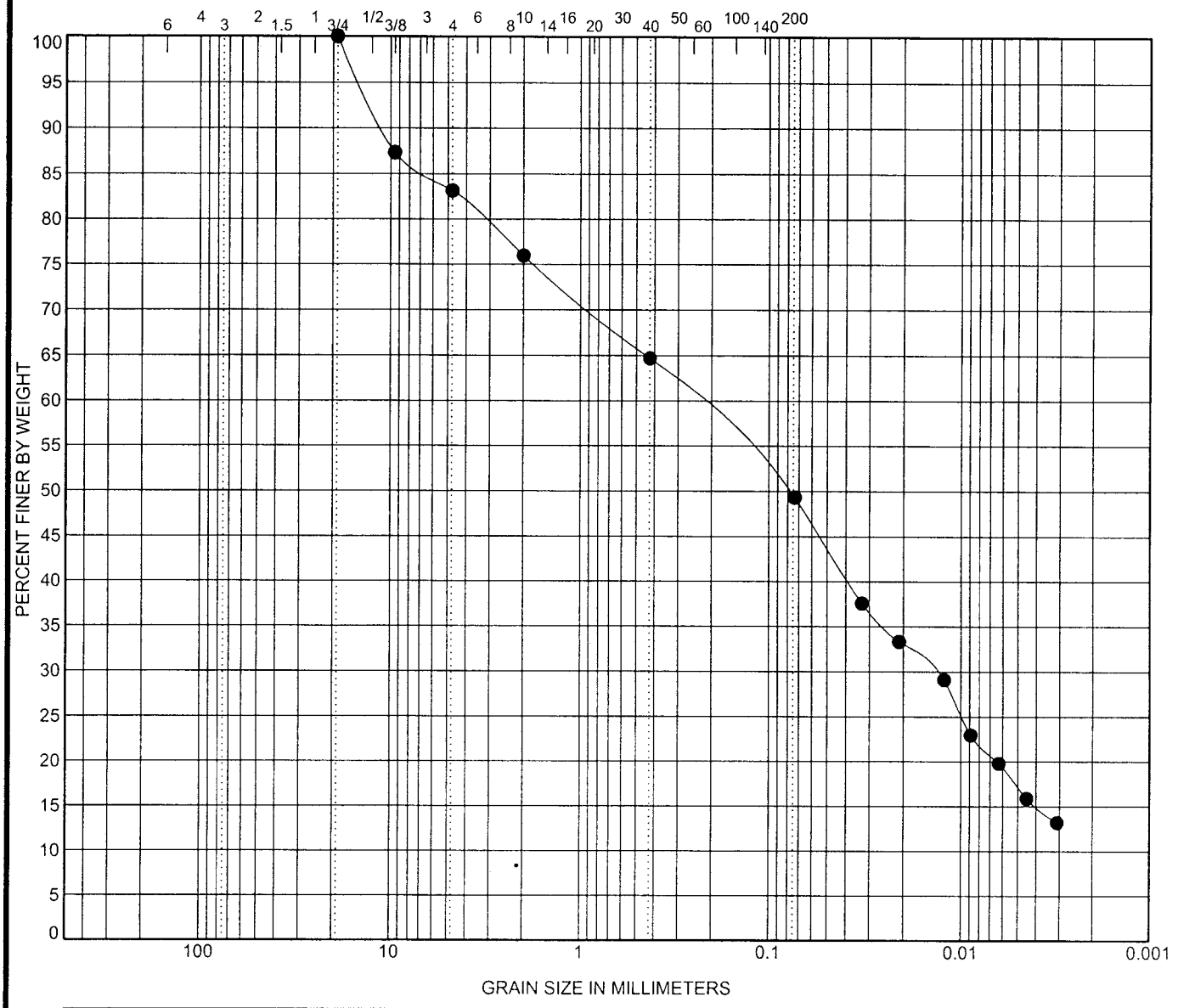

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-2	SS-3	6.0	A-4a (3)	14	23	15	8		
⊠				SANDY SILT						
▲				some gravel little clay, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-2	SS-3	6.0	19	0.249	0.08	0.014		24	11	15	33	17
⊠													
▲													
★													
⊙													

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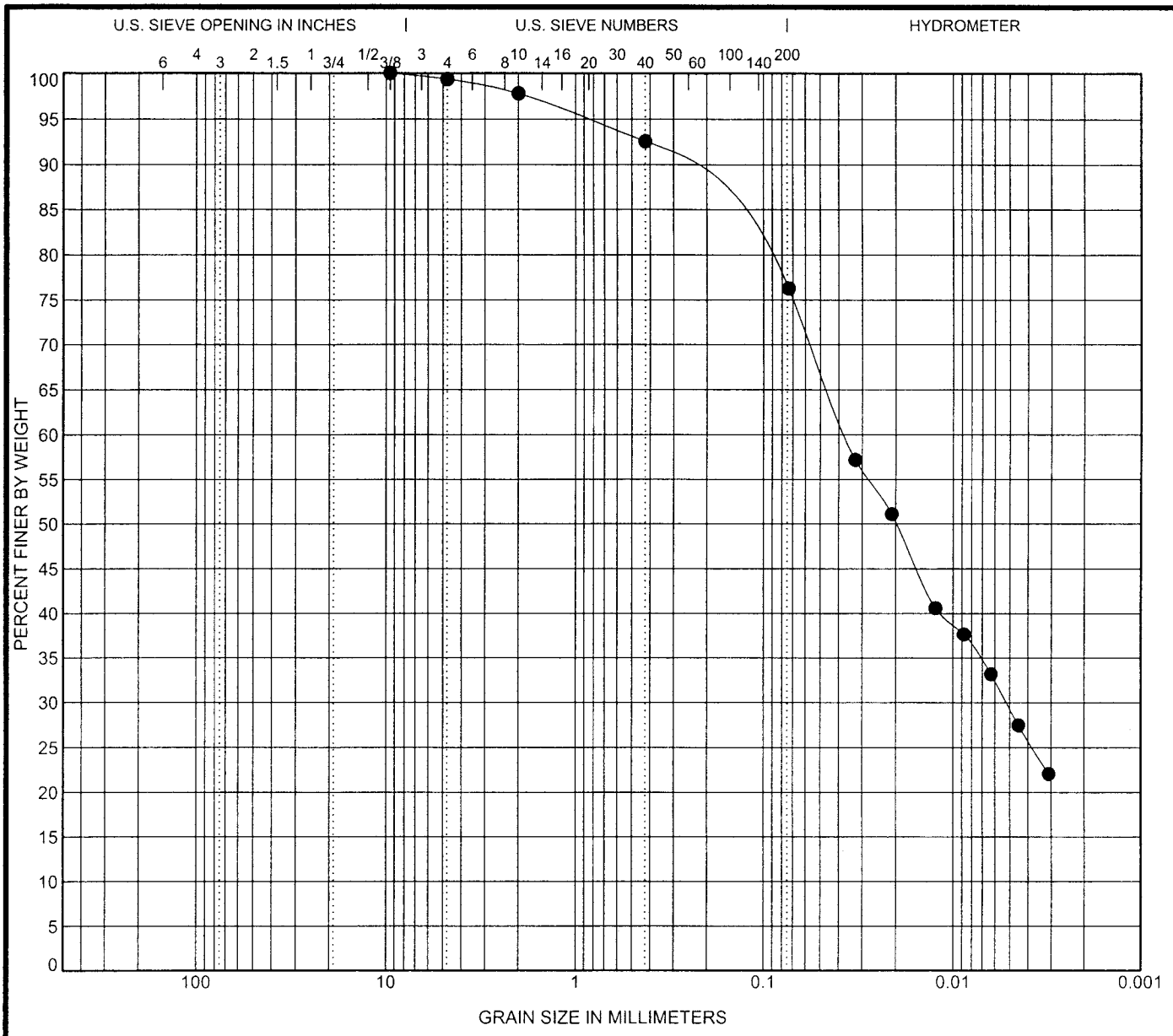

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● B-2	SS-5	11.0	A-4a (8)	12	25	15	10		
⊠			SANDY SILT						
▲			some clay, trace gravel, damp						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● B-2	SS-5	11.0	9.525	0.037	0.02	0.005		2	5	16	48	29
⊠												
▲												
★												
⊙												

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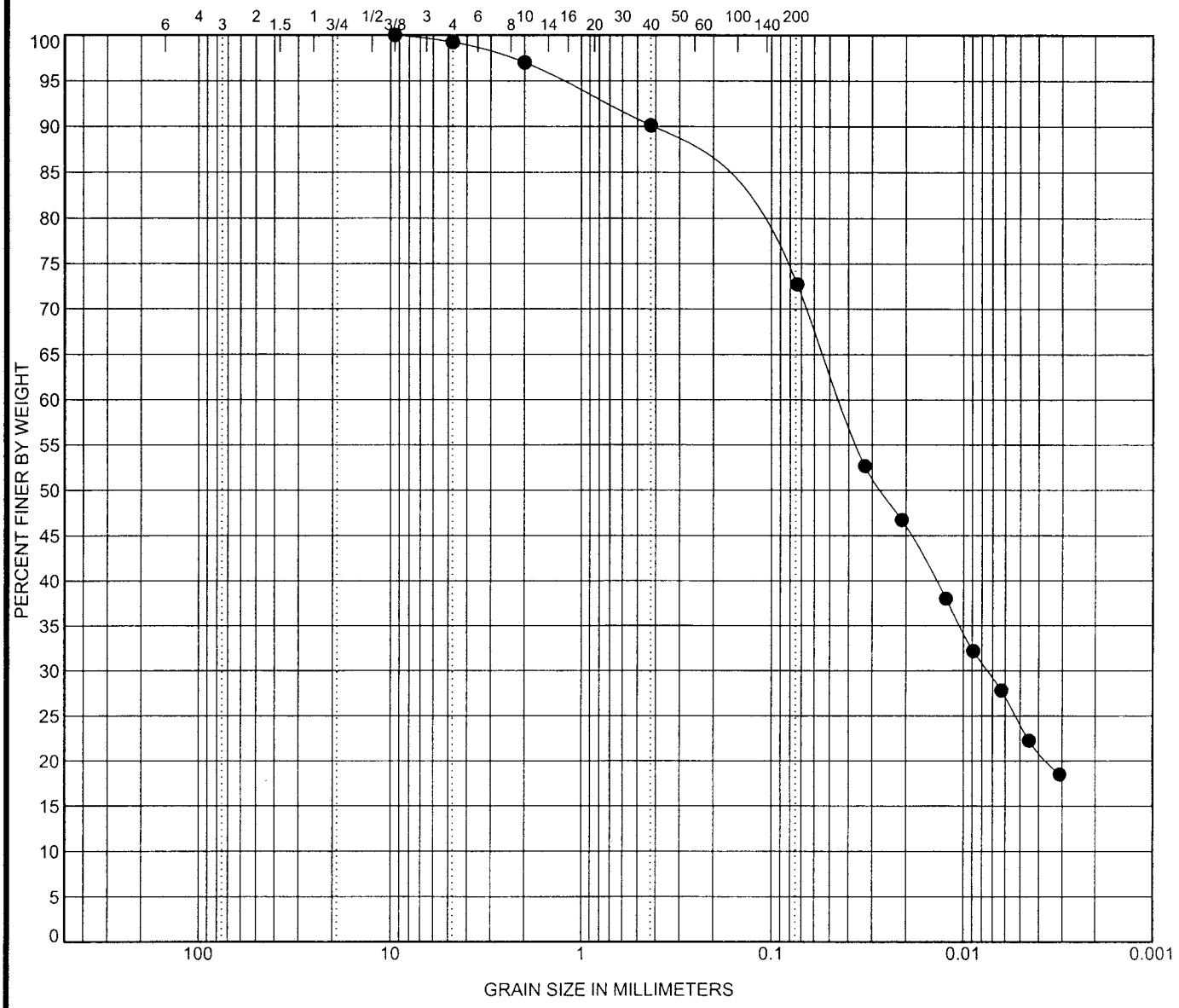

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-2	SS-8	18.5	A-4a (8)	12	25	15	10		
■				SANDY SILT						
▲				some clay, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-2	SS-8	18.5	9.525	0.044	0.027	0.007		3	7	17	49	24
■													
▲													
★													
⊙													

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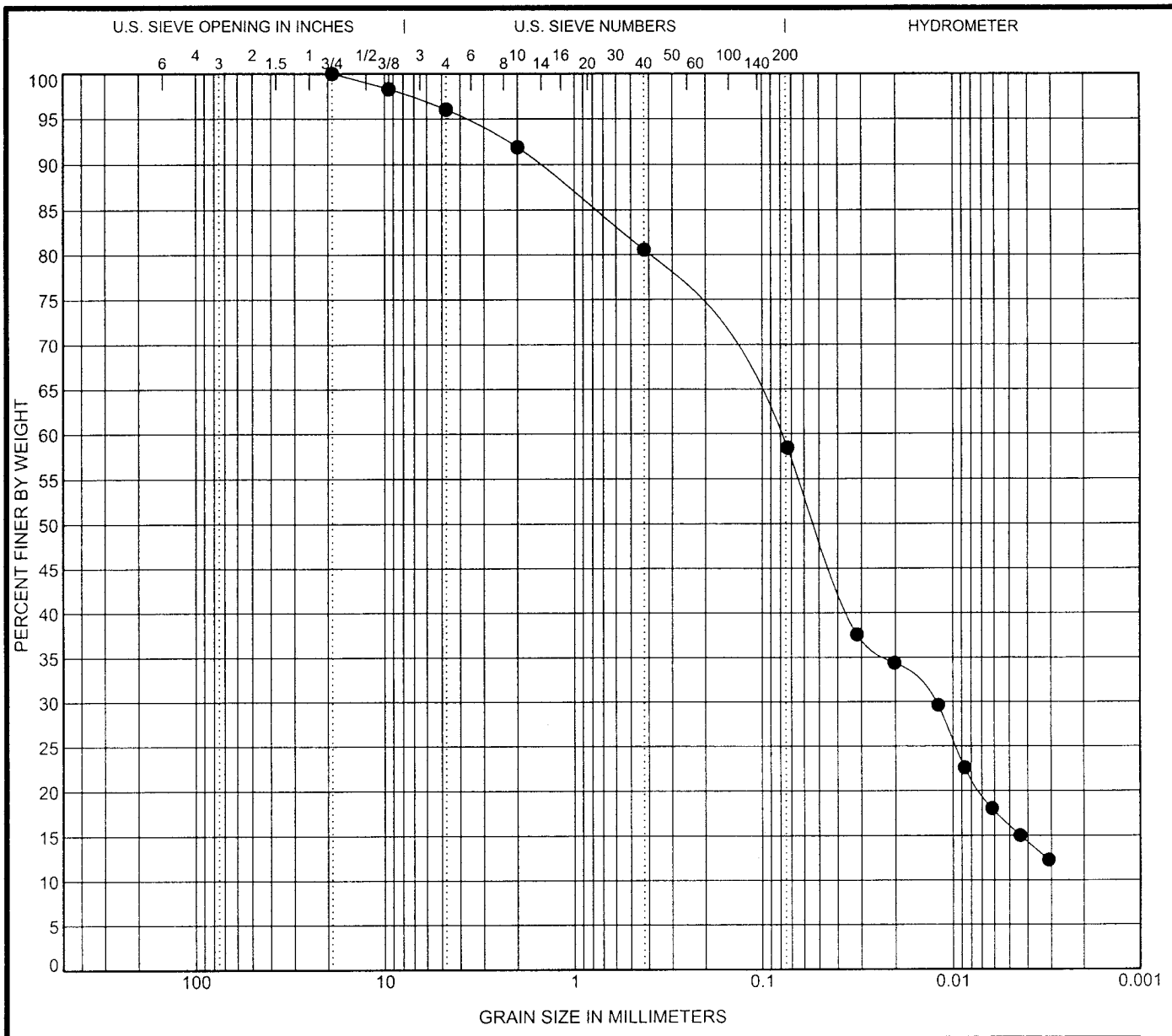
Project: EMH&T
Location: Hayden Run Blvd, Columbus, Ohio
CTL Project Number: 09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-2	SS-11	33.5	A-4a (5)	9	21	13	8		
⊠				SANDY SILT						
▲				little clay, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-2	SS-11	33.5	19	0.083	0.052	0.013		8	11	22	43	16
⊠													
▲													
★													
⊙													

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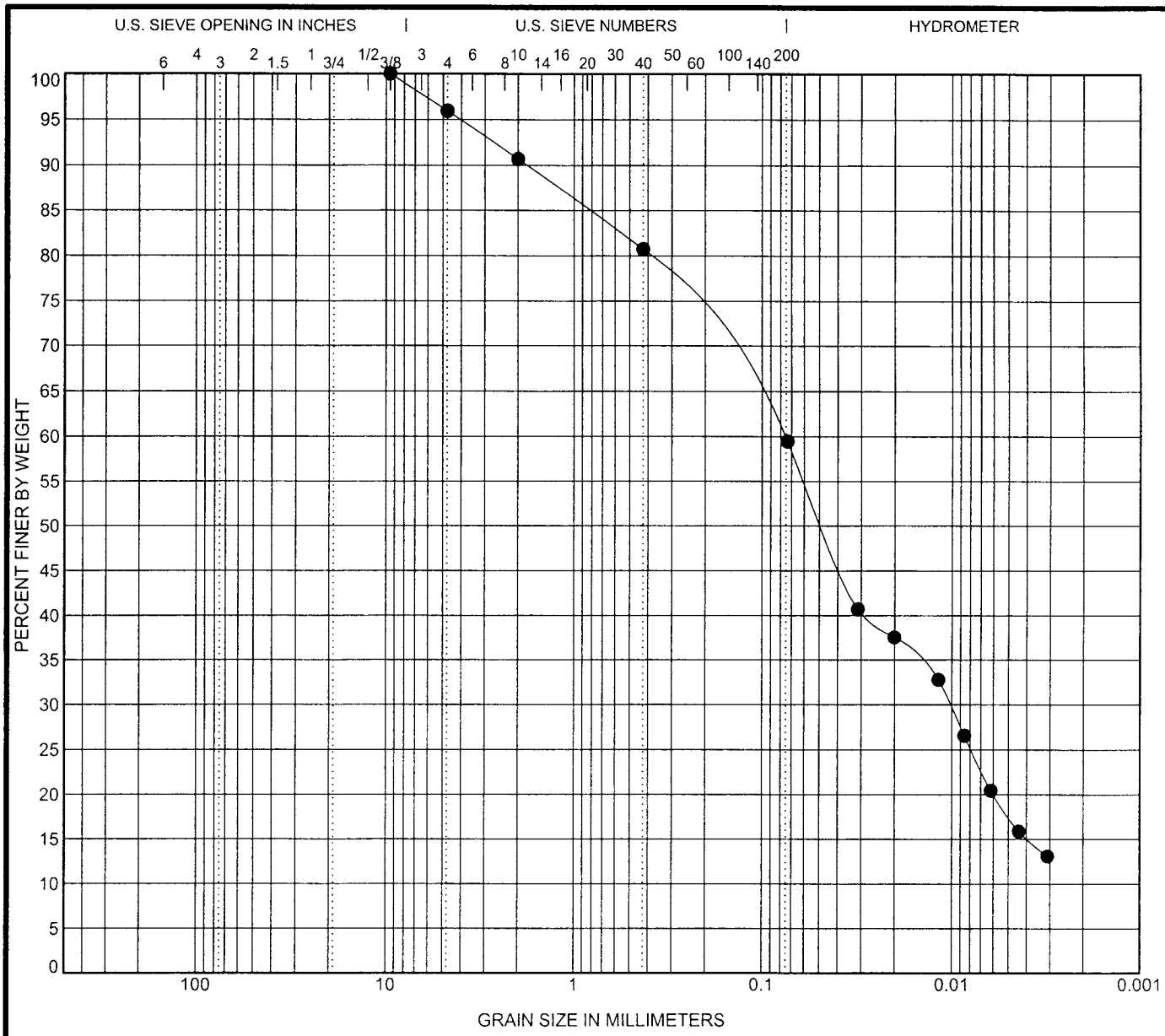

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	B-2	SS-14	48.5	A-4a (5)	9	21	13	8		
⊠				SANDY SILT						
▲				little clay, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	B-2	SS-14	48.5	9.525	0.077	0.048	0.01		9	10	21	42	18
⊠													
▲													
★													
⊙													

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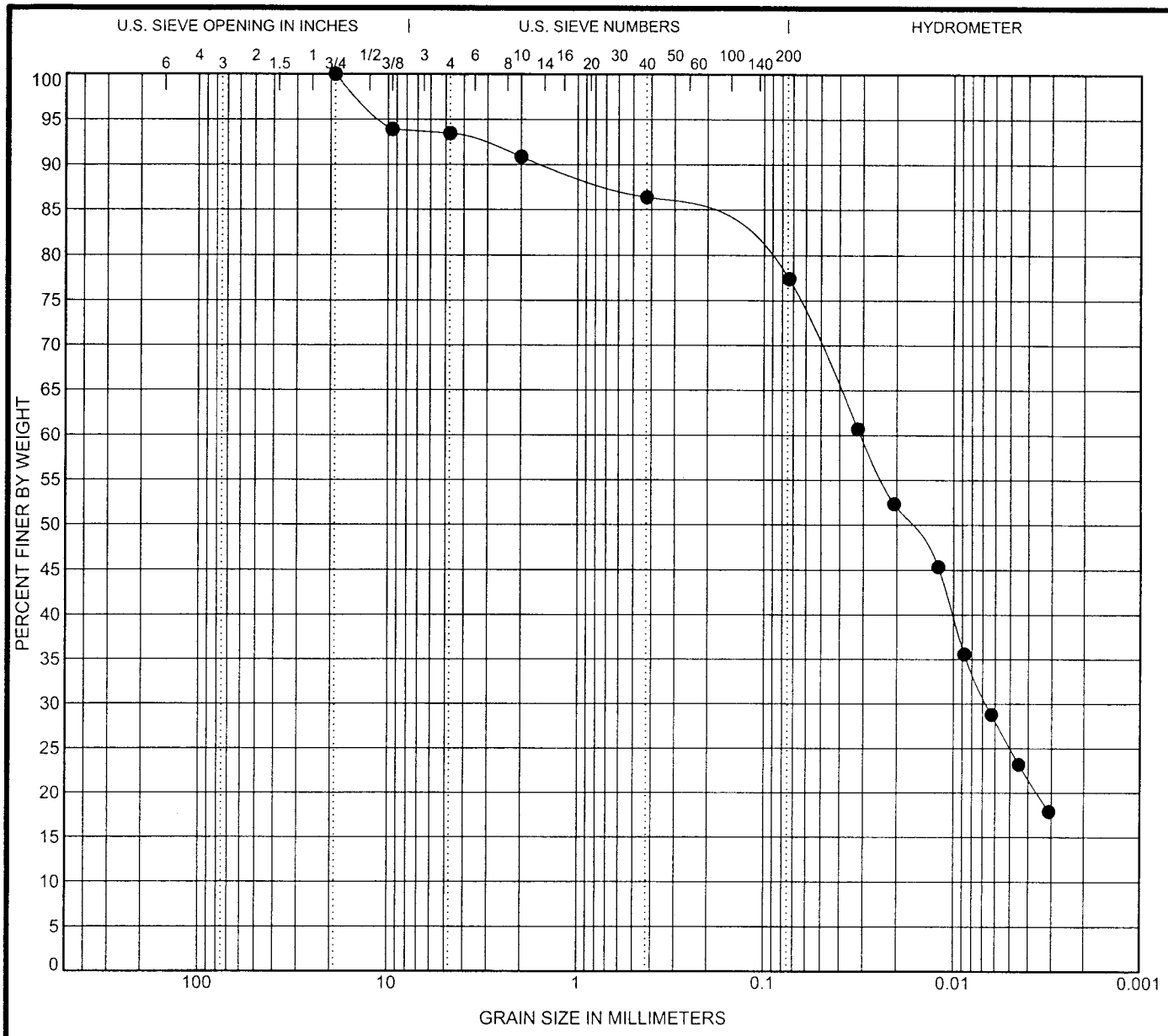

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	PS-1	SS-5	11.0	A-4b (8)	16	25	17	8		
⊠				SILT						
▲				some clay, little sand, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	PS-1	SS-5	11.0	19	0.031	0.017	0.007		9	5	9	52	25
⊠													
▲													
★													
⊙													

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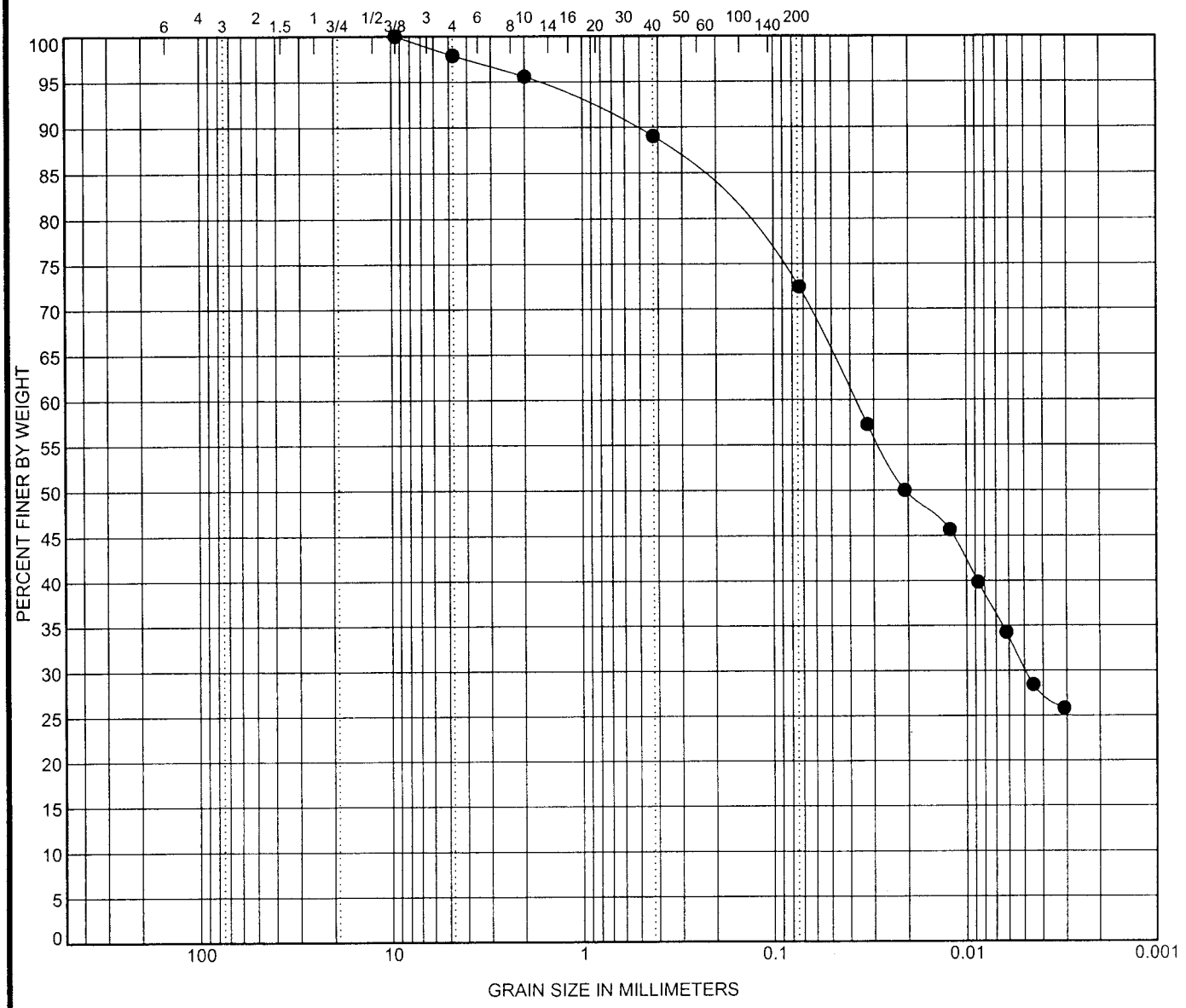

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	PS-1	SS-9	23.5	A-6a (8)	24	28	16	12		
⊠				SILT AND CLAY						
▲				some sand, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	PS-1	SS-9	23.5	9.525	0.038	0.021	0.005		4	7	17	42	30
⊠													
▲													
★													
⊙													

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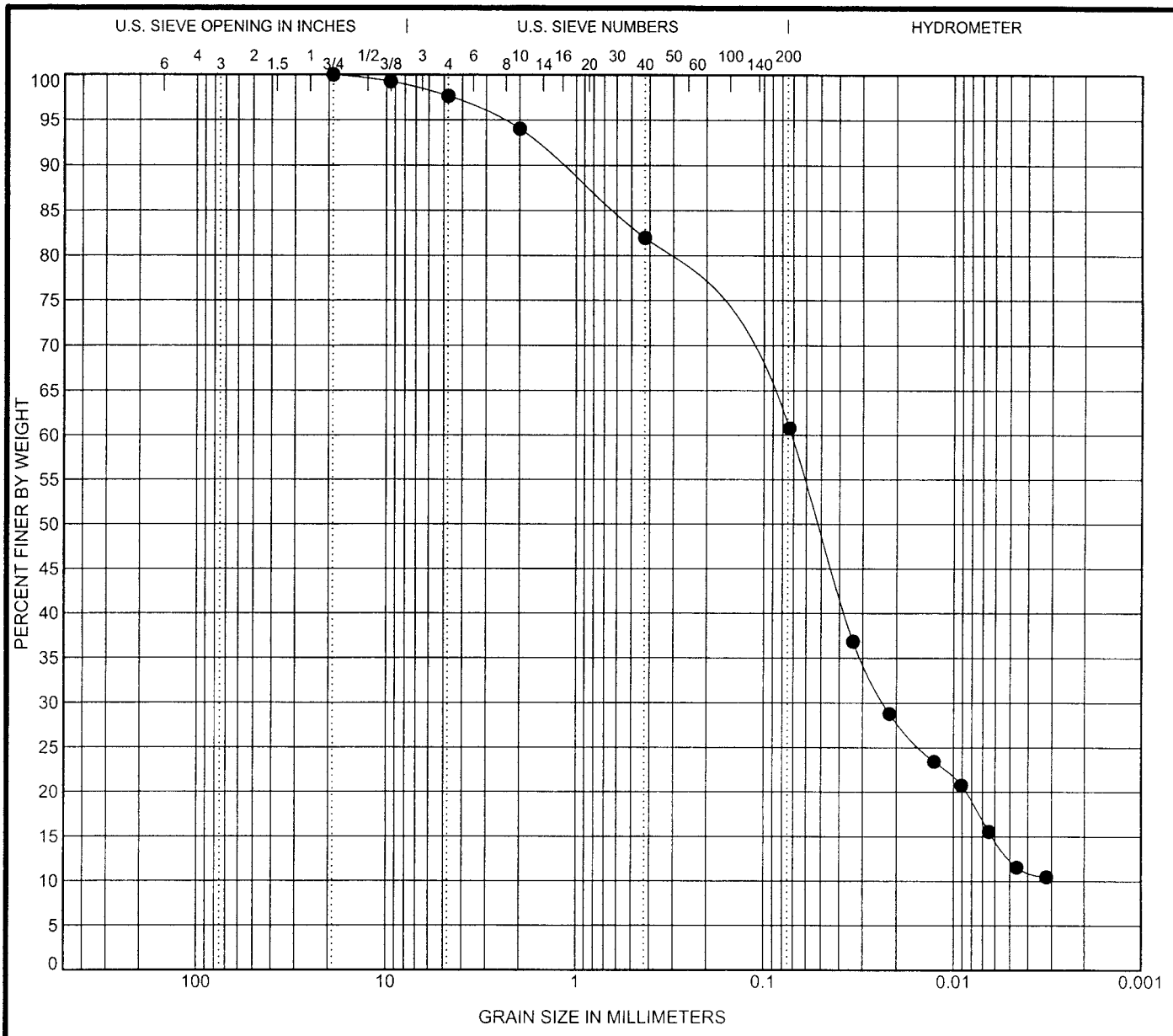

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● RB-1	SS-2	1.5	**A-4a (5)**	18	23	17	6		
⊠			**SANDY SILT**						
▲			**little clay, trace gravel, moist**						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● RB-1	SS-2	1.5	19	0.072	0.052	0.023		6	12	21	48	13
⊠												
▲												
★												
⊙												

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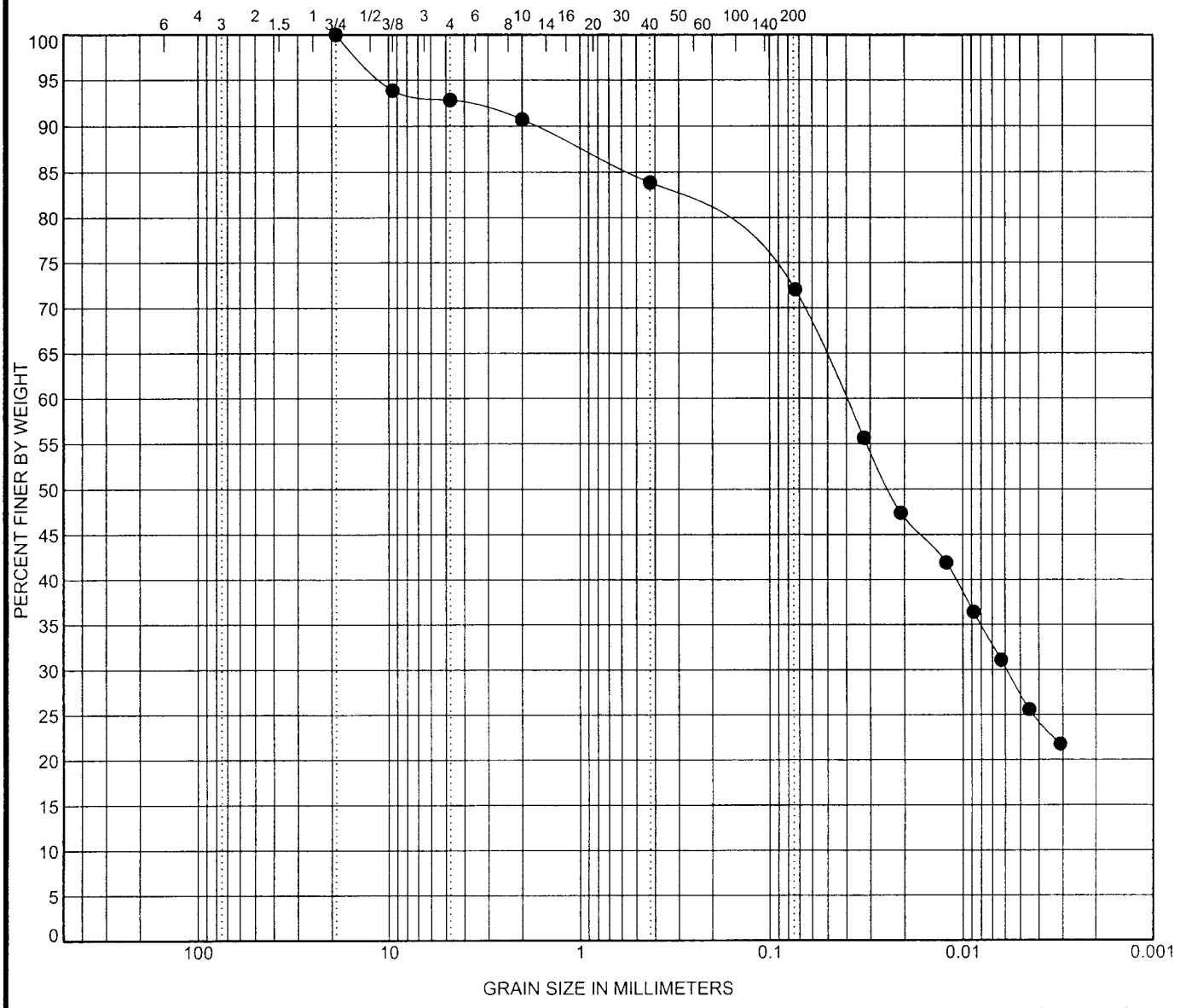

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	RB-1	SS-3	3.0	A-4a (7)	23	28	18	10		
⊠				SANDY SILT						
▲				some clay, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	RB-1	SS-3	3.0	19	0.04	0.024	0.006		9	7	12	45	27
⊠													
▲													
★													
⊙													

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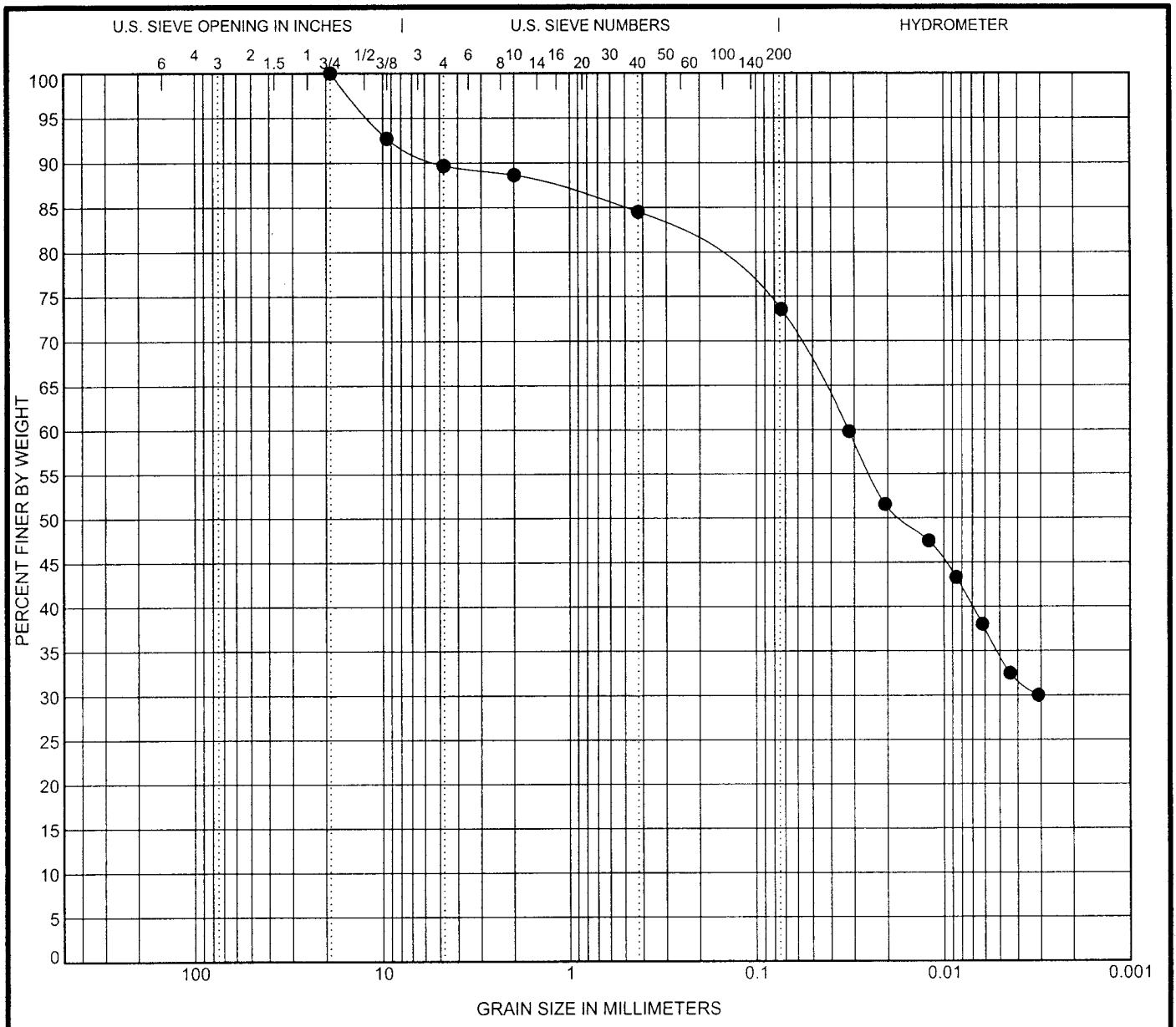

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	RB-2	SS-2	1.5	A-6b (12)	25	40	19	21		
⊠				SILTY CLAY						
▲				little gravel, little sand, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	RB-2	SS-2	1.5	19	0.032	0.017			11	4	11	39	35
⊠													
▲													
★													
⊙													

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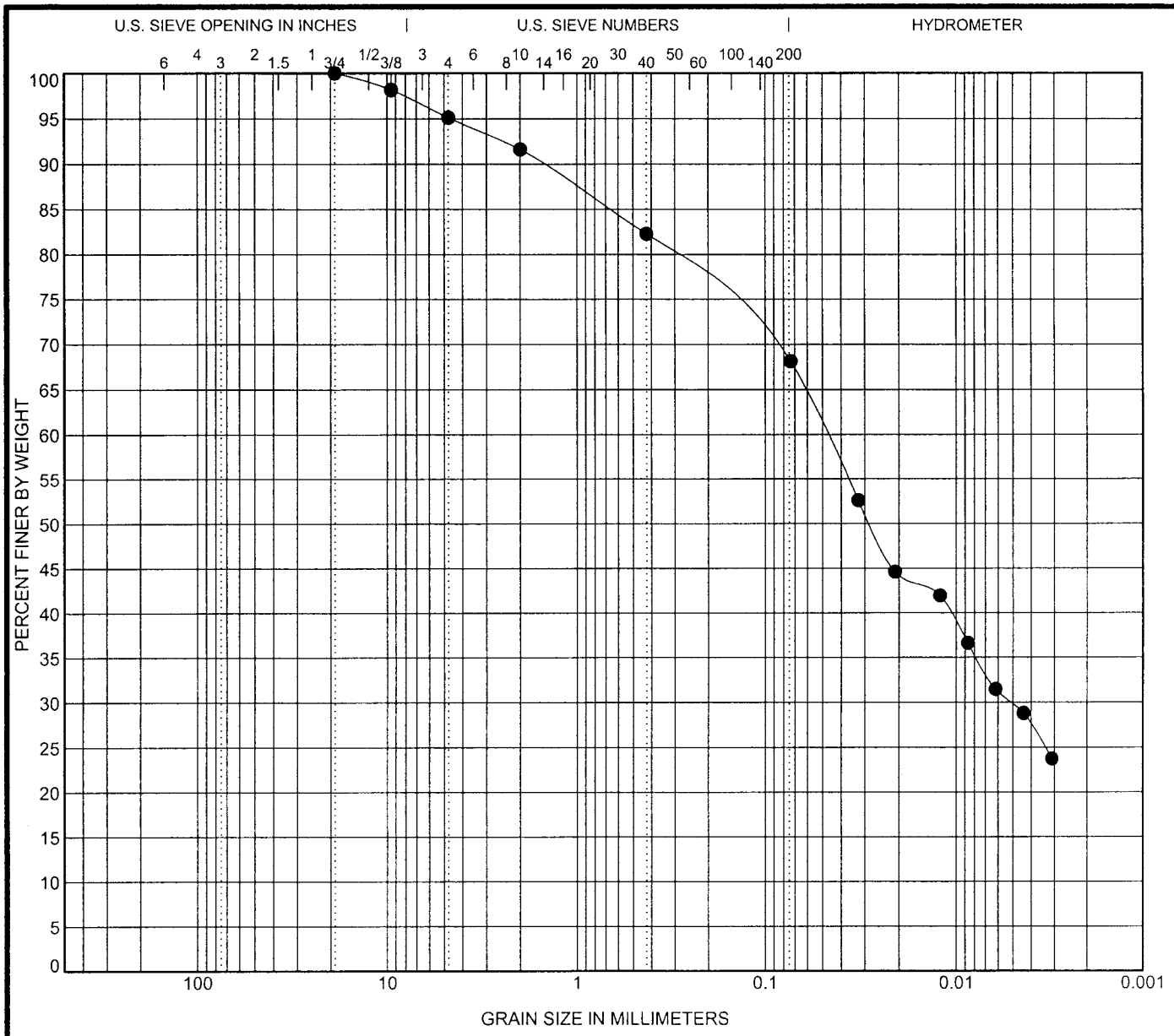

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	RB-2	SS-3	3.0	A-4a (7)	13	27	17	10		
⊠				SANDY SILT						
▲				some clay, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	RB-2	SS-3	3.0	19	0.048	0.028	0.005		8	9	14	39	30
⊠													
▲													
★													
⊙													

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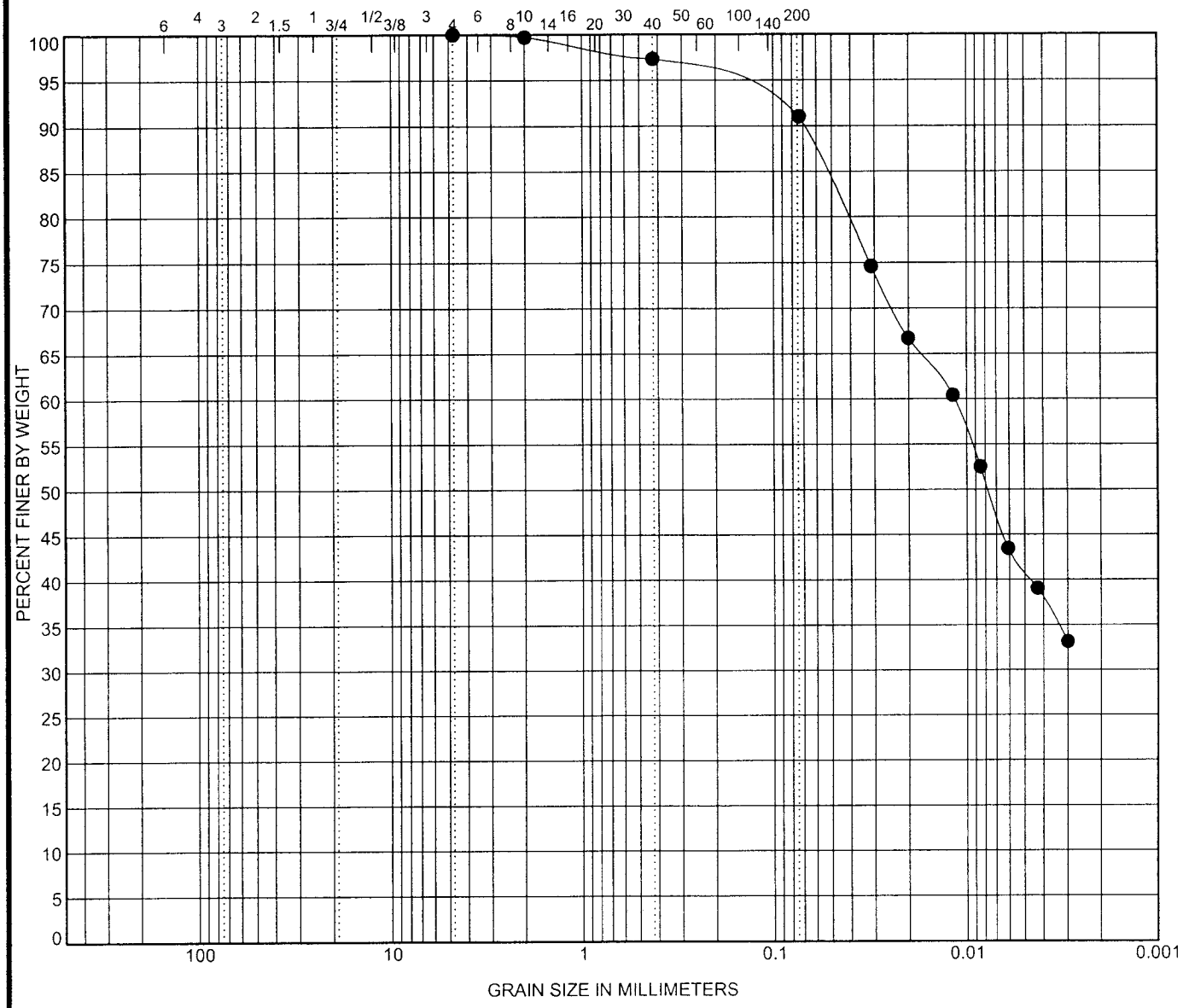

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	RB-3	SS-1	0.2	A-6b (12)	25	40	21	19		
⊠				SILTY CLAY						
▲				trace sand, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	RB-3	SS-1	0.2	4.75	0.012	0.008			0	2	6	51	41
⊠													
▲													
★													
⊙													

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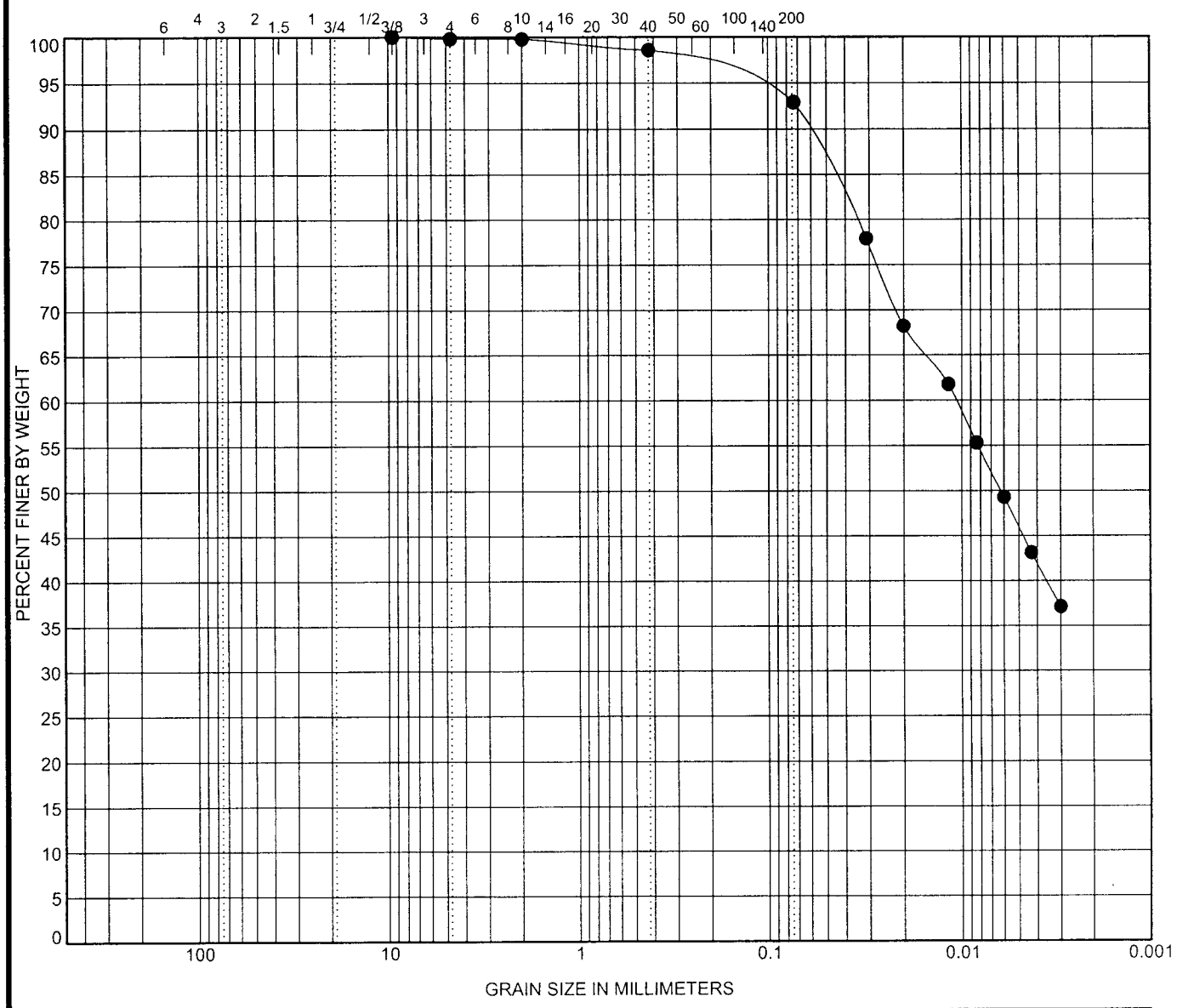

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	RB-3	SS-2	1.5	A-7-6 (13)	24	43	21	22		
⊠				CLAY						
▲				and silt, trace sand, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	RB-3	SS-2	1.5	9.525	0.011	0.006			0	1	6	47	46
⊠													
▲													
★													
⊙													

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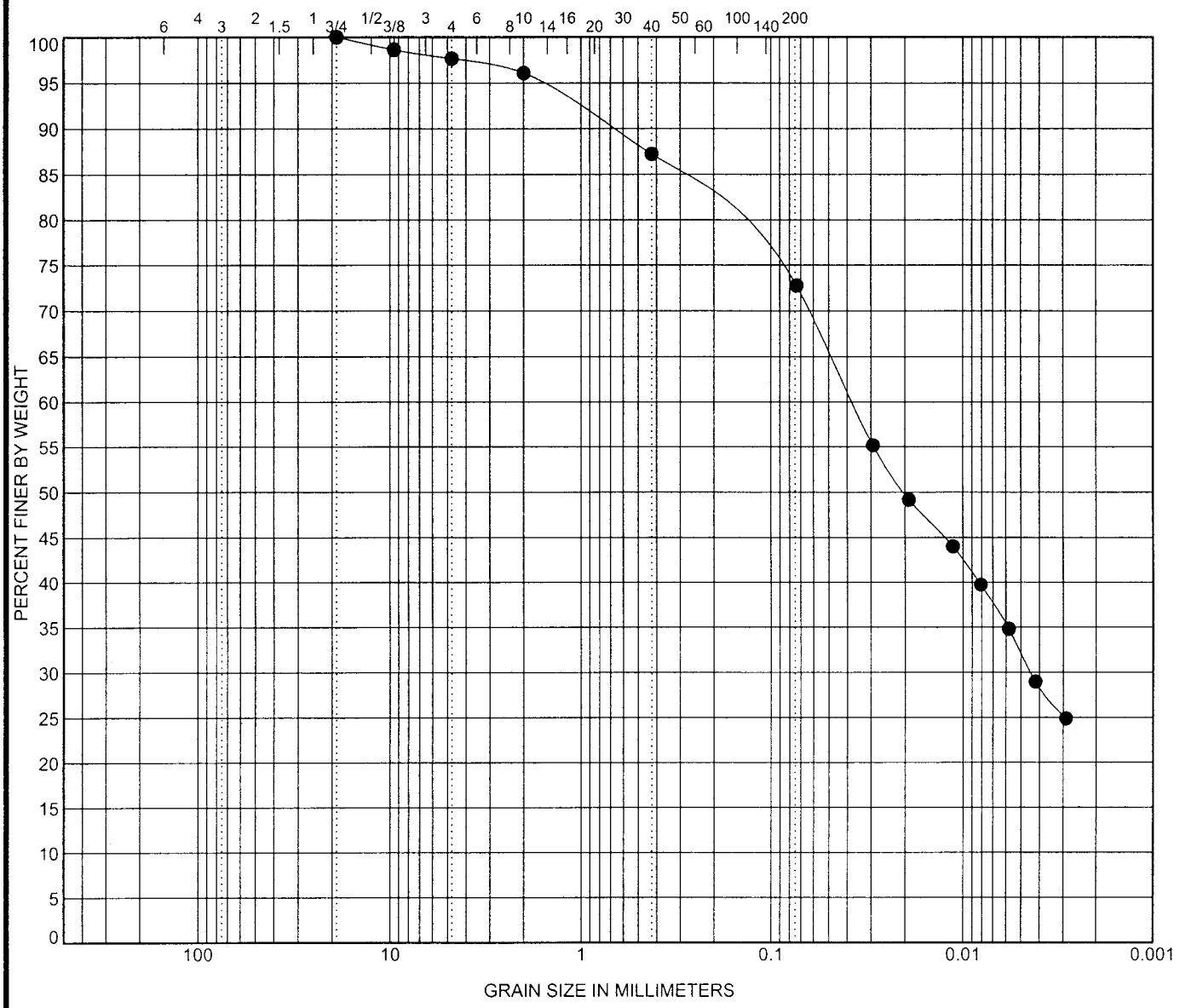

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	RB-3	SS-4	4.5	A-6a (8)	17	28	17	11		
⊠				SILT AND CLAY						
▲				some sand, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	RB-3	SS-4	4.5	19	0.038	0.02	0.004		4	9	15	40	32
⊠													
▲													
★													
⊙													

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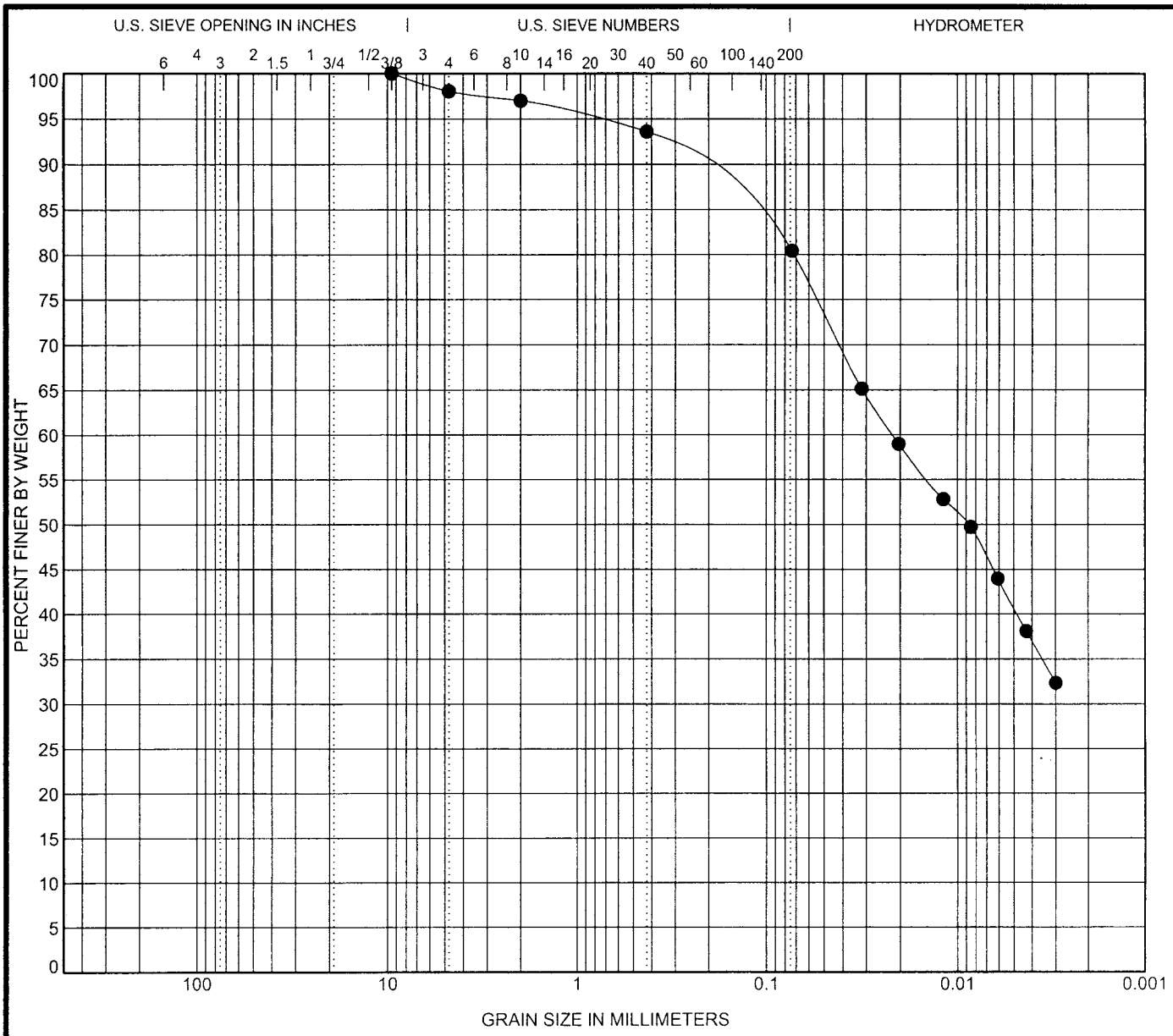

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	RB-4	SS-1	0.2	A-6b (11)	22	37	20	17		
⊠				SILTY CLAY						
▲				little sand, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	RB-4	SS-1	0.2	9.525	0.022	0.009			3	3	13	40	41
⊠													
▲													
★													
⊙													

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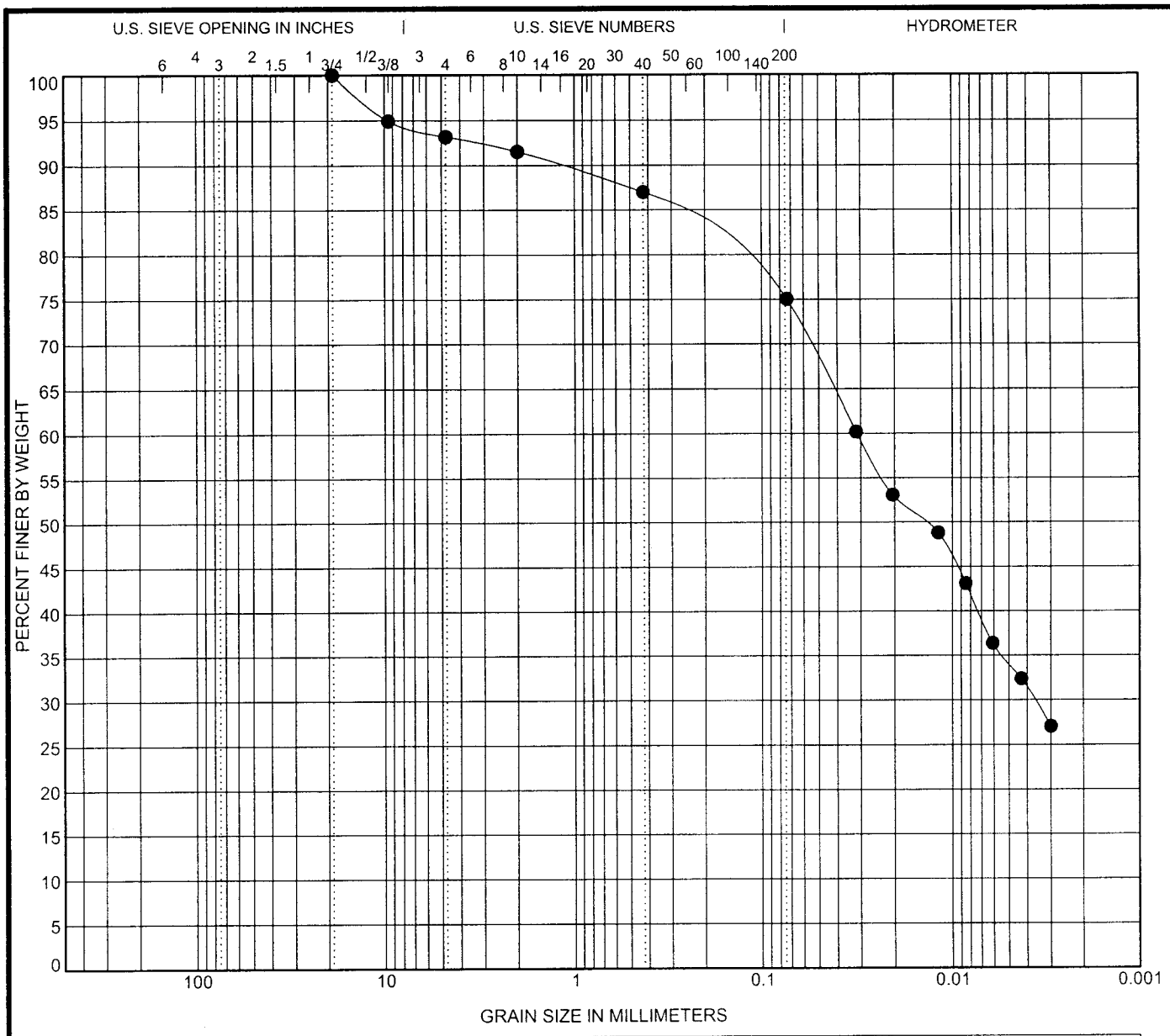

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	RB-4	SS-2	1.5	A-6a (9)	21	32	20	12		
⊠				SILT AND CLAY						
▲				little sand, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	RB-4	SS-2	1.5	19	0.031	0.014	0.004		8	5	12	41	34
⊠													
▲													
★													
⊙													

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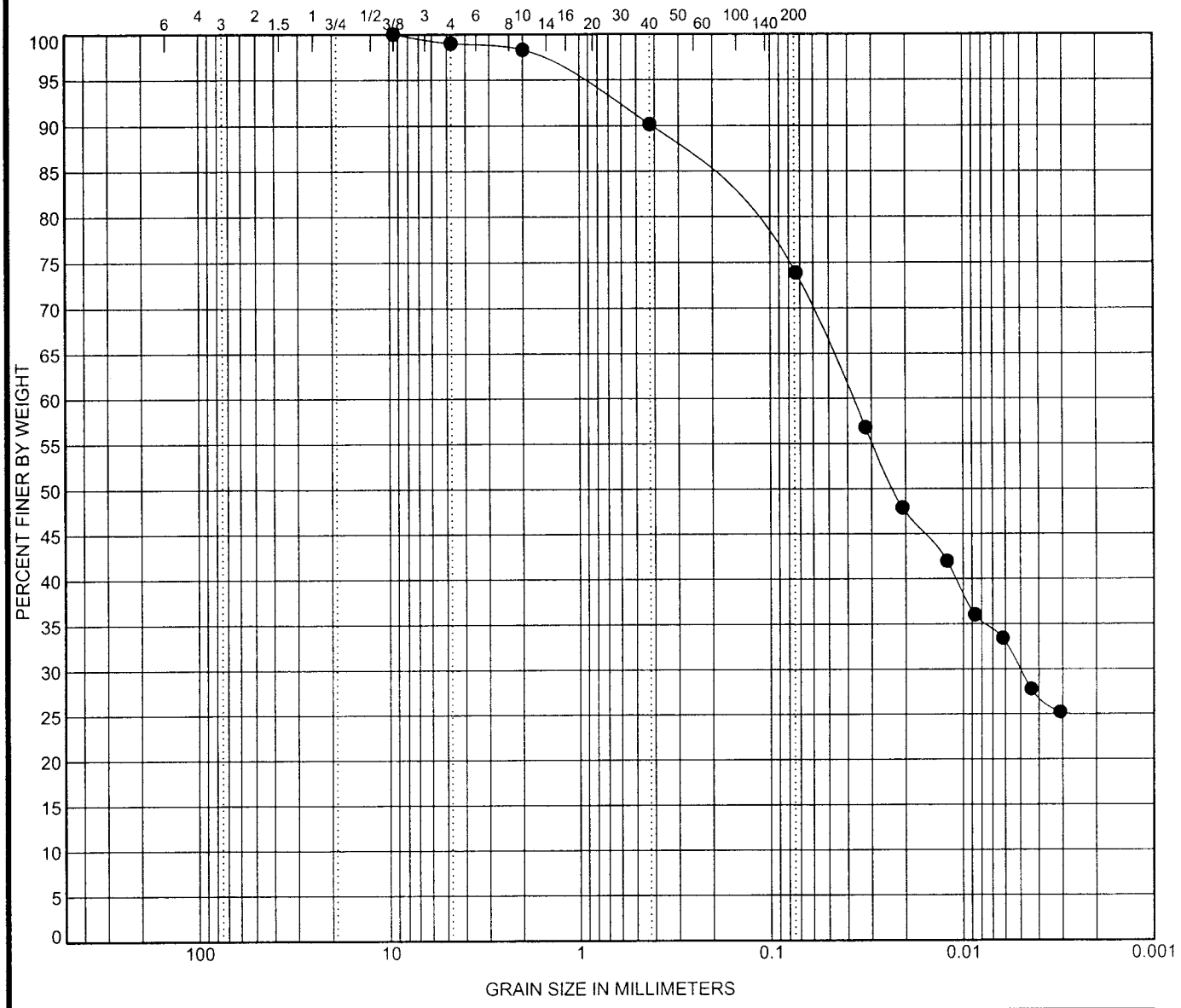

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	RB-4	SS-4	4.5	A-6a (9)	13	28	16	12		
⊠				SILT AND CLAY						
▲				some clay, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	RB-4	SS-4	4.5	9.525	0.038	0.023	0.005		2	8	16	44	30
⊠													
▲													
★													
⊙													

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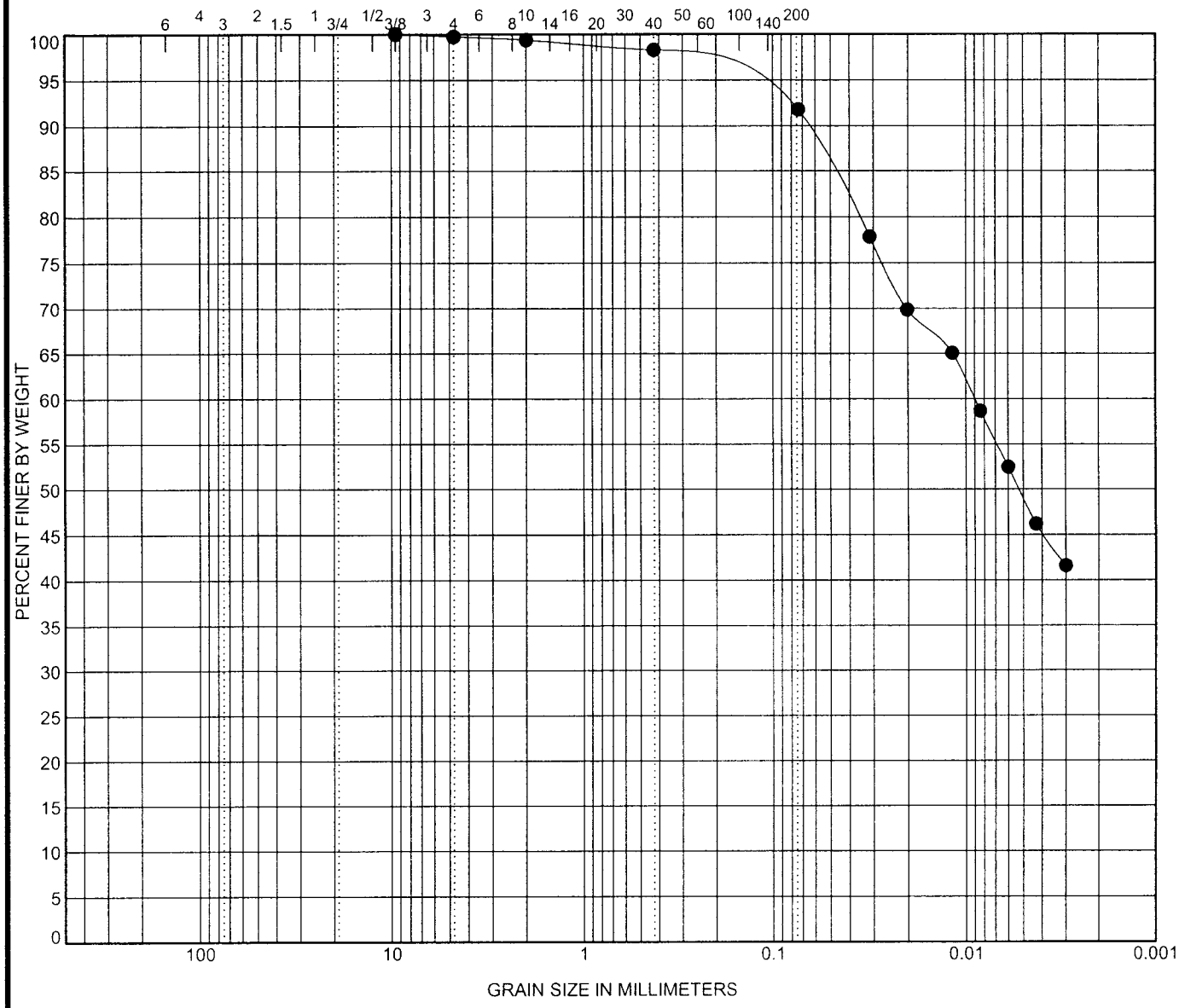

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-1	SS-2	1.5	A-7-6 (17)	24	51	23	28		
⊠				CLAY						
▲				and silt, trace sand, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-1	SS-2	1.5	9.525	0.009	0.005			1	1	6	43	49
⊠													
▲													
★													
⊙													

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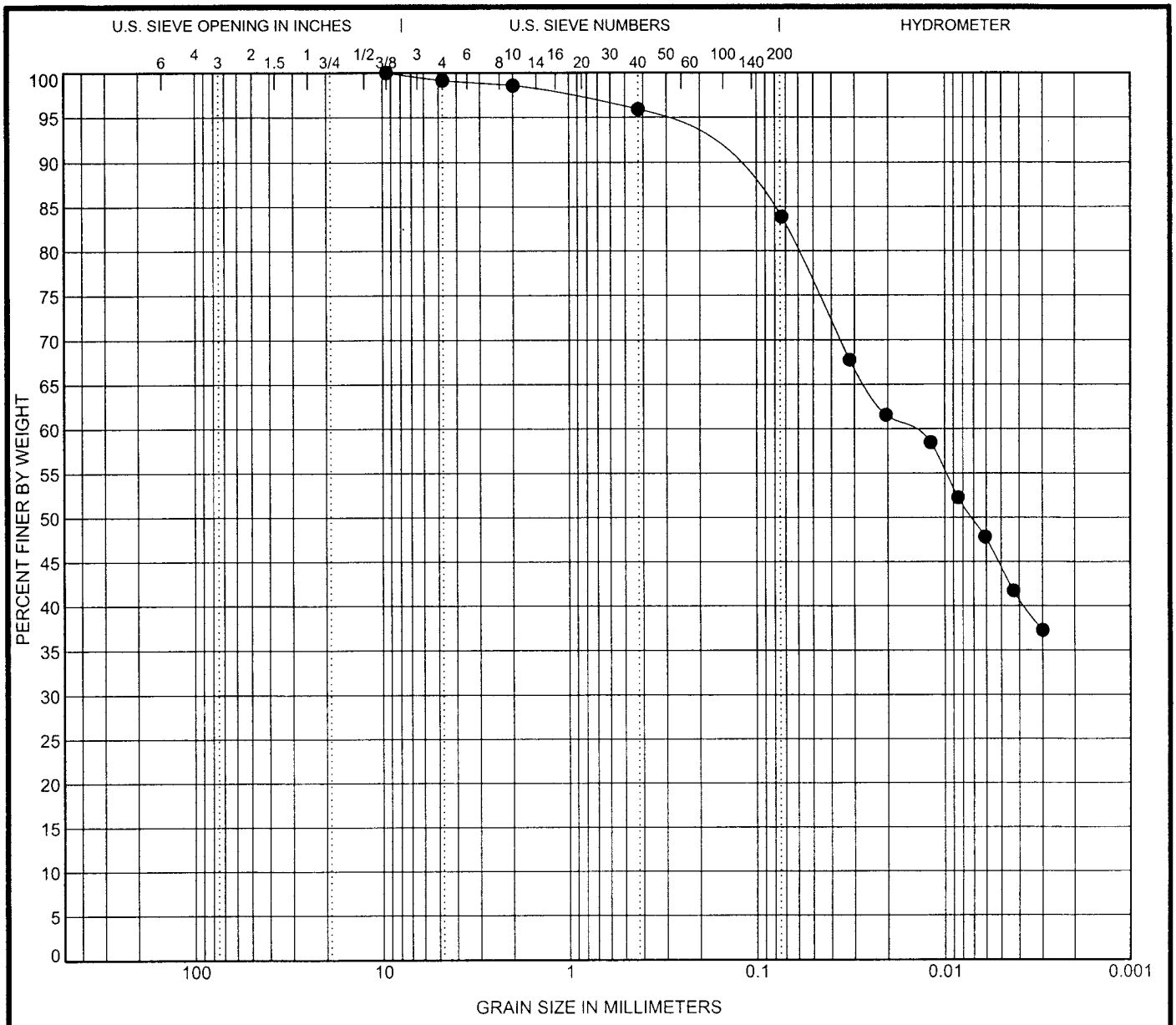

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-1	SS-3	3.0	A-7-6 (13)	24	43	21	22		
⊠				CLAY						
▲				and silt, little sand, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-1	SS-3	3.0	9.525	0.016	0.007			1	3	12	40	44
⊠													
▲													
★													
⊙													

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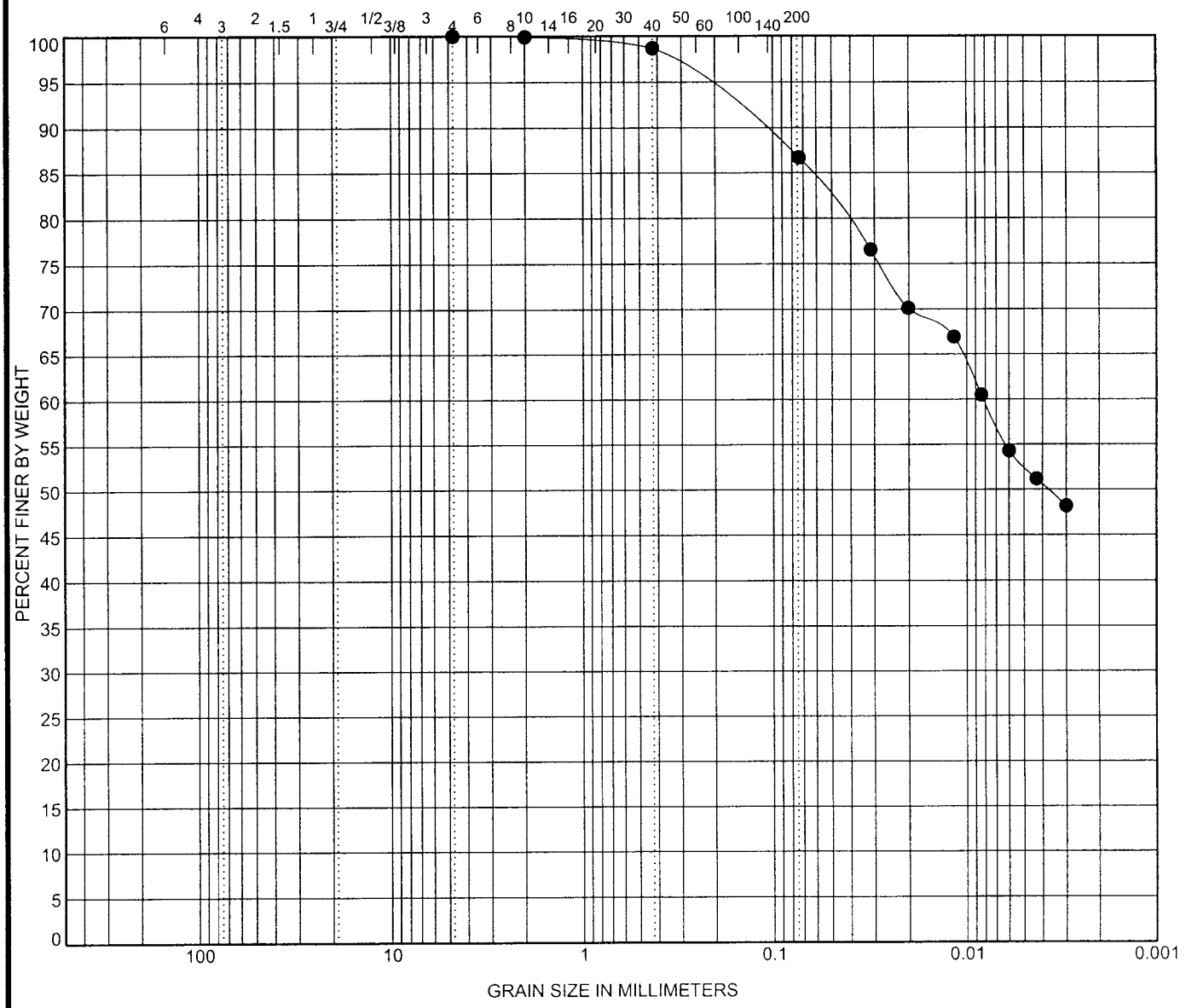

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-2	SS-1	1.0	A-7-6 (20)	25	62	25	37		
⊠				CLAY						
▲				some silt, little sand, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-2	SS-1	1.0	4.75	0.008	0.004			0	1	12	34	53
⊠													
▲													
★													
⊙													

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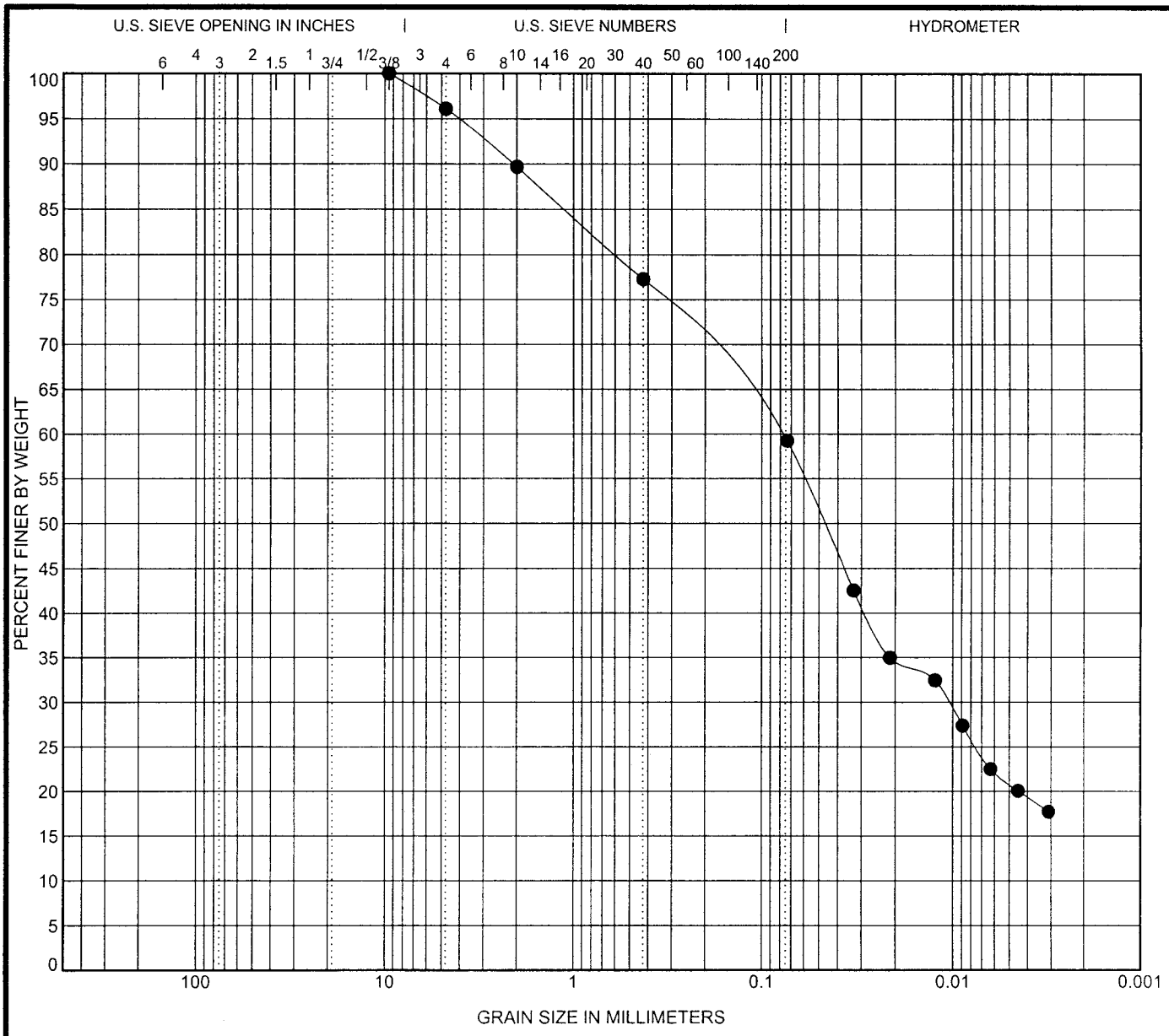
Project: EMH&T
Location: Hayden Run Blvd, Columbus, Ohio
CTL Project Number: 09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-2	SS-4	8.5	A-4a (5)	11	22	14	8		
▣				SANDY SILT						
▲				some clay, little gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-2	SS-4	8.5	9.525	0.079	0.047	0.011		10	12	18	39	21
▣													
▲													
★													
⊙													

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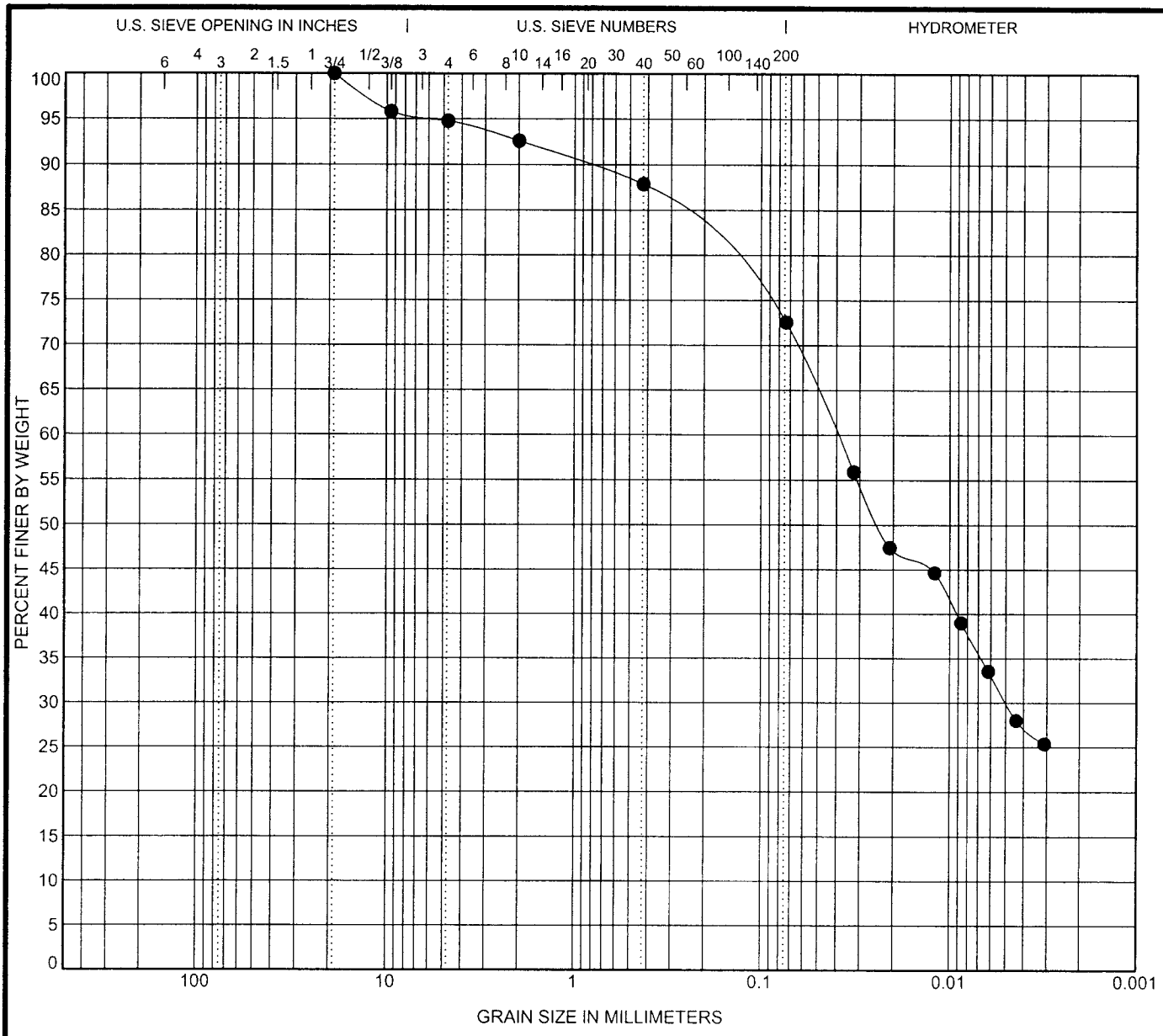

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● SB-2	SS-7	16.0	A-6a (8)	13	25	14	11		
▣			SILT AND CLAY						
▲			little sand, trace gravel, damp						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● SB-2	SS-7	16.0	19	0.04	0.024	0.005		7	5	15	43	30
▣												
▲												
★												
⊙												

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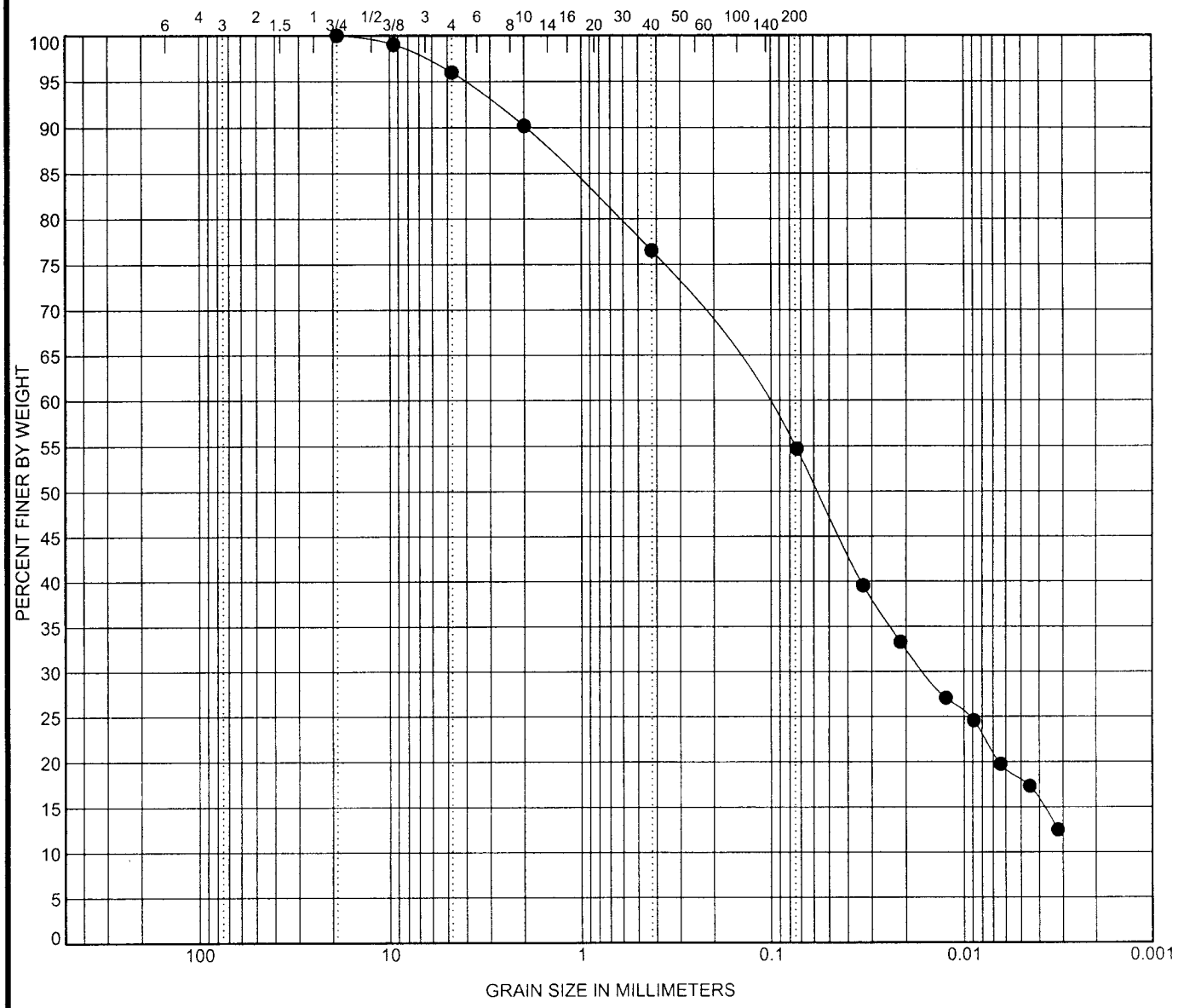

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-2	SS-11	33.5	A-4a (4)	7	19	12	7		
⊠				SANDY SILT						
▲				little clay, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-2	SS-11	33.5	19	0.113	0.058	0.016		10	14	22	36	18
⊠													
▲													
★													
⊙													

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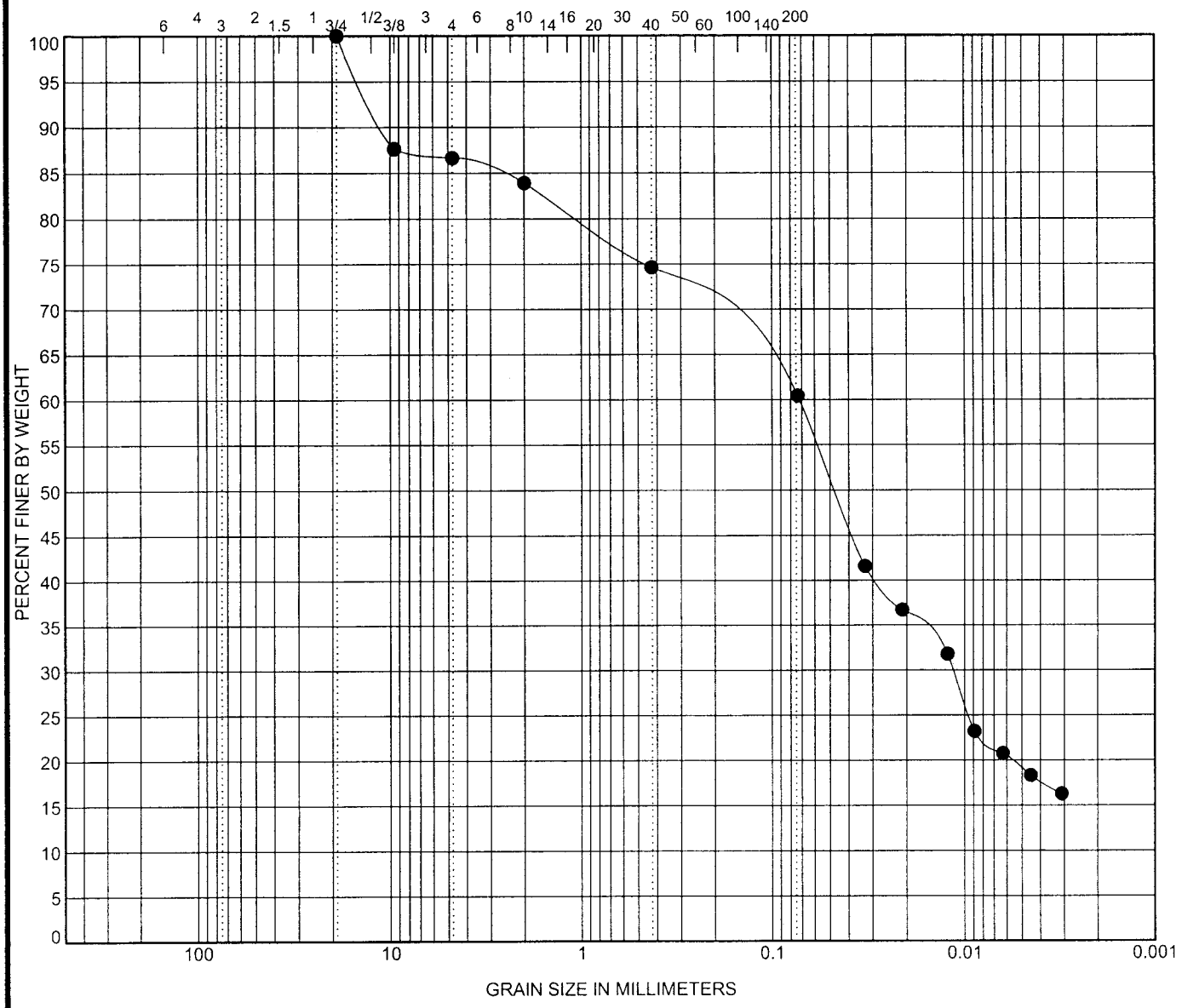
ODOT SAMPLE CTL OH DOT.GDT 04050070CIN.GLB 09050029COL.GPJ 4/29/09



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● SB-3	SS-2	1.5	A-6a (6)	21	30	18	12		
▣			SILT AND CLAY						
▲			some sand, little gravel, moist						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● SB-3	SS-2	1.5	19	0.072	0.047	0.011		16	9	14	42	19
▣												
▲												
★												
⊙												

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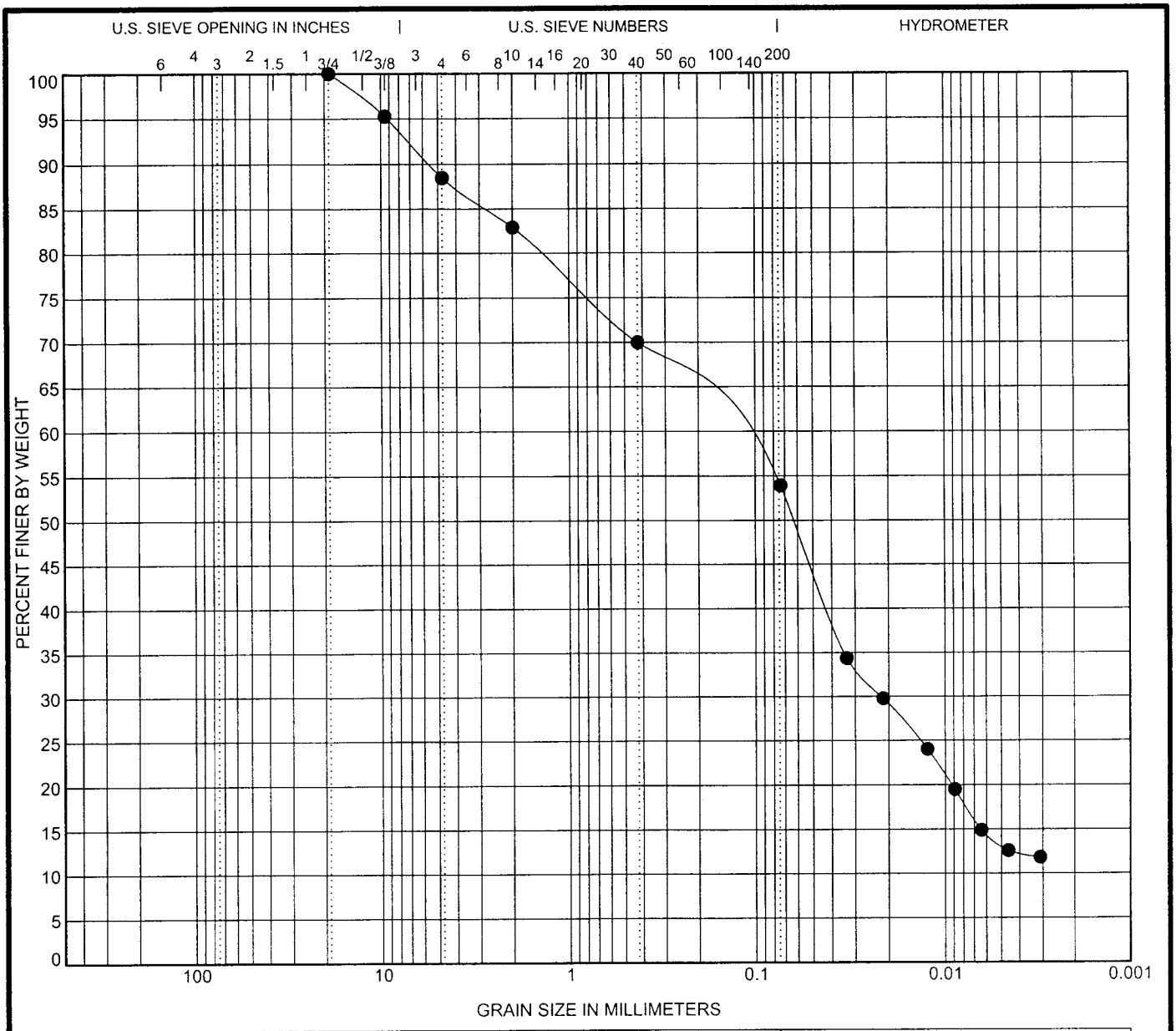

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● SB-3	SS-6	8.5	A-4a (4)	11	22	15	7		
⊠			SANDY SILT						
▲			little gravel little clay, damp						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● SB-3	SS-6	8.5	19	0.143	0.063	0.022		17	13	16	41	13
⊠												
▲												
★												
⊙												

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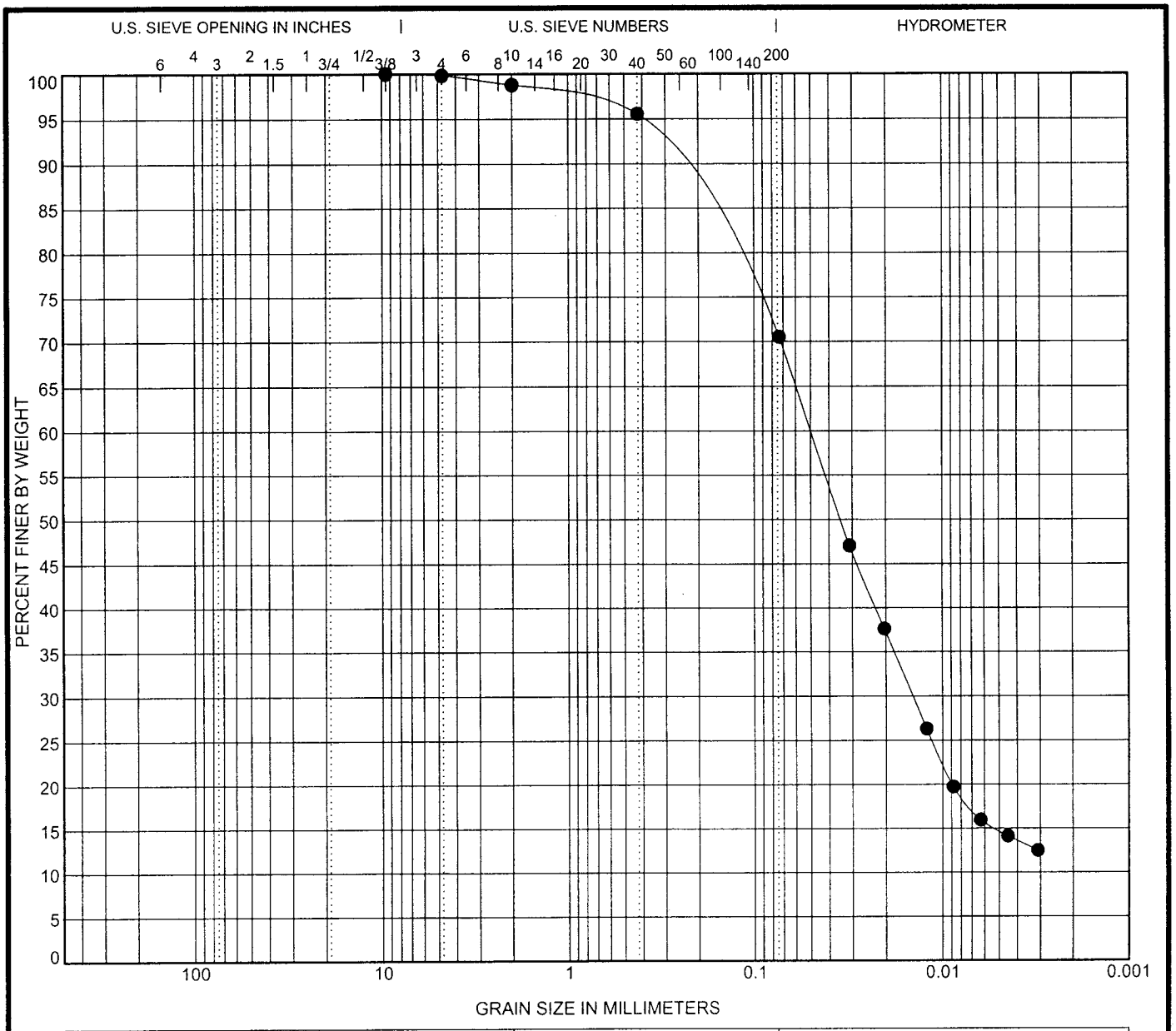

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● SB-3	SS-9	16.0	A-4b (7)	12	18	14	4		
⊠			SILT						
▲			some sand, little clay, trace gravel, damp						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● SB-3	SS-9	16.0	9.525	0.05	0.035	0.014		1	3	25	56	15
⊠												
▲												
★												
⊙												

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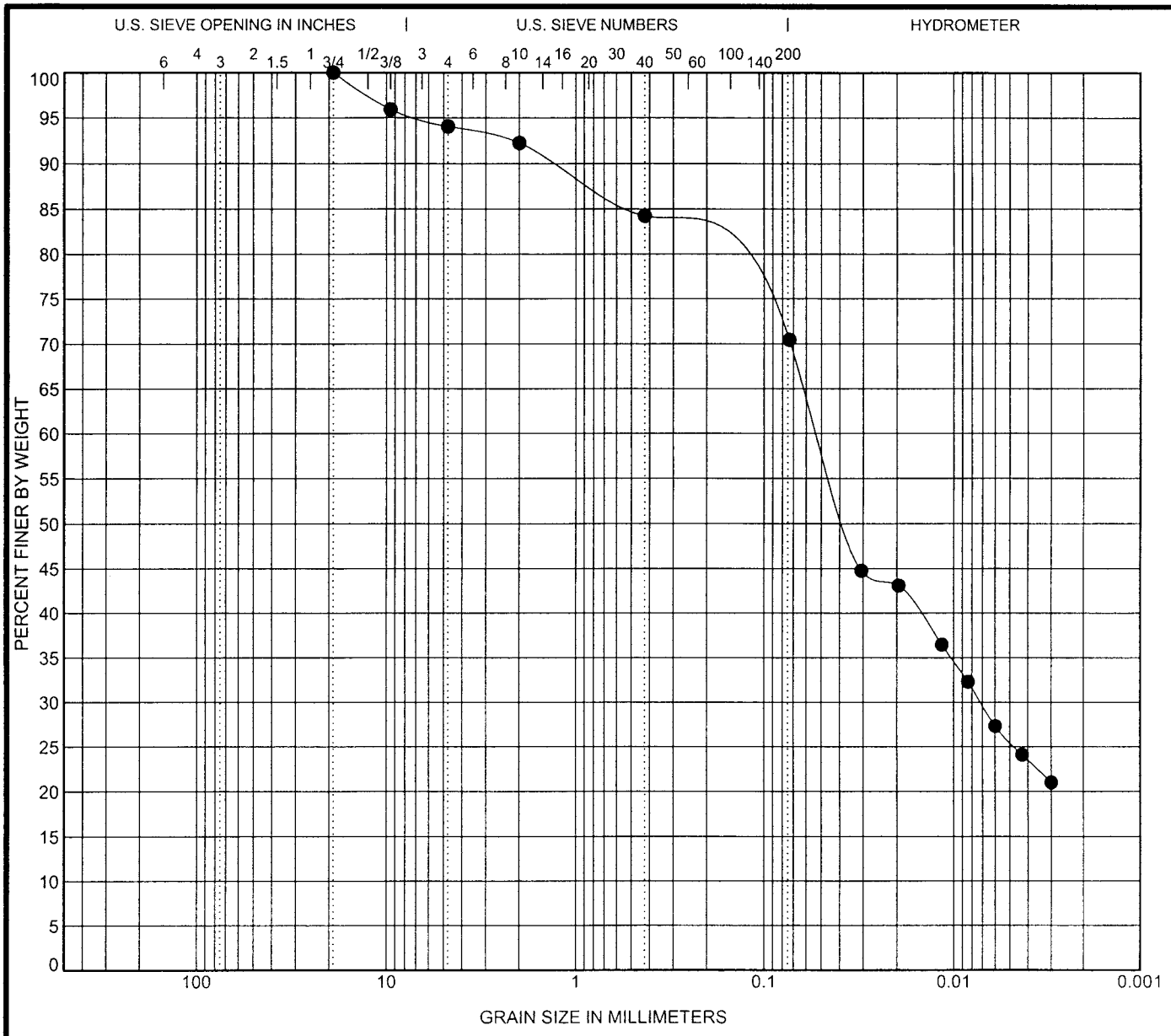

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-3	SS-12	28.5	A-6a (8)	11	30	18	12		
⊠				SILT AND CLAY						
▲				some sand, trace gravel, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-3	SS-12	28.5	19	0.052	0.037	0.007		8	8	14	44	26
⊠													
▲													
★													
⊙													

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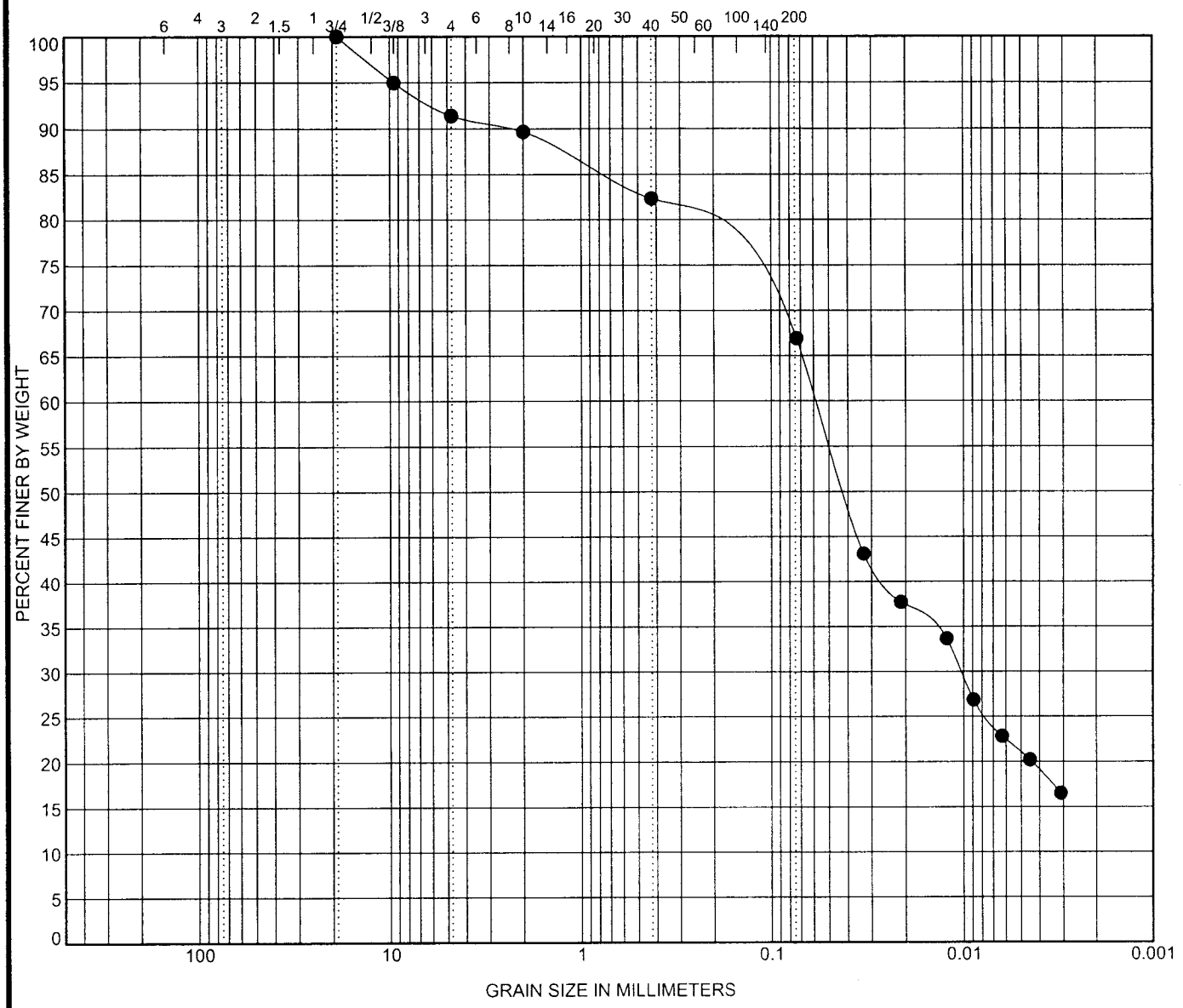

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● SB-4	SS-2	1.5	A-4a (6)		26	17	9		
▣			SANDY SILT						
▲			some clay, little gravel, moist						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● SB-4	SS-2	1.5	19	0.058	0.042	0.01		10	7	15	47	21
▣												
▲												
★												
⊙												

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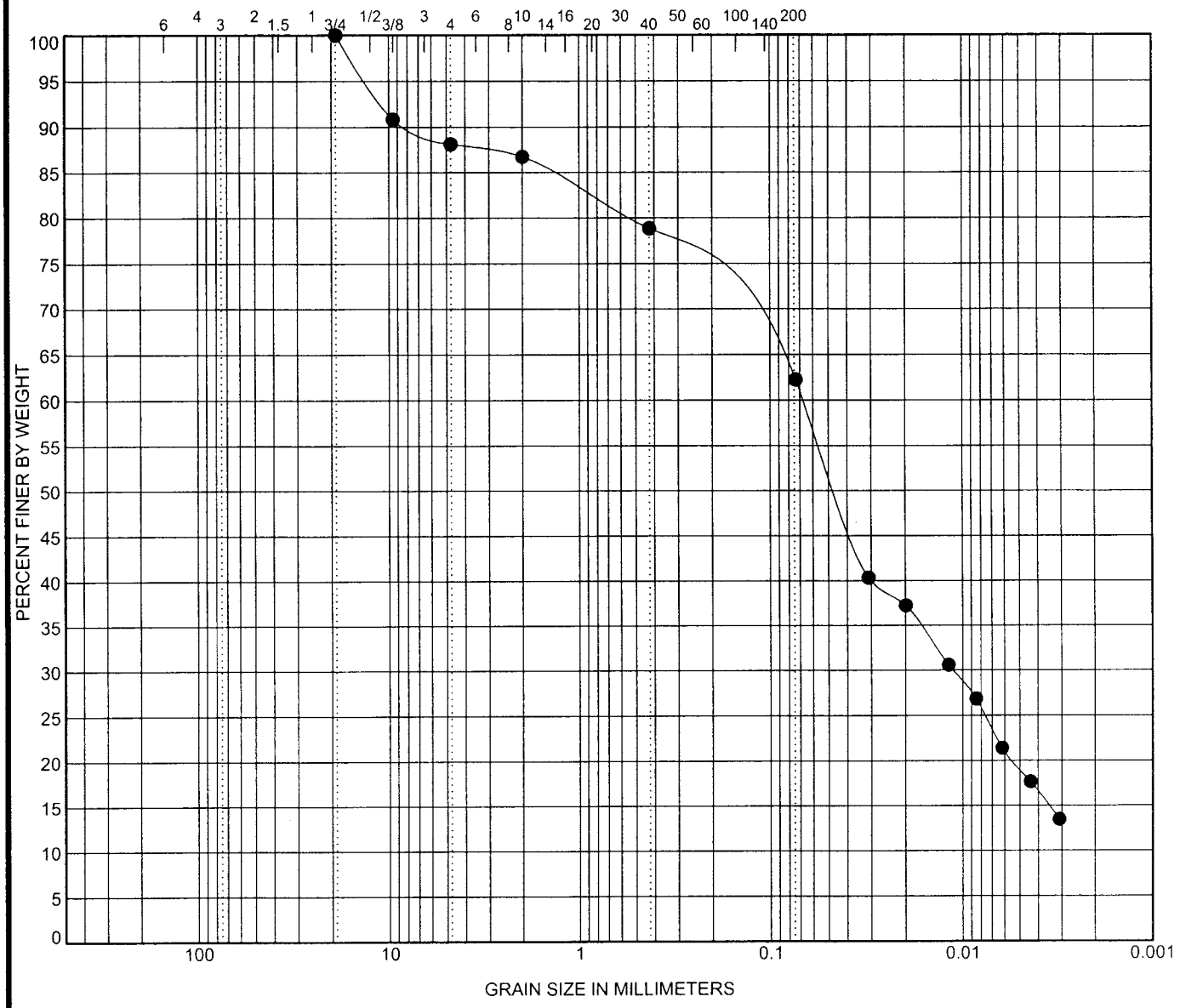

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-4	SS-3	3.0	A-4a (5)		23	16	7		
⊠				SANDY SILT						
▲				little gravel, little clay, damp						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-4	SS-3	3.0	19	0.067	0.045	0.011		13	8	17	43	19
⊠													
▲													
★													
⊙													

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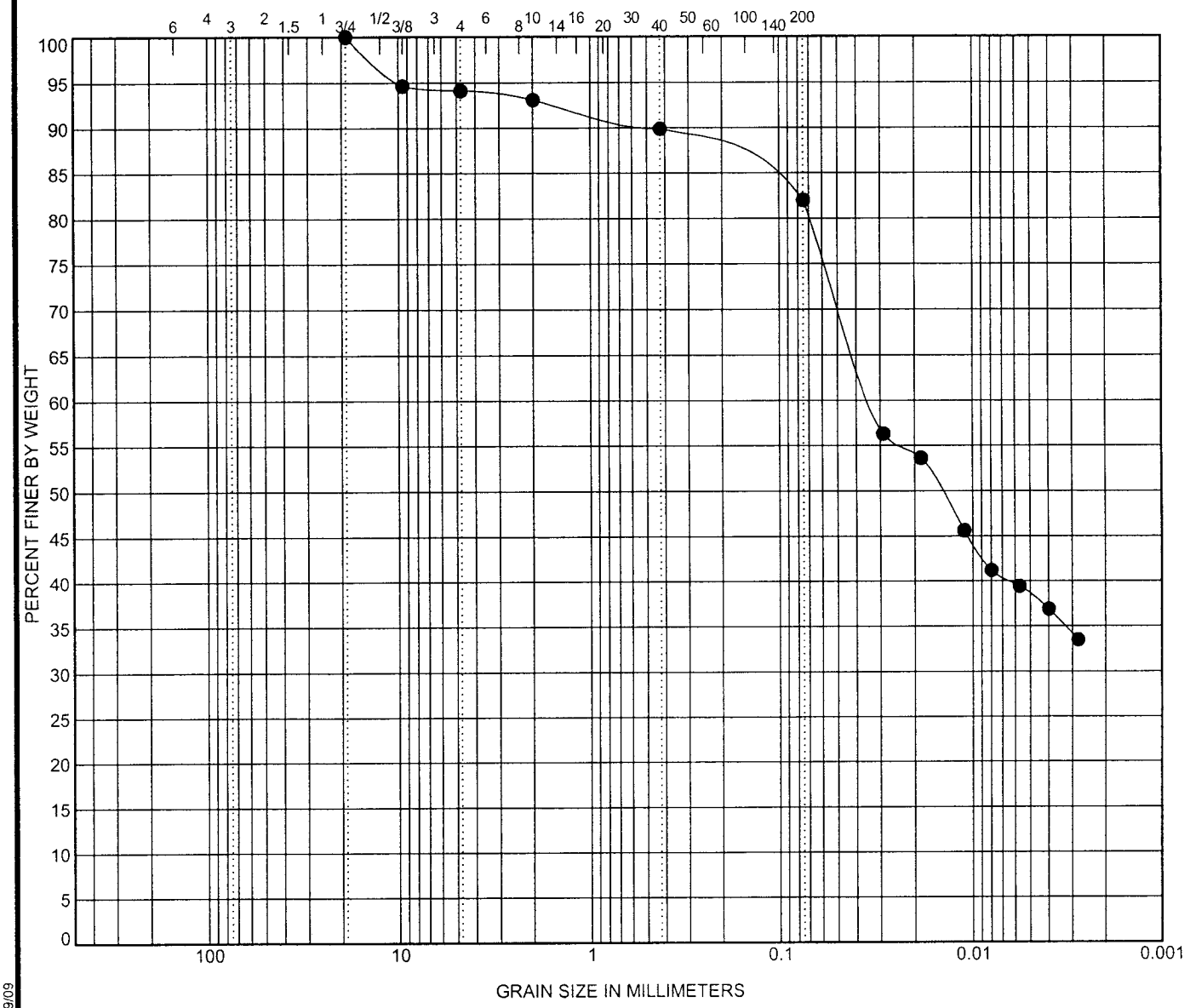

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-5	2	2.0	A-7-6(18)	26	51	22	29		
⊠				CLAY						
▲				trace gravel						
★				moist						
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-5	2	2.0	19	0.033	0.015			7	3	8	44	38
⊠													
▲													
★													
⊙													

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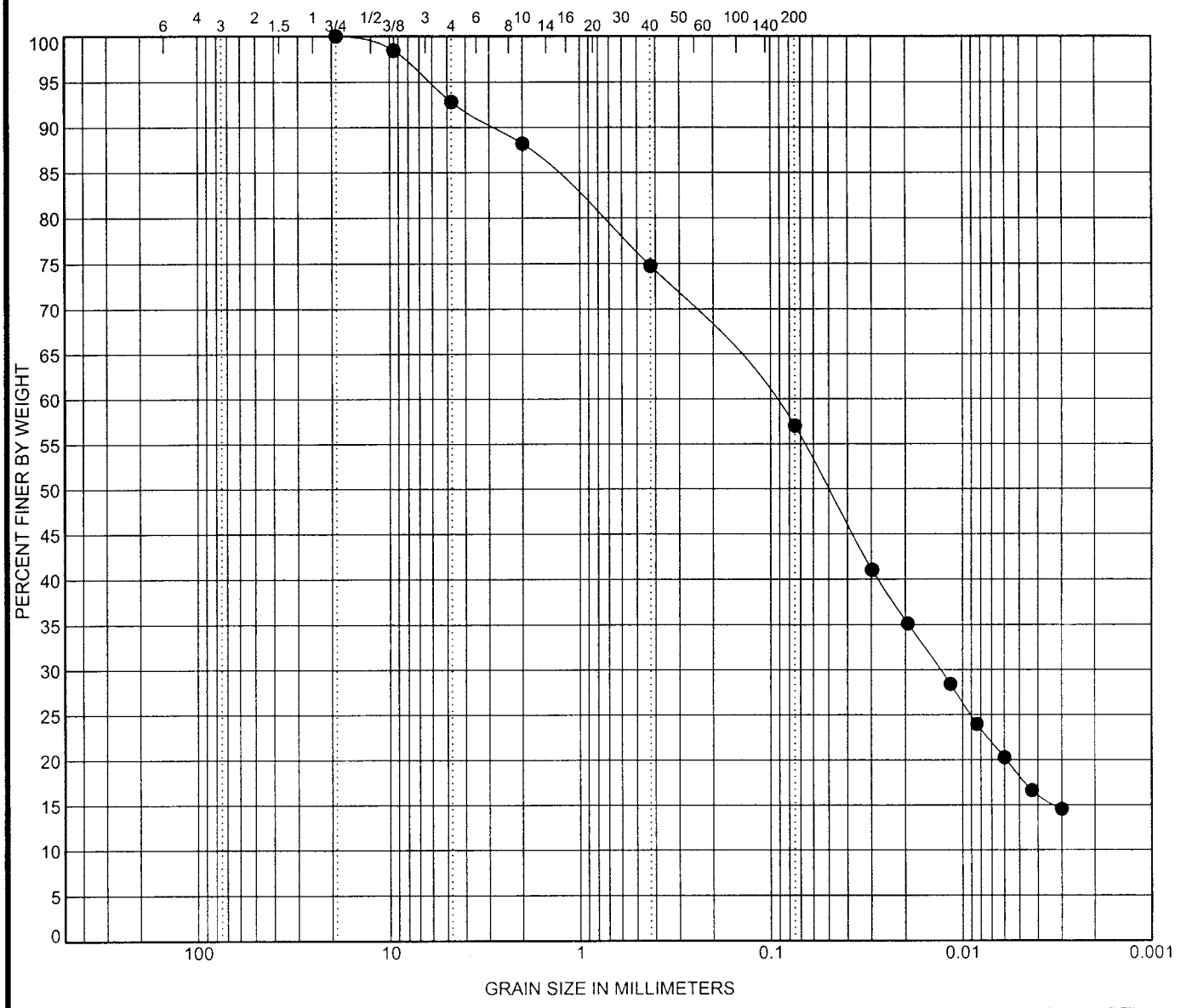

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-5	SS-4	5.0	A-4a(4)	10	20	14	6		
⊠				SANDY SILT						
▲				little clay, little gravel						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-5	SS-4	5.0	19	0.101	0.05	0.013		12	13			18
⊠													
▲													
★													
⊙													

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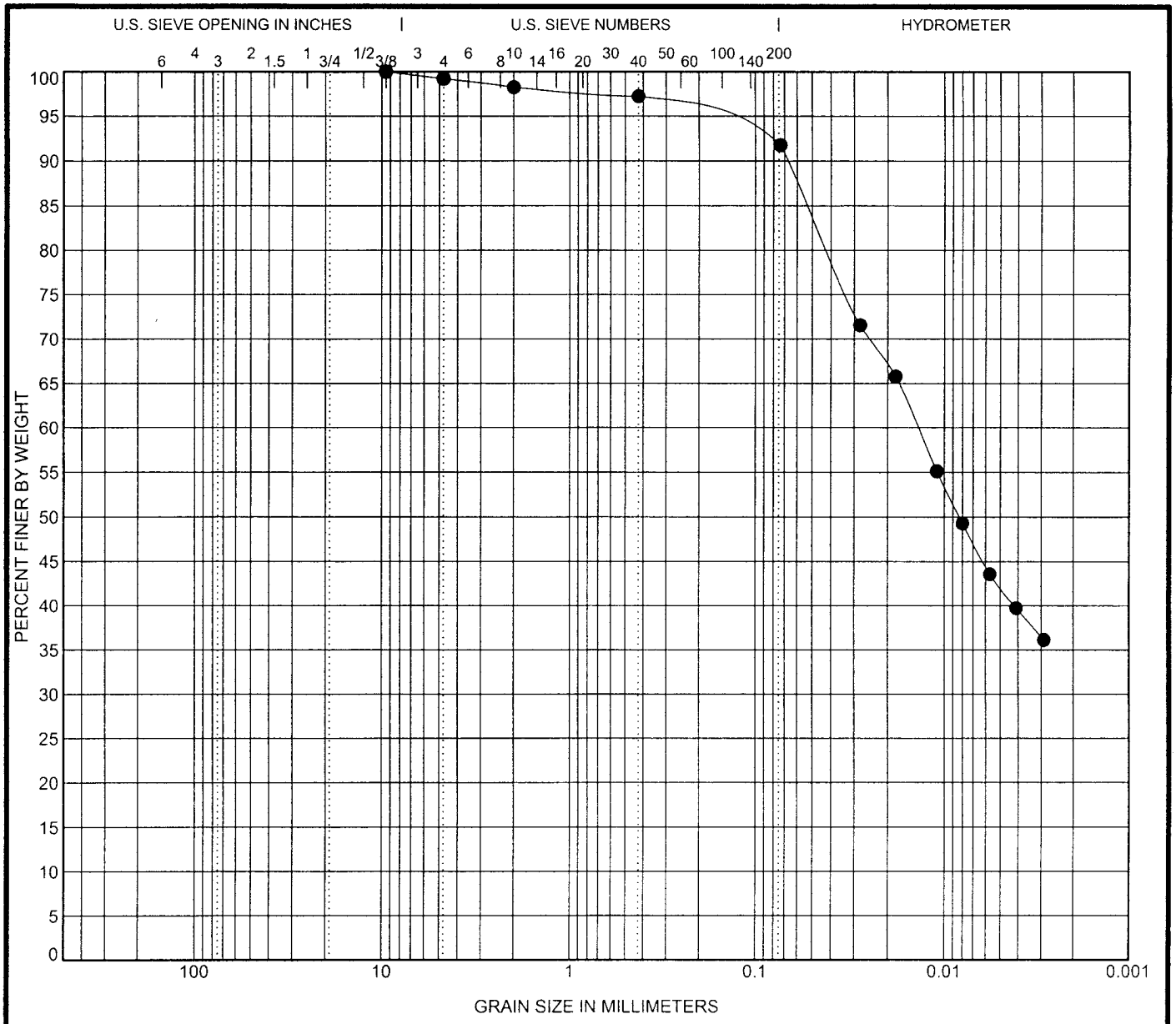

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● SB-6	SS-1	1.0	A-7-6 (17)	27	49	22	27		
⊠			CLAY						
▲			and silt, trace sand, trace gravel, moist						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● SB-6	SS-1	1.0	9.525	0.014	0.008			2	1	5	50	42
⊠												
▲												
★												
⊙												

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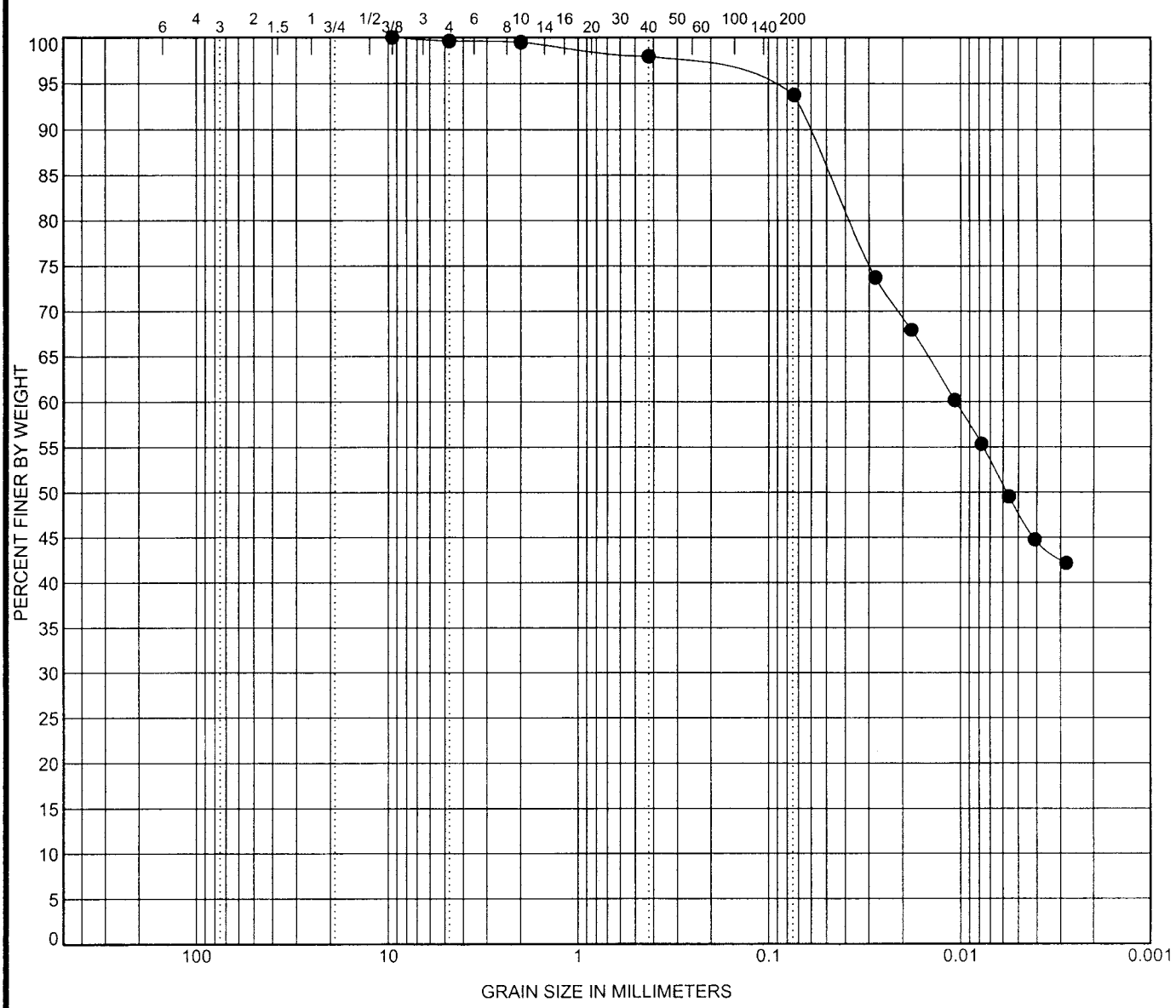

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● SB-6	SS-2	2.5	A-7-6 (16)	19	49	24	25		
⊠			CLAY						
▲			and silt, trace sand, trace gravel, moist						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● SB-6	SS-2	2.5	9.525	0.011	0.006			1	2	4	45	48
⊠												
▲												
★												
⊙												

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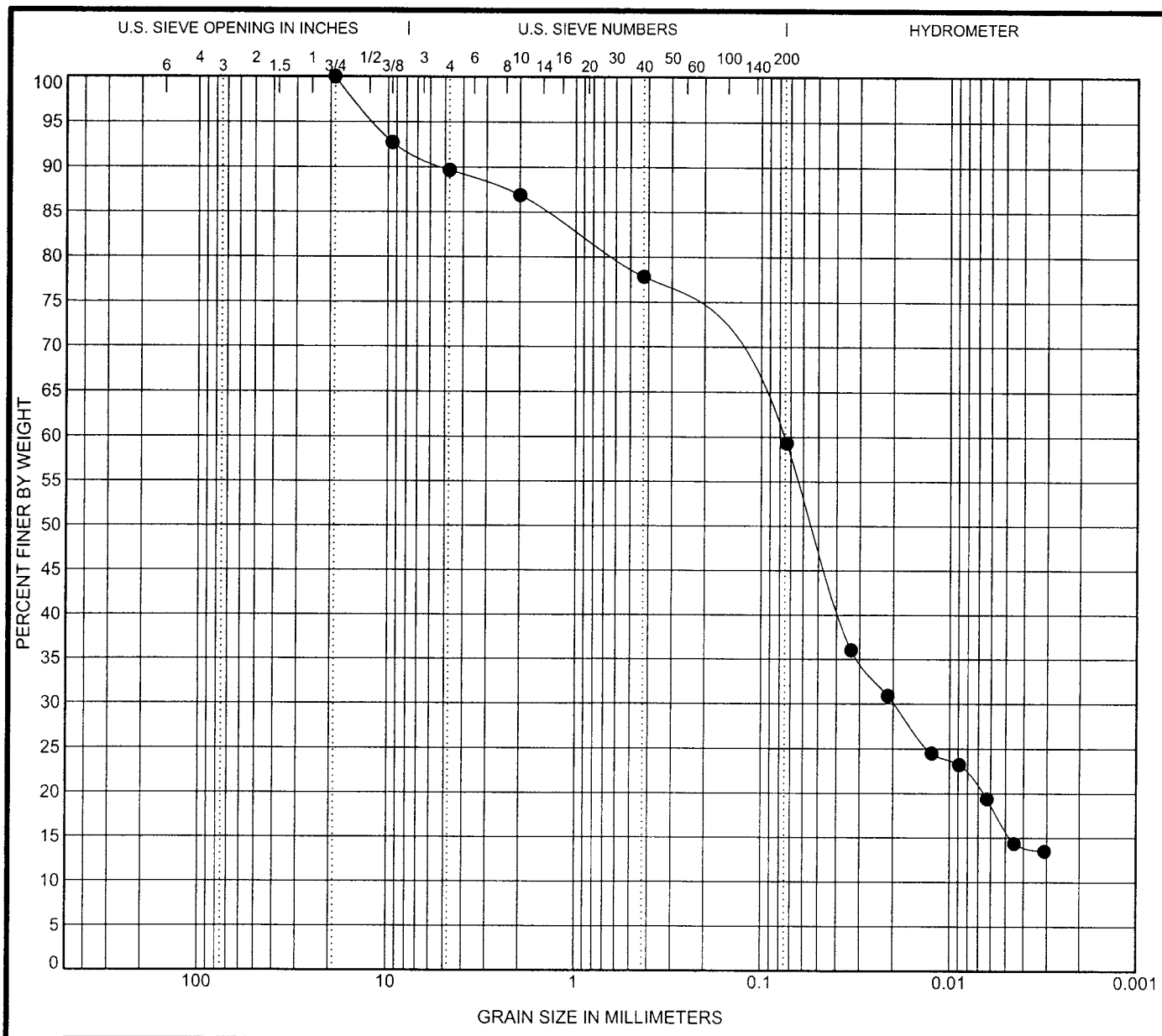

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-6	SS-4	5.5	A-4a (5)	10	23	15	8		
⊠				SANDY SILT						
▲				little clay, little gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-6	SS-4	5.5	19	0.079	0.054	0.02		13	9	19	43	16
⊠													
▲													
★													
⊙													

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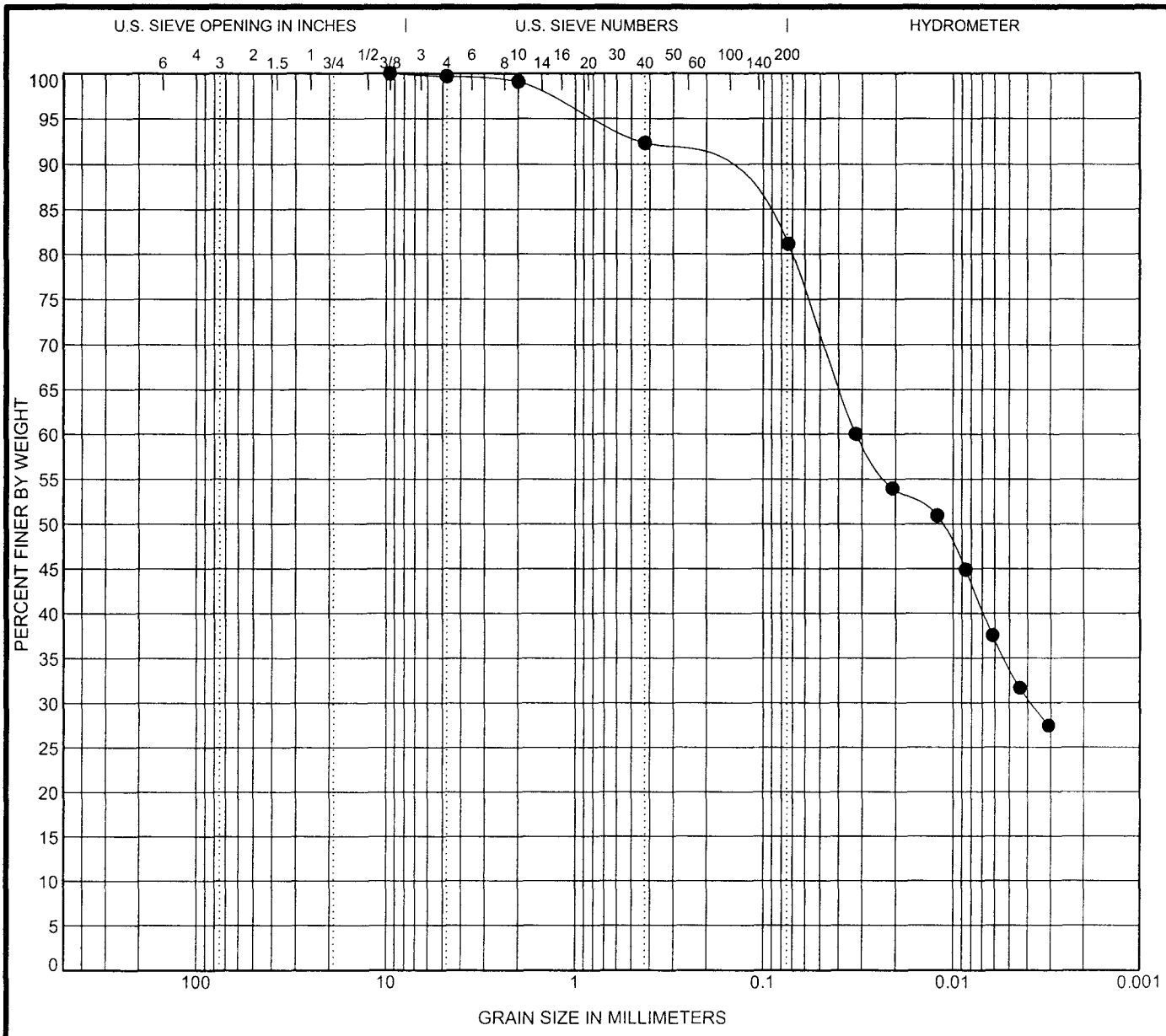

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
● SB-7	SS-1	1.0	A-7-5 (16)	32	55	32	23		
⊠			ELASTIC CLAY						
▲			and silt, little sand, trace gravel, moist						
★									
⊙									

Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
● SB-7	SS-1	1.0	9.525	0.032	0.011	0.004		1	7	11	47	34
⊠												
▲												
★												
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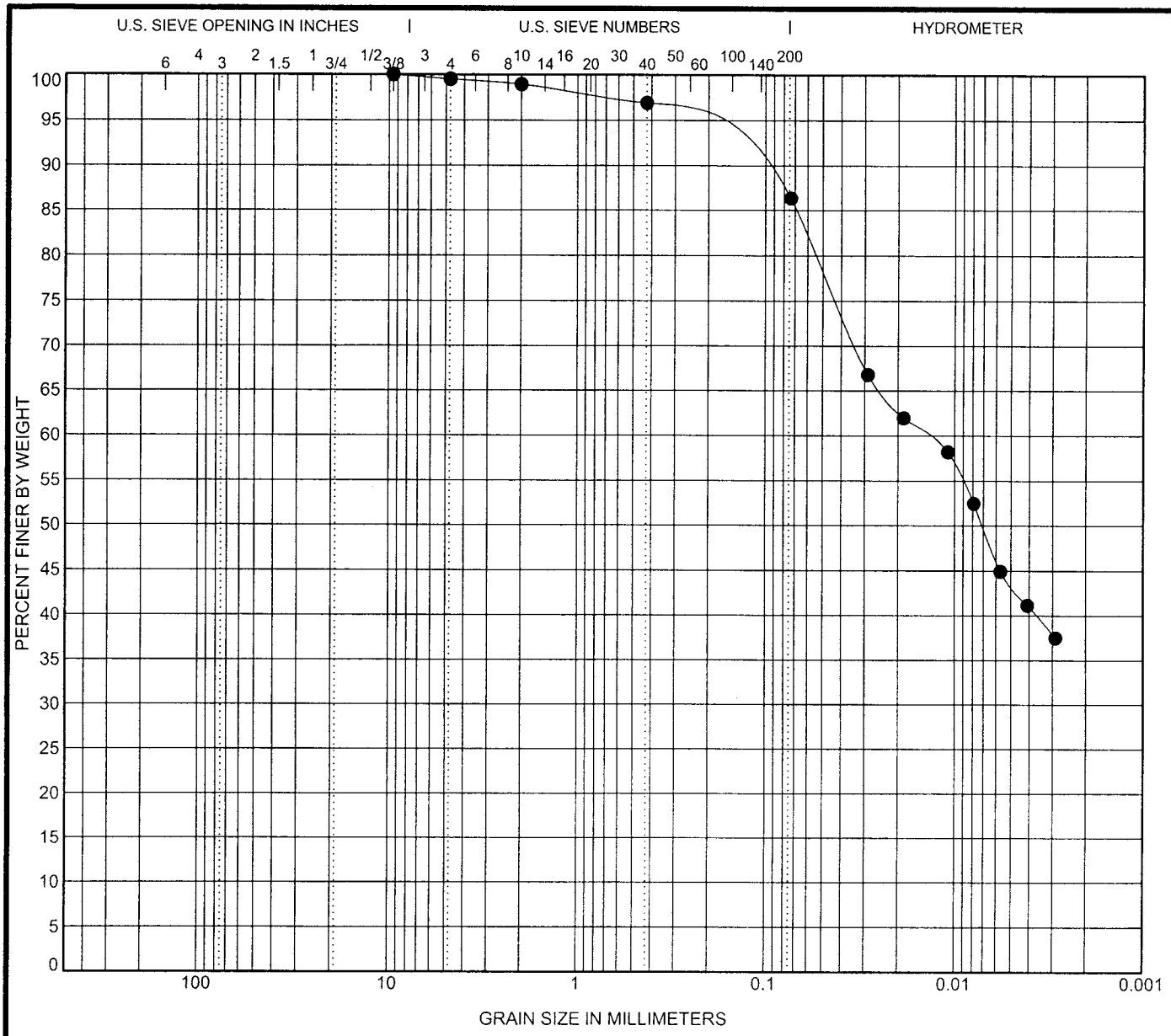

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-7	SS-2	2.5	A-7-6 (14)	25	46	23	23		
⊠				CLAY						
▲				and silt, trace sand, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-7	SS-2	2.5	9.525	0.014	0.007			1	2	11	43	43
⊠													
▲													
★													
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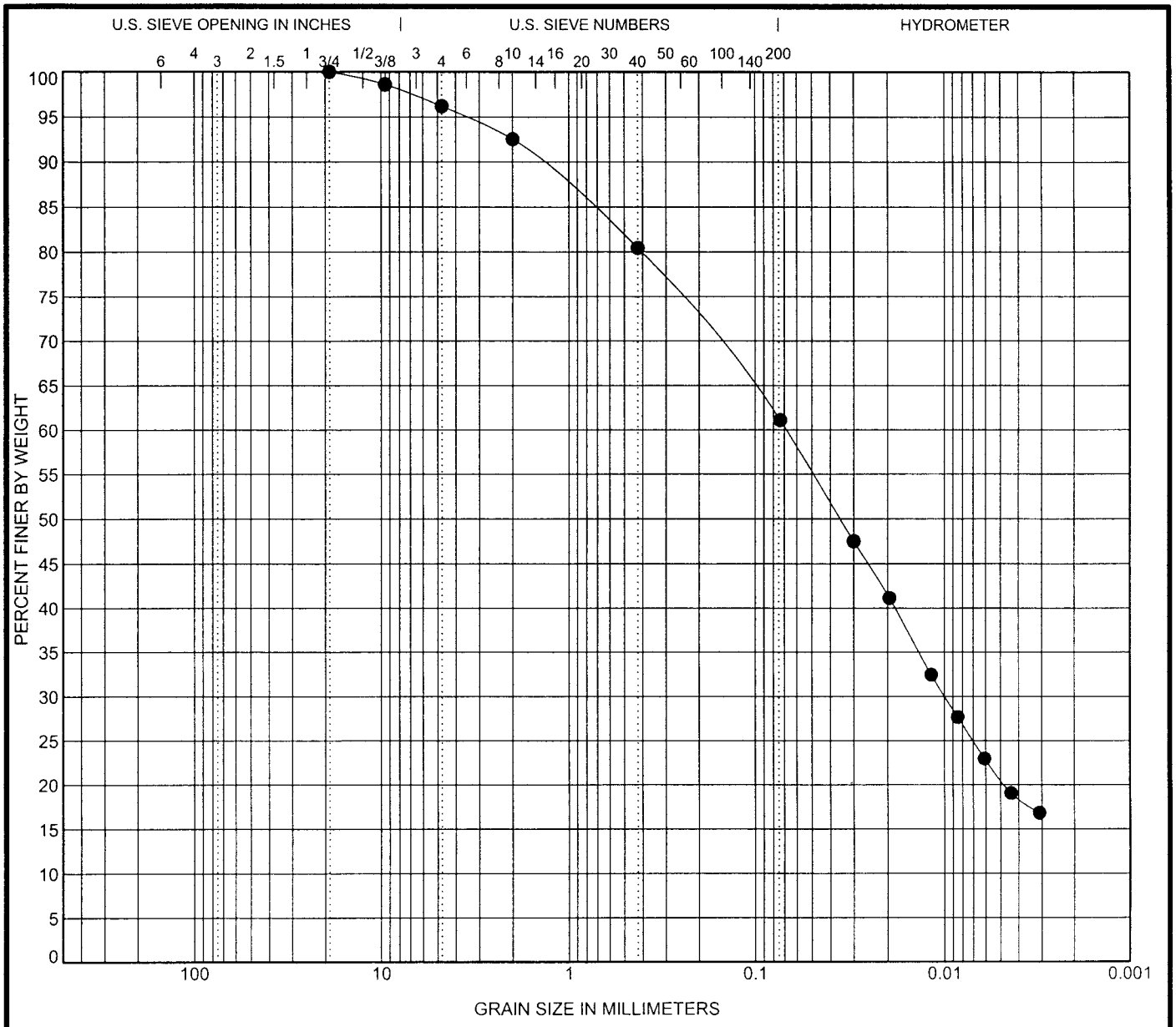

COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-7	SS-3	4.0	A-4a (5)	13	21	15	6		
⊠				SANDY SILT						
▲				some clay, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-7	SS-3	4.0	19	0.068	0.035	0.01		7	12	19	41	21
⊠													
▲													
★													
⊙													

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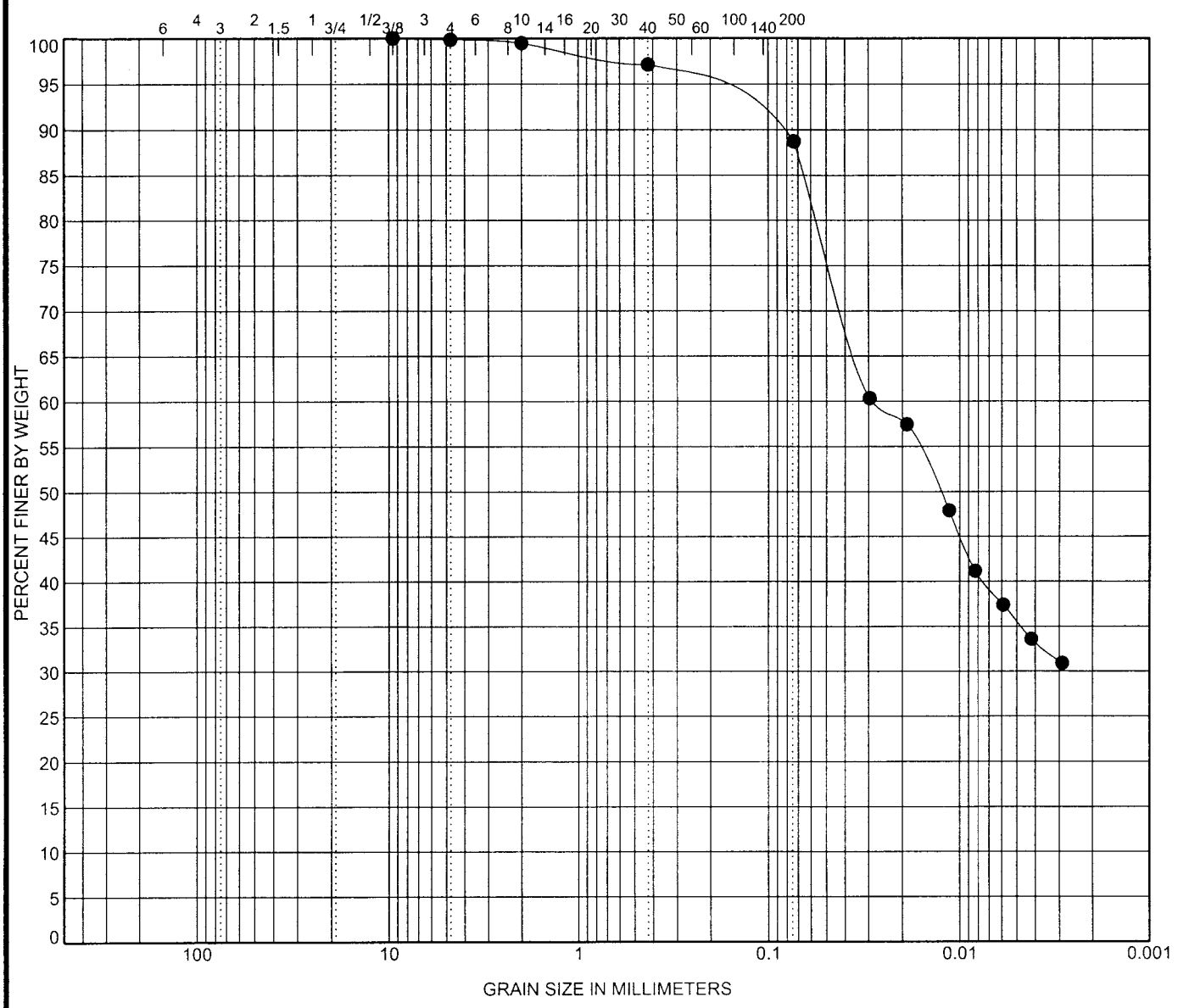
Location: Hayden Run Blvd, Columbus, Ohio
CTL Project Number: 09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

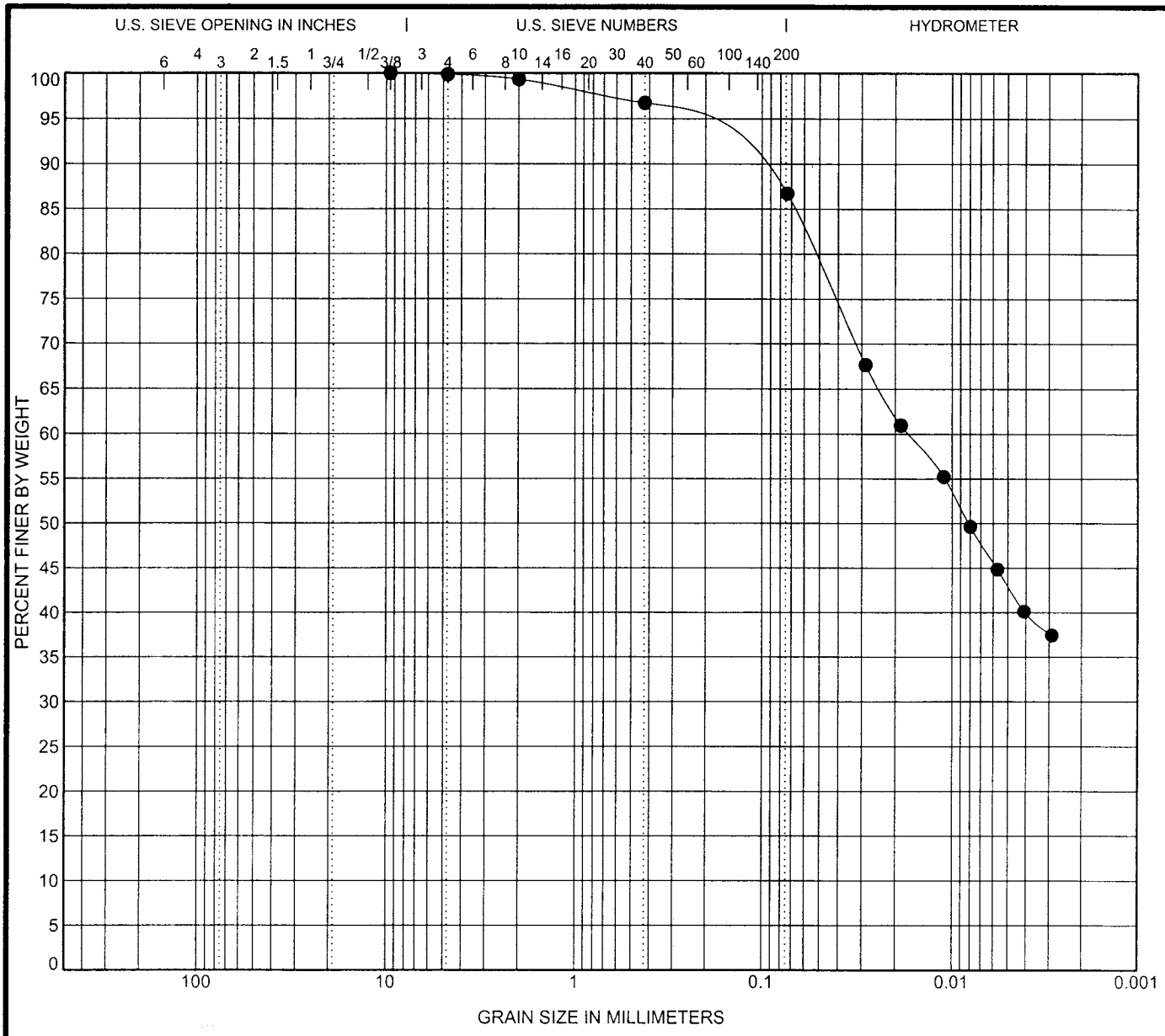
	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-8	SS-1	1.0	A-7-6 (14)	27	44	21	23		
⊠				CLAY						
▲				and silt, trace sand, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-8	SS-1	1.0	9.525	0.028	0.013			1	2	8	53	36
⊠													
▲													
★													
⊙													

CTL Engineering, Inc.
2860 Fisher Rd.
Columbus, Ohio 43204
Telephone: 614-276-8123
Fax: 614-276-6377

GRAIN SIZE DISTRIBUTION

Project: EMH&T
Location: Hayden Run Blvd, Columbus, Ohio
CTL Project Number: 09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-8	SS-2	2.5	A-7-6 (16)	24	48	23	25		
⊠				CLAY						
▲				and silt, little sand, trace gravel, moist						
★										
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-8	SS-2	2.5	9.525	0.017	0.008			1	3	10	43	43
⊠													
▲													
★													
⊙													

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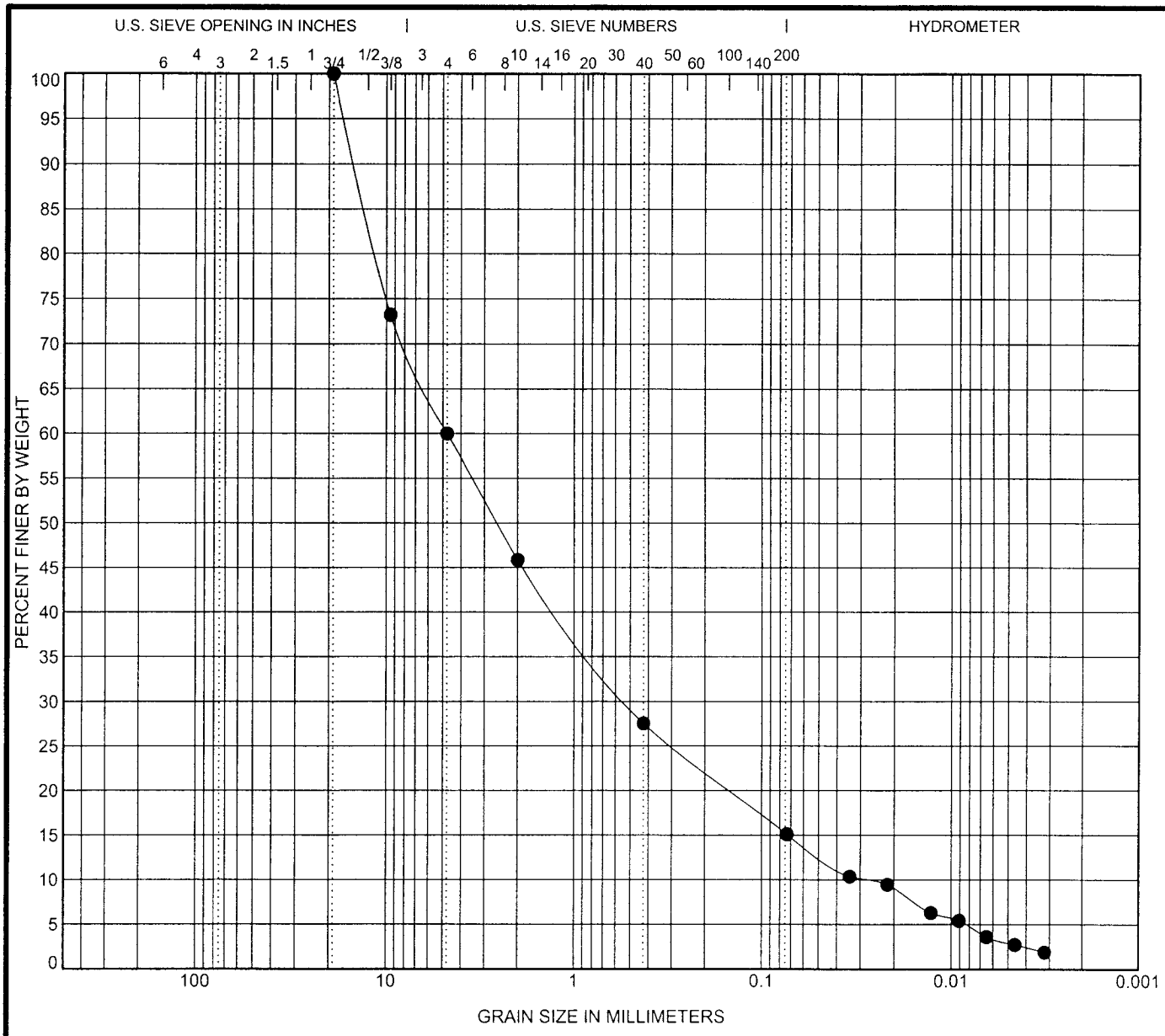
GRAIN SIZE DISTRIBUTION

Project: EMH&T
Location: Hayden Run Blvd, Columbus, Ohio
CTL Project Number: 09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-9	SS-1	0.0	VIS.	9				2.03	166.99
⊠				GRAVEL AND/OR STONE FRAGMENTS						
▲				WITH SAND						
★				wet						
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-9	SS-1	0.0	19	4.754	2.577	0.524	0.028	54	18	12	13	3
⊠													
▲													
★													
⊙													

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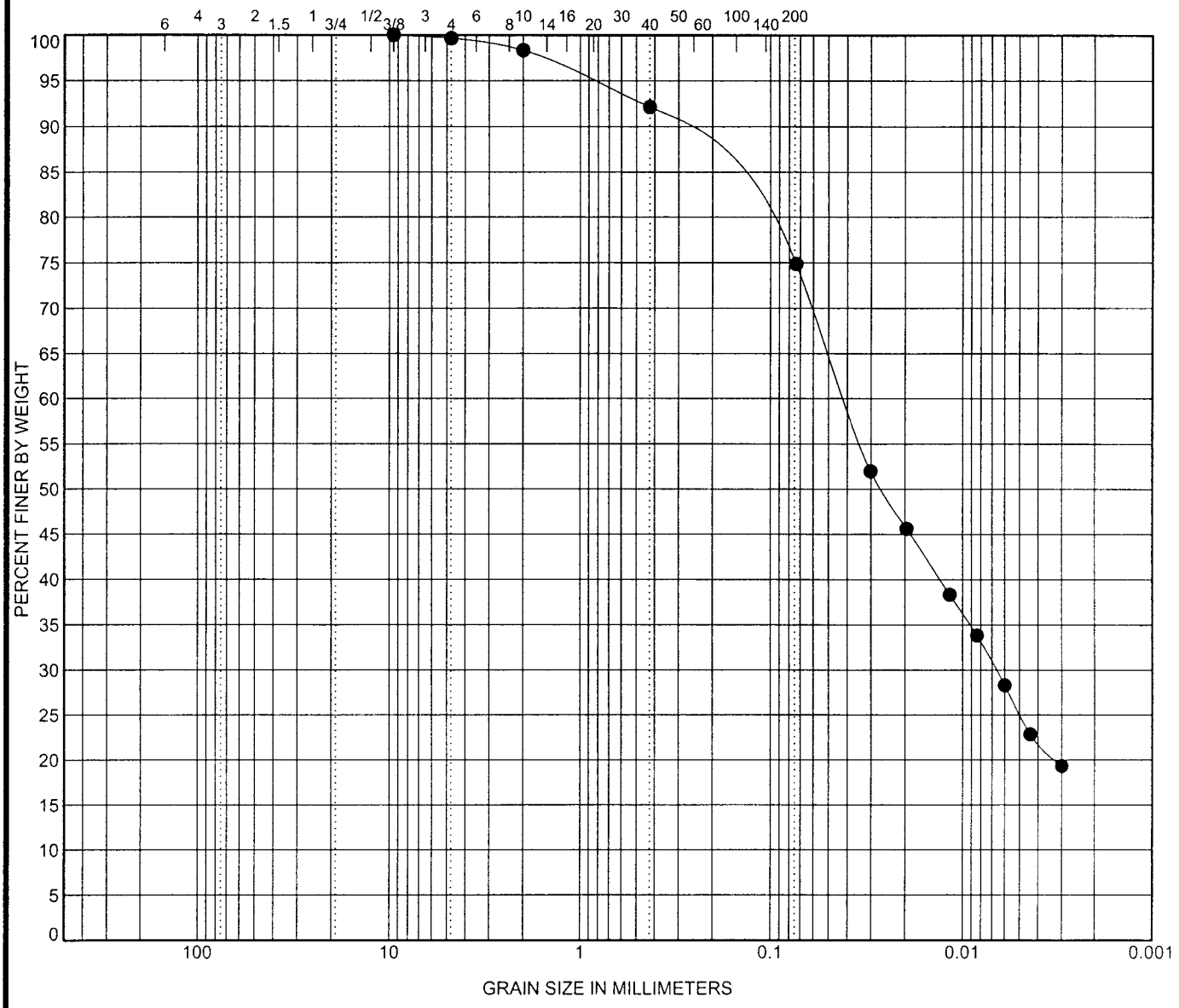
GRAIN SIZE DISTRIBUTION

Project: EMH&T
Location: Hayden Run Blvd, Columbus, Ohio
CTL Project Number: 09050029COL



COBBLES	GRAVEL		SAND		SILT OR CLAY
	coarse	fine	coarse	fine	

	Boring No.	Sample	Depth	Classification	%MC	LL	PL	PI	Cc	Cu
●	SB-9	SS-5	6.5	A-4a (8)	16	25	17	8		
⊠				SILT						
▲				some clay, some sand, trace gravel						
★				moist						
⊙										

	Boring No.	Sample	Depth	D100	D60	D50	D30	D10	%Gravel	%Coarse Sand	%Fine Sand	%Silt	%Clay
●	SB-9	SS-5	6.5	9.525	0.041	0.026	0.007		2	6	17	50	25
⊠													
▲													
★													
⊙													

CTL Engineering, Inc.
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Columbus, Ohio 43204
Telephone: 614-276-8123
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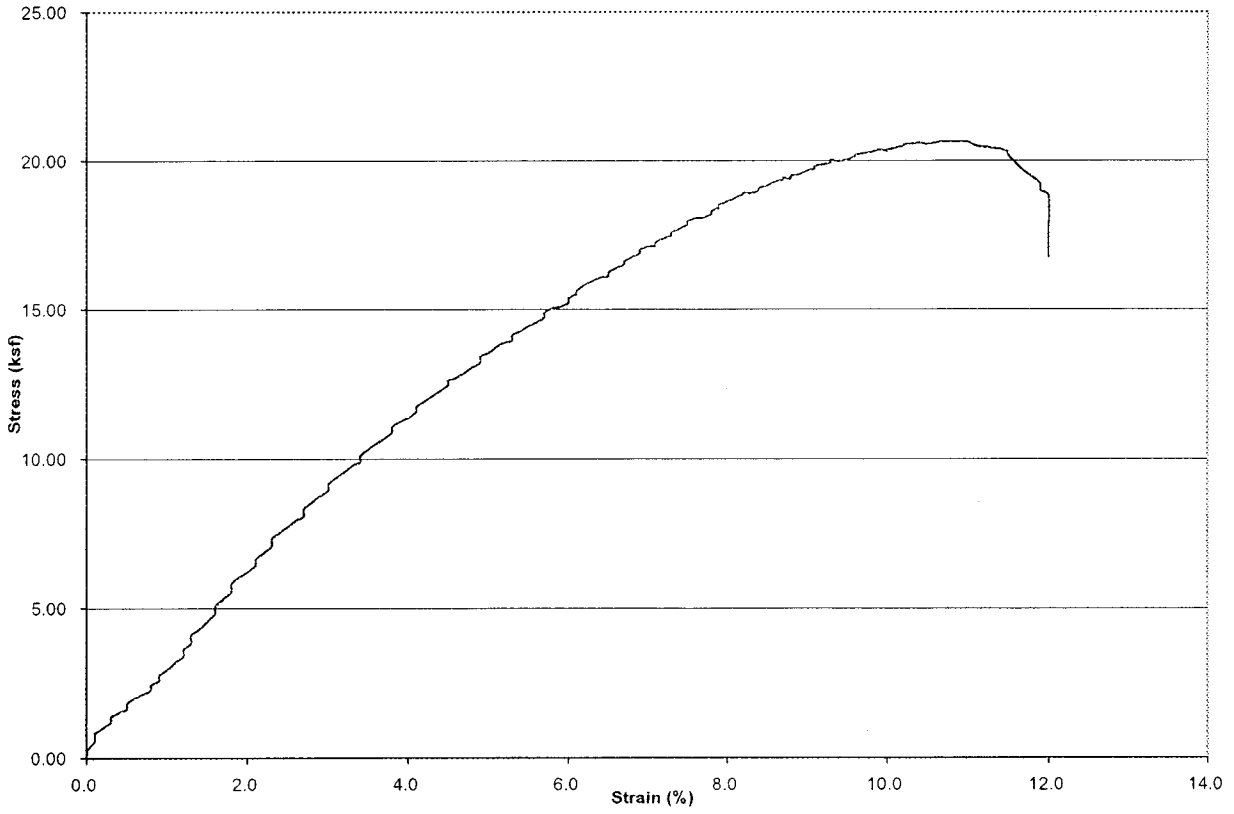
GRAIN SIZE DISTRIBUTION

Project: EMH&T
Location: Hayden Run Blvd, Columbus, Ohio
CTL Project Number: 09050029COL

Unconfined Compression Test Results ASTM D 2166, D 5102	CTL ENGINEERING, INC. 2860 Fisher Road Columbus, Ohio 43204
Sample ID: SB-2, SS-8	
Avg. Sample Height (in.): 2.7727 Avg. Sample Diameter (in.): 1.3567 Height-to-diameter ratio: 2.04	Client: EMH&T Project: Hayden Run Blvd, Part II Location: Project No. 09050029COL Lab Code No.
Ultimate Strength (ksf): 20.6 Ultimate Strain (%): 11 Wet Density (pcf): 142.3	Date Tested: 4/30/09 Reviewed by: JG/SM



CTL Engineering, Inc.
Specific Gravity
ASTM D 854 / AASHTO T 100
Method B

Client: EMH&T
Project: Hayden Run Blvd, Part II
Project #: 09050029COL

Date: 11/26/2012
Tech: EW
Reviewed by: JG

Sample ID	Specific Gravity (20°C)
B-5, ST-1	2.67
B-3, ST-1	2.66

One Dimensional Consolidation and Swell Properties of Soil - ASTM D 2435

CTL ENGINEERING, INC.

2860 Fisher Road

Columbus, OH 43204

Project No.: 09050029COL
Project: Hayden Run Blvd, Part II
Boring No.: B-3
Sample No.: ST
Test No.:

Client: EMHT

Tested By: JD
Test Date: 11/1/2012
Sample Type: Shelby Tube

Location: Dublin, Ohio
Checked By: SM
Depth: 3.0-5.0
Elevation:

Soil Description: Gray SILT AND CLAY, moist
Remarks:

Step No.	Applied Stress (tsf)	Final Displacement (in)	Void Ratio	Strain at End (%)	Log. T_{50} (min)	Cv (ft^2/sec)	Mv (1/tsf)
1	0.125	0.05329	0.859	5.33			4.26E-01
2	0.25	0.0856	0.795	8.56			2.58E-01
3	0.5	0.1188	0.73	11.88	2	2.21E-06	1.33E-01
4	1	0.1422	0.684	14.22	2	7.75E-06	4.68E-02
5	2	0.1627	0.644	16.27			2.05E-02
6	4	0.1821	0.606	18.21			9.72E-03
7	8	0.1997	0.571	19.97			4.39E-03
8	16	0.2178	0.536	21.78			2.26E-03
9	4	0.2101	0.551	21.01			6.38E-04
10	1	0.2022	0.566	20.22			2.63E-03
11	0.25	0.188	0.594	18.8			1.90E-02

CONSOLIDATION PARAMETERS

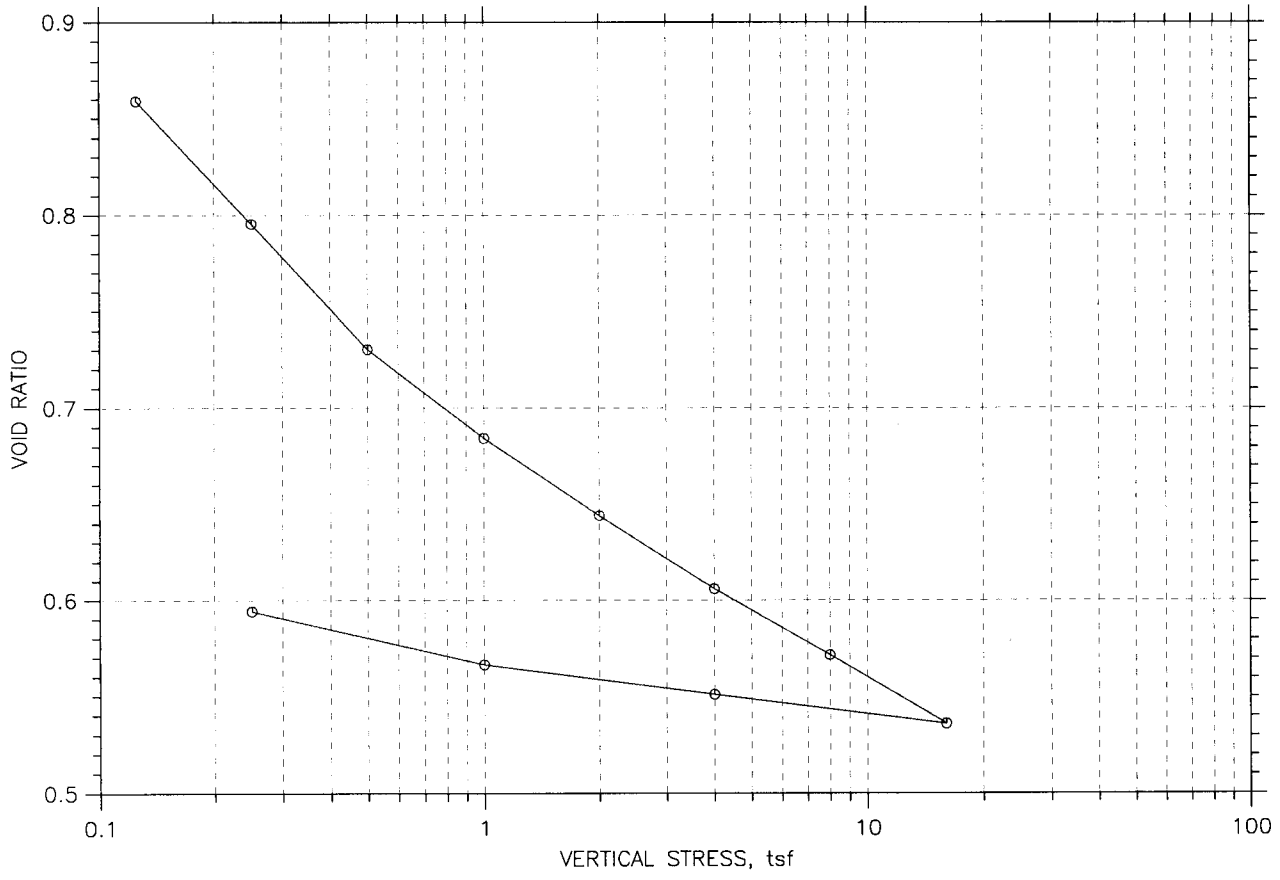
Preconsolidation Pressure (tsf): 1.00
Compression Index (C_c): 0.116
Recompression Index (C_r): 0.025

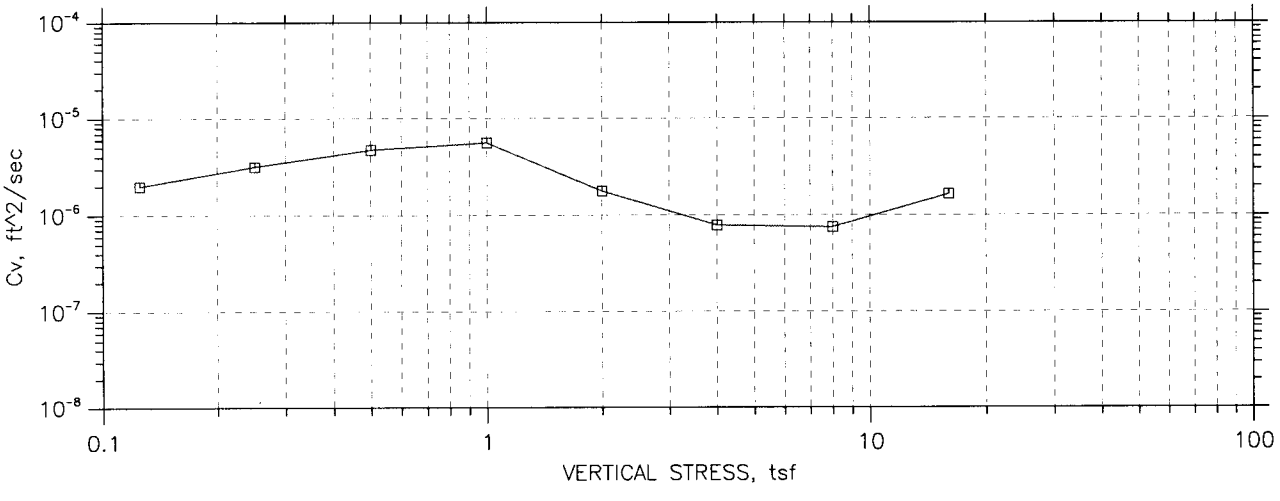
Initial Void Ratio: 0.86
Compression Ratio : 0.06
Recompression Ratio: 0.01

CTL ENGINEERING

CONSOLIDATION TEST DATA

SUMMARY REPORT



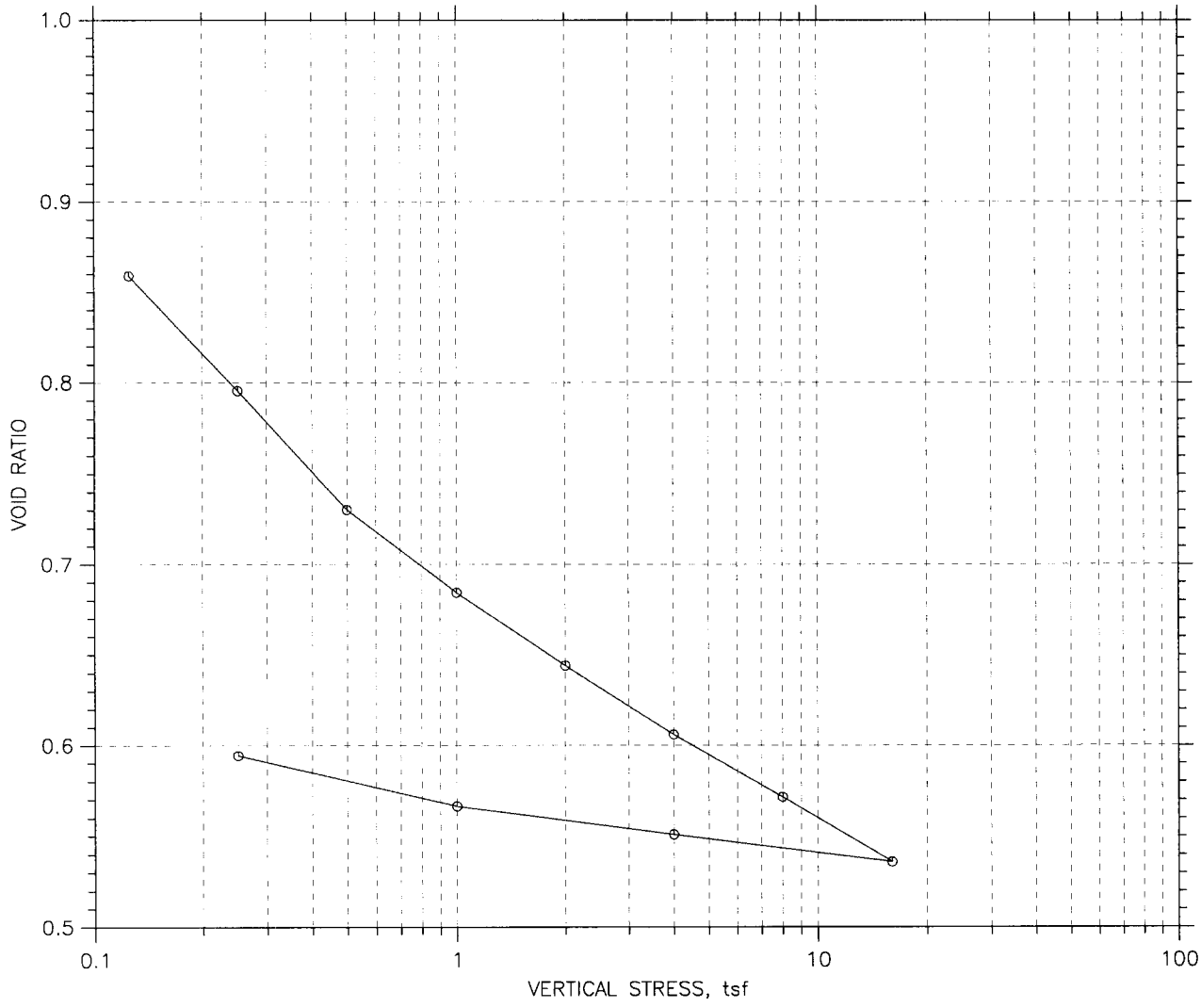


Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

Wed, 17-JUL-2013 10:12:27

CONSOLIDATION TEST DATA

SUMMARY REPORT



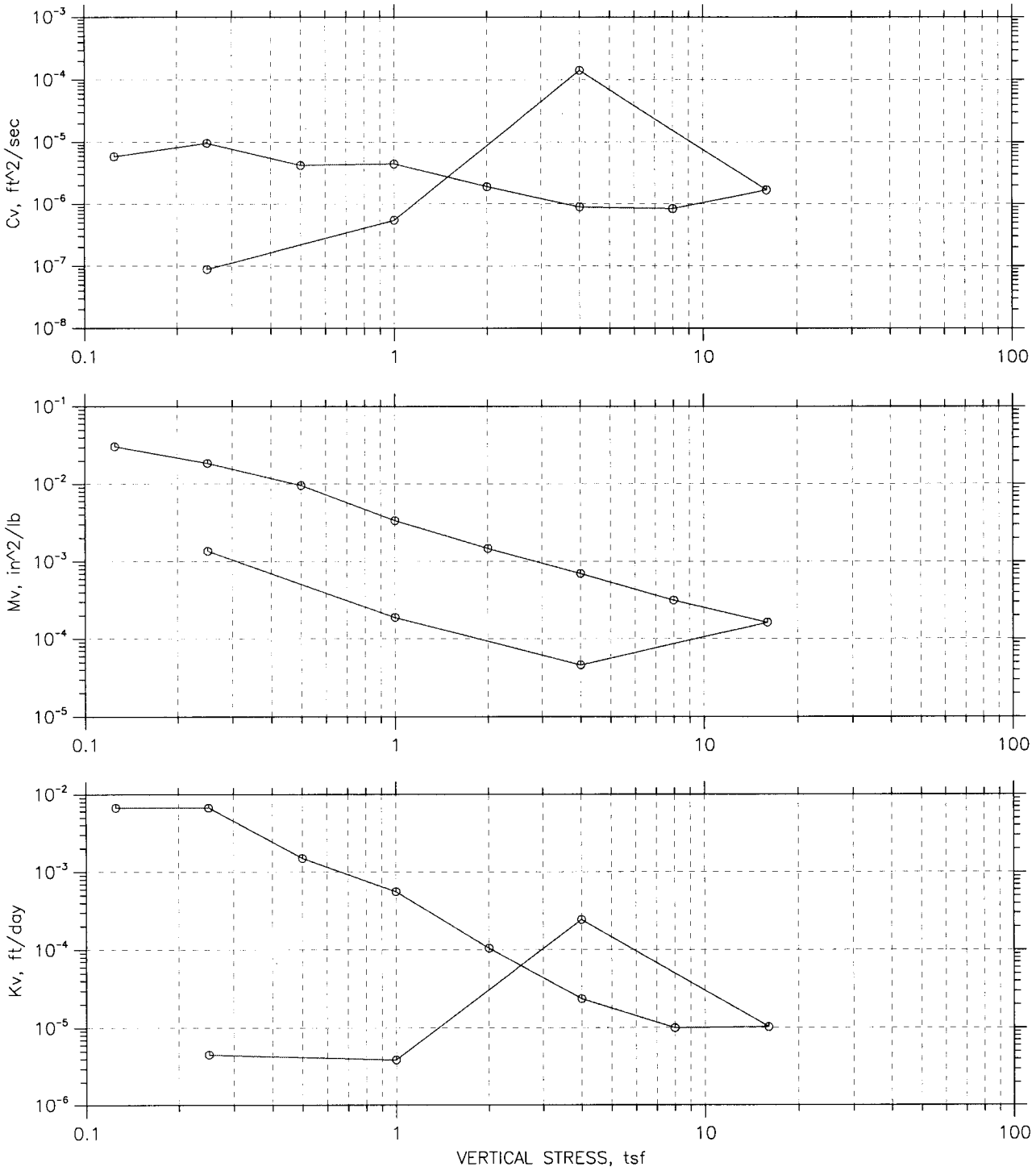
					Before Test	After Test
Overburden Pressure, tsf:				Water Content, %	14.97	17.31
Preconsolidation Pressure, tsf:				Dry Unit Weight, pcf	85.524	103.17
Compression Index:				Saturation, %	41.80	74.20
Diameter: 2.5 in		Height: 1 in		Void Ratio	0.96	0.63
LL: 32	PL: 18	PI: 14	GS: 2.69	Back Pressure, tsf	0	0

Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

Wed, 17-JUL-2013 10:12:27

CONSOLIDATION TEST DATA

ROOT of TIME COEFFICIENTS

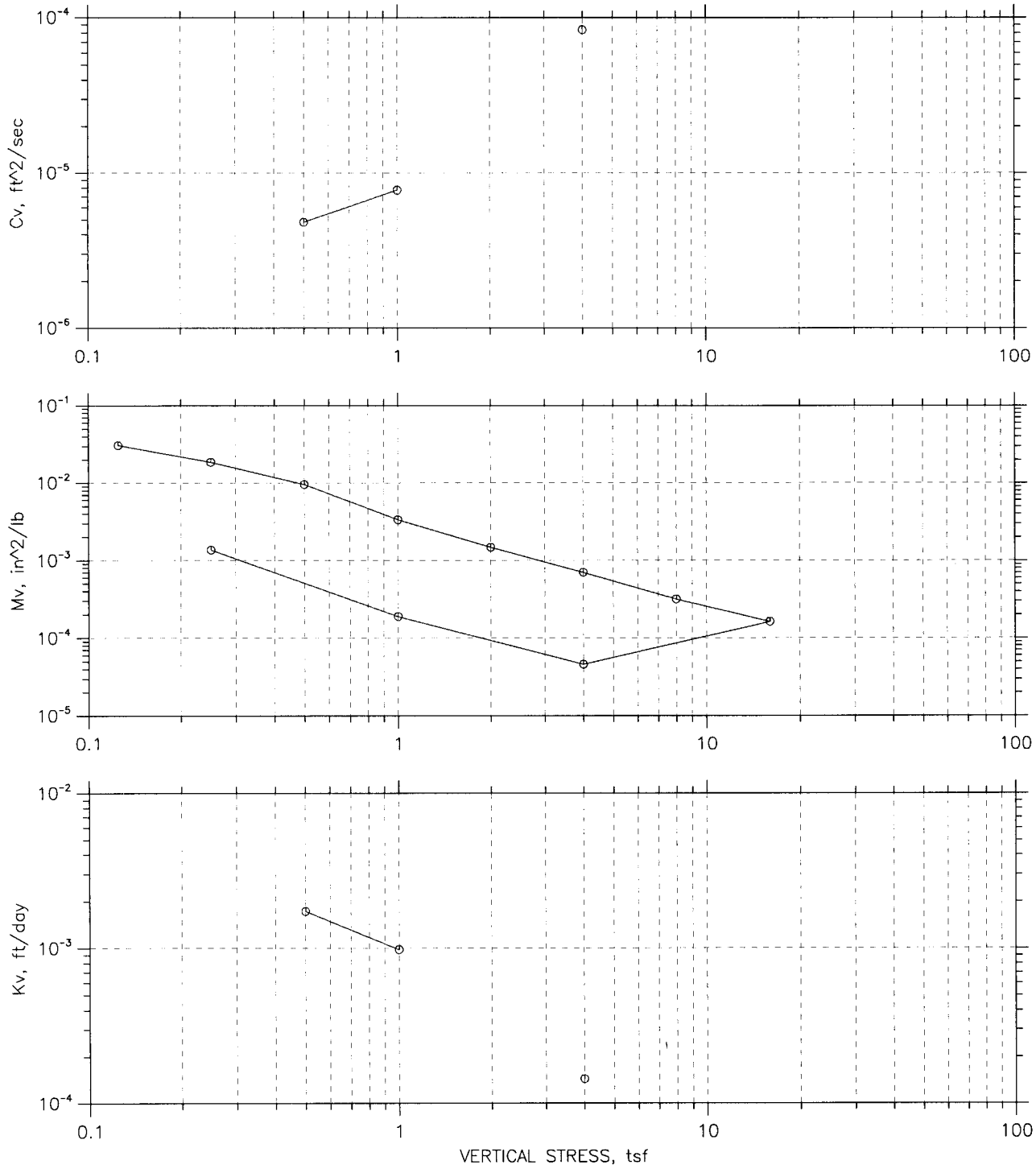


Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

Wed, 17-JUL-2013 10:12:27

CONSOLIDATION TEST DATA

LOG of TIME COEFFICIENTS



Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

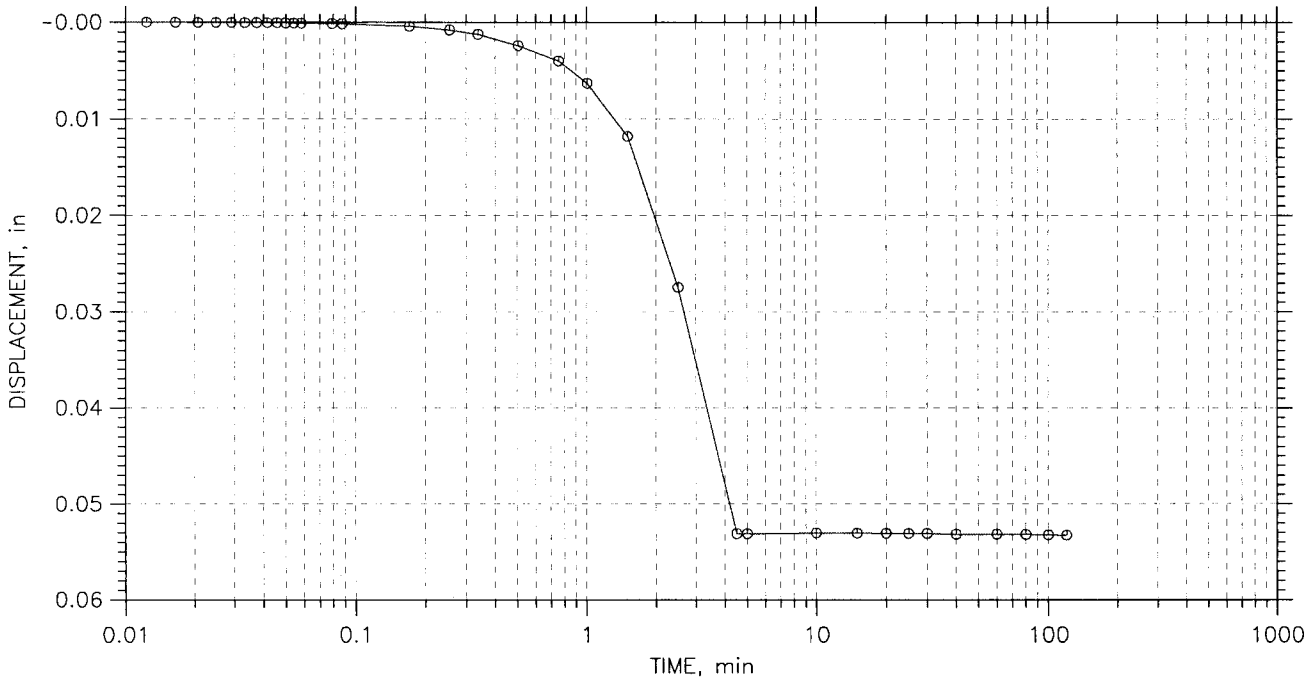
Wed, 17-JUL-2013 10:12:27

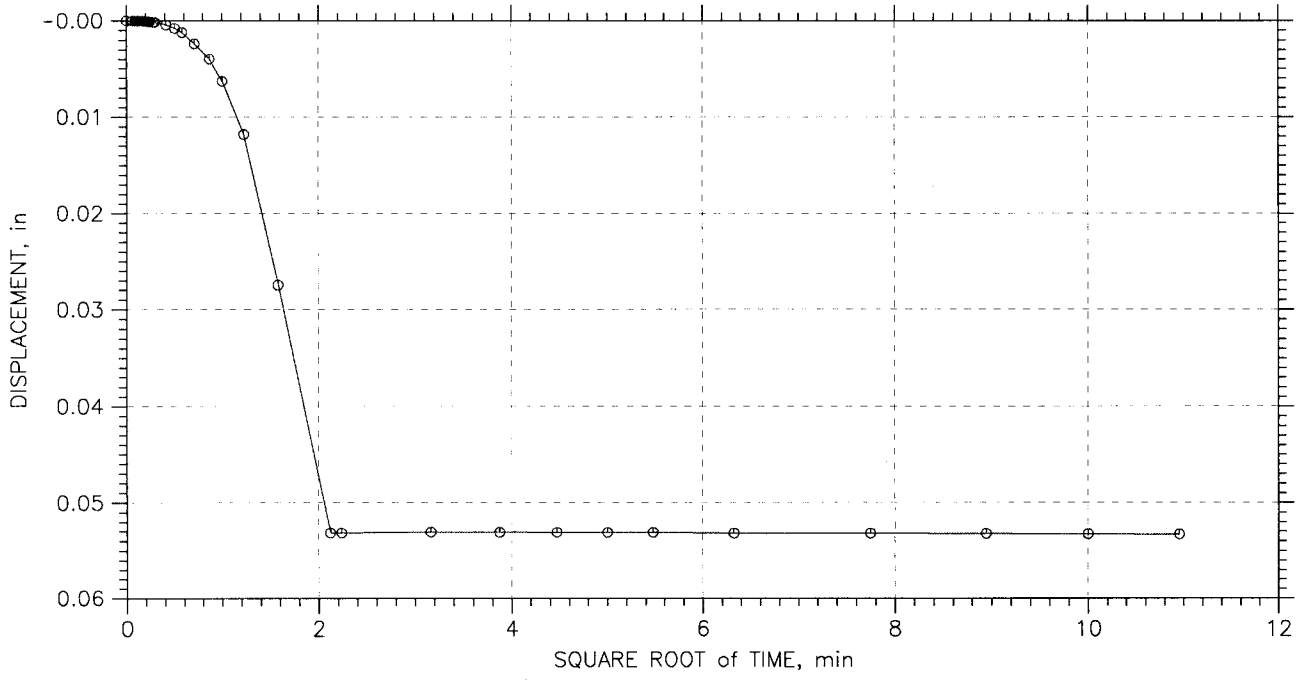
CONSOLIDATION TEST DATA

TIME CURVES

Step: 1 of 11

Stress: 0.125 tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

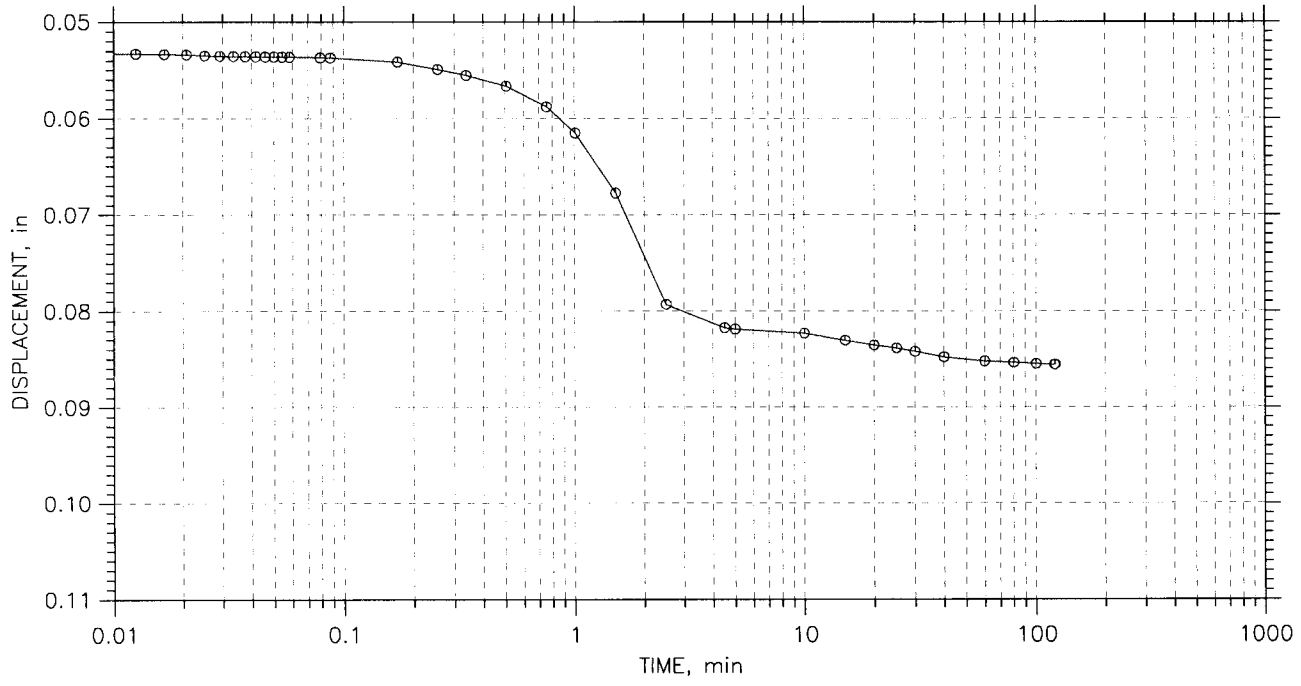
Wed, 17-JUL-2013 10:12:27

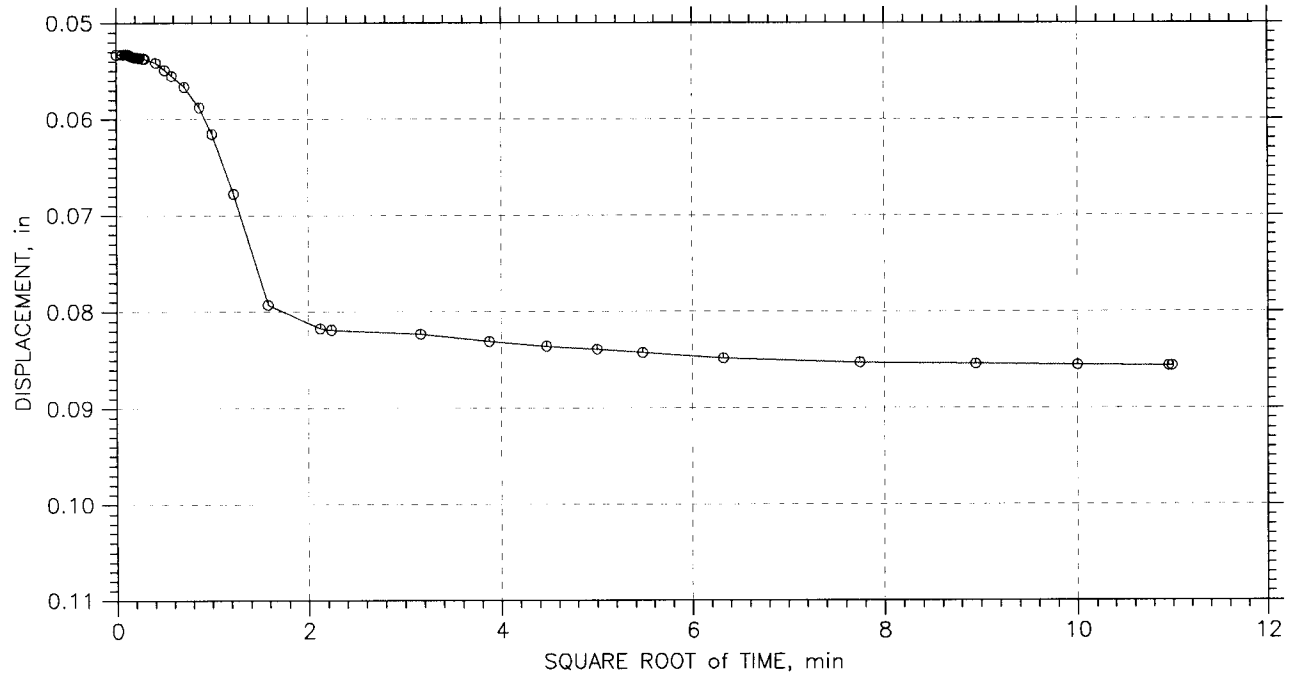
CONSOLIDATION TEST DATA

TIME CURVES

Step: 2 of 11

Stress: 0.25 tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

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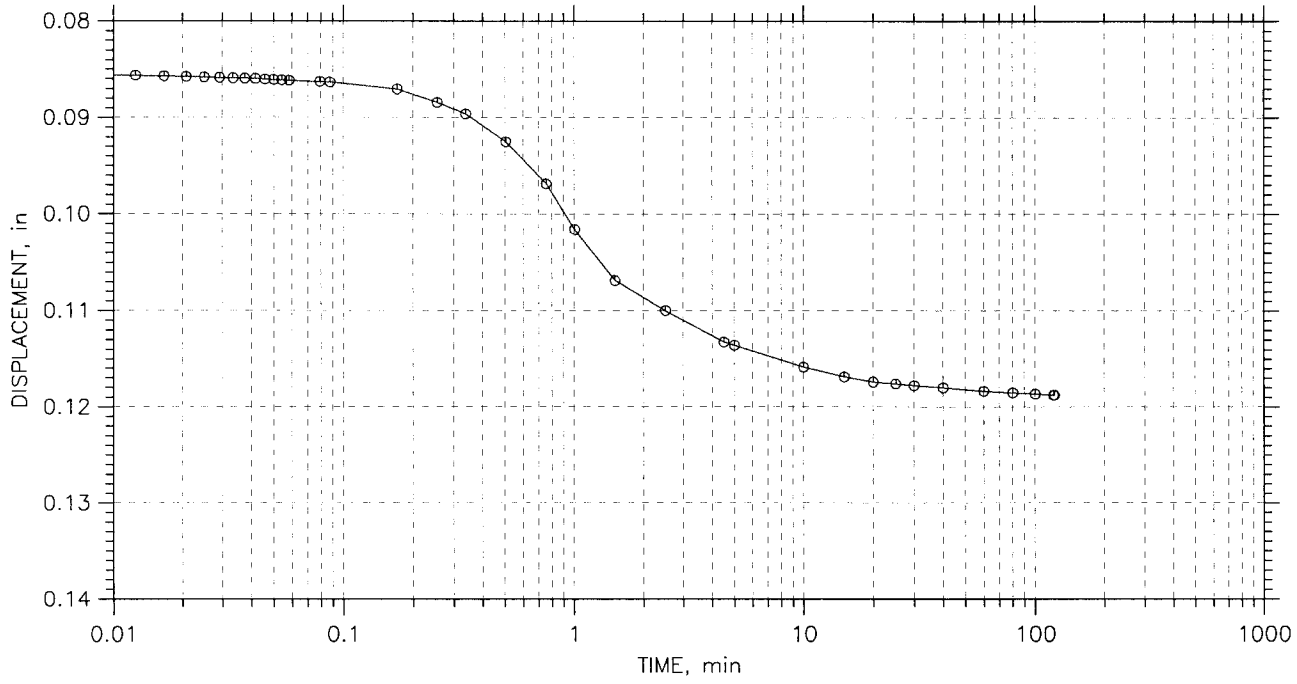
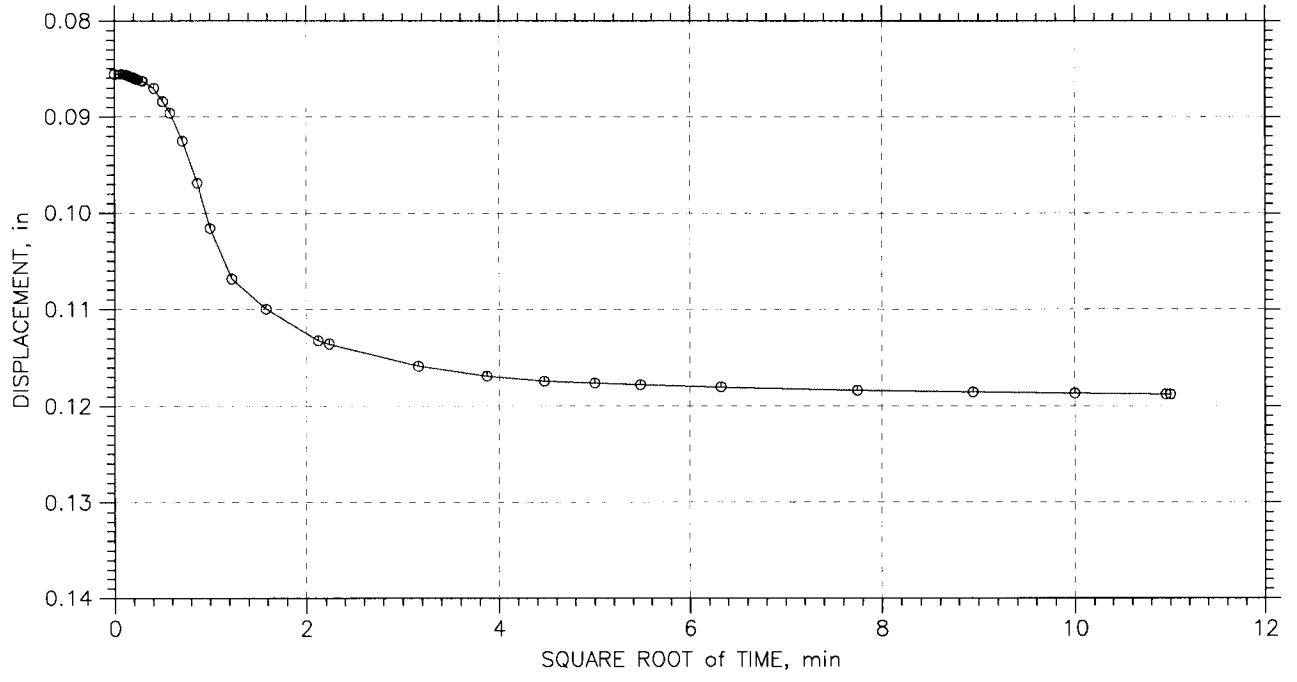
CONSOLIDATION TEST DATA

TIME CURVES

Step: 3 of 11

Stress: 0.5 tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

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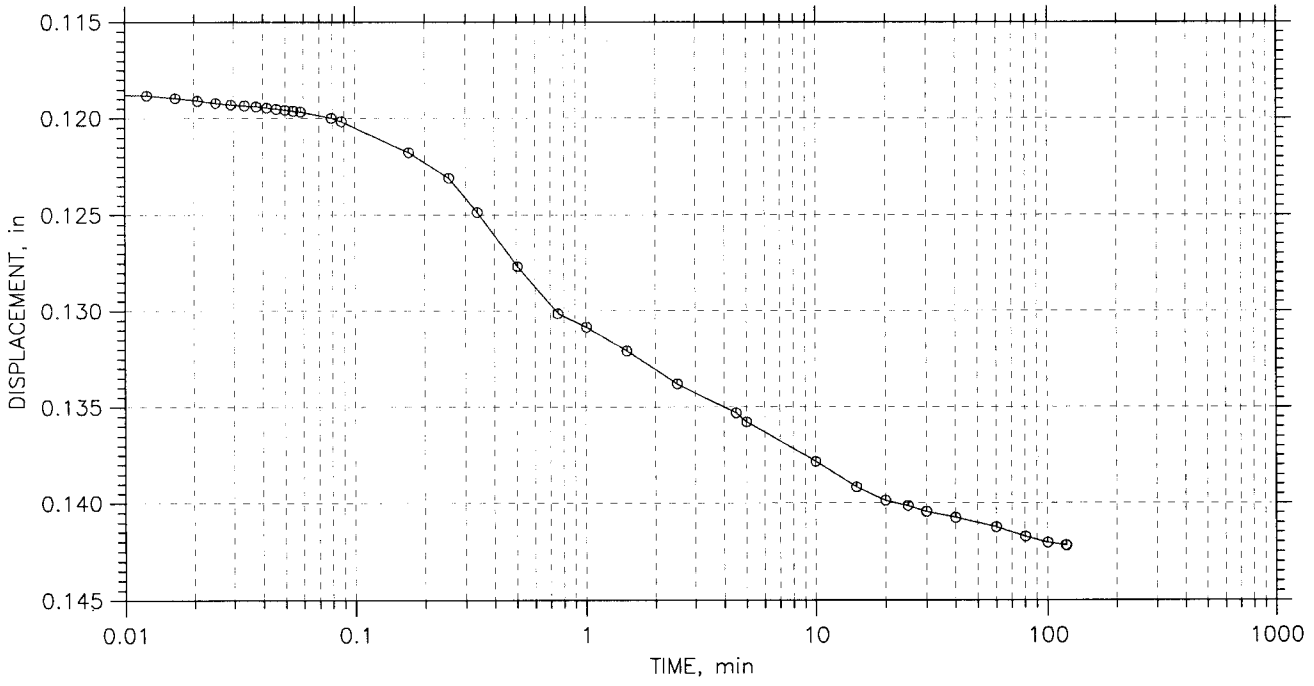
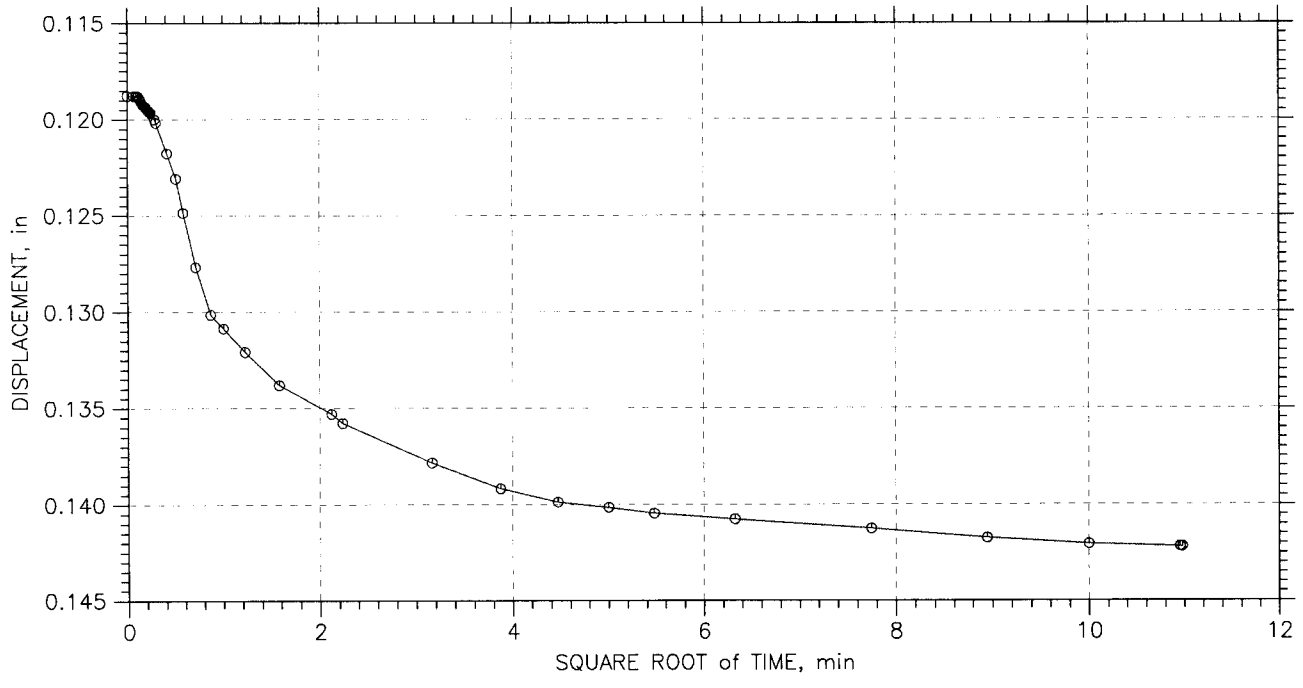
CONSOLIDATION TEST DATA

TIME CURVES

Step: 4 of 11

Stress: 1. tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

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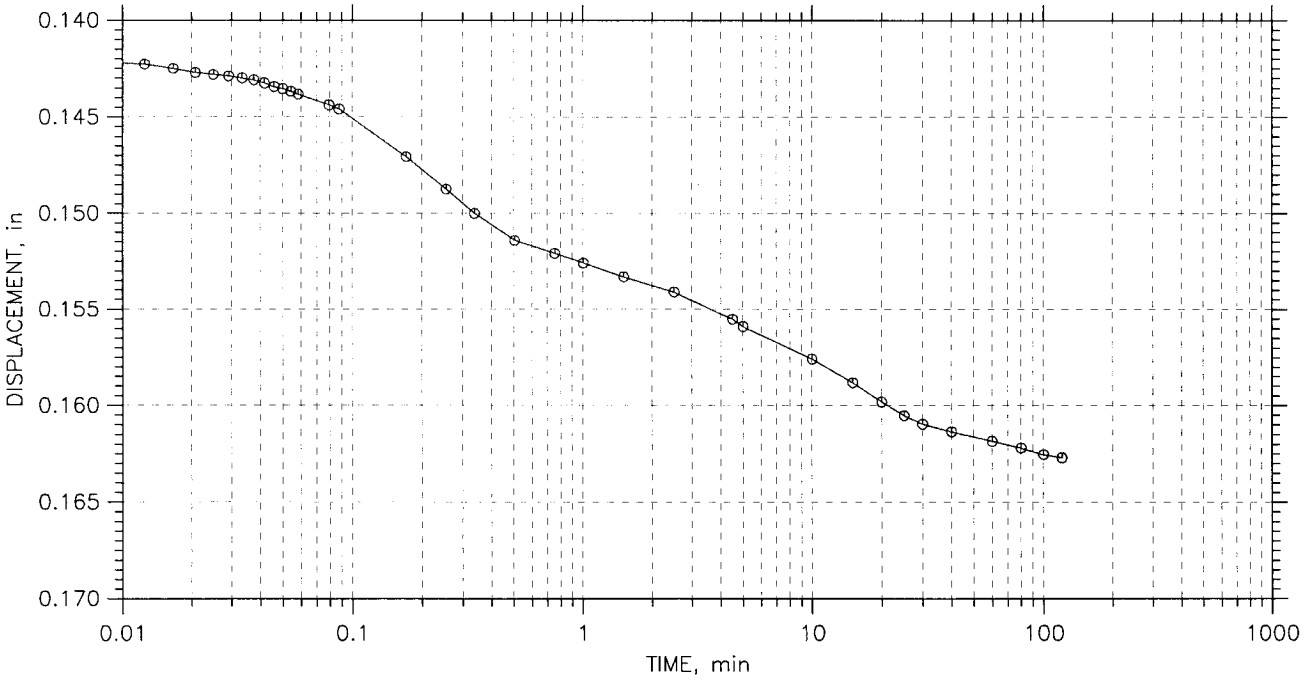
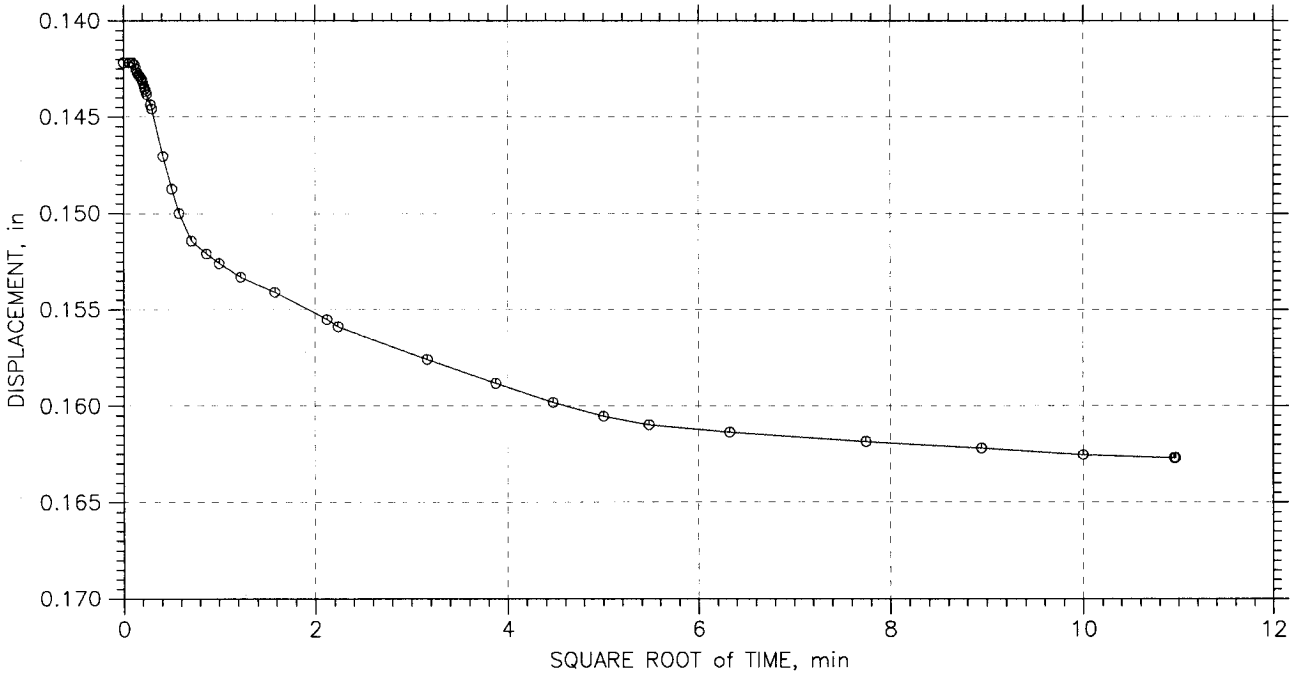
CONSOLIDATION TEST DATA

TIME CURVES

Step: 5 of 11

Stress: 2. tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

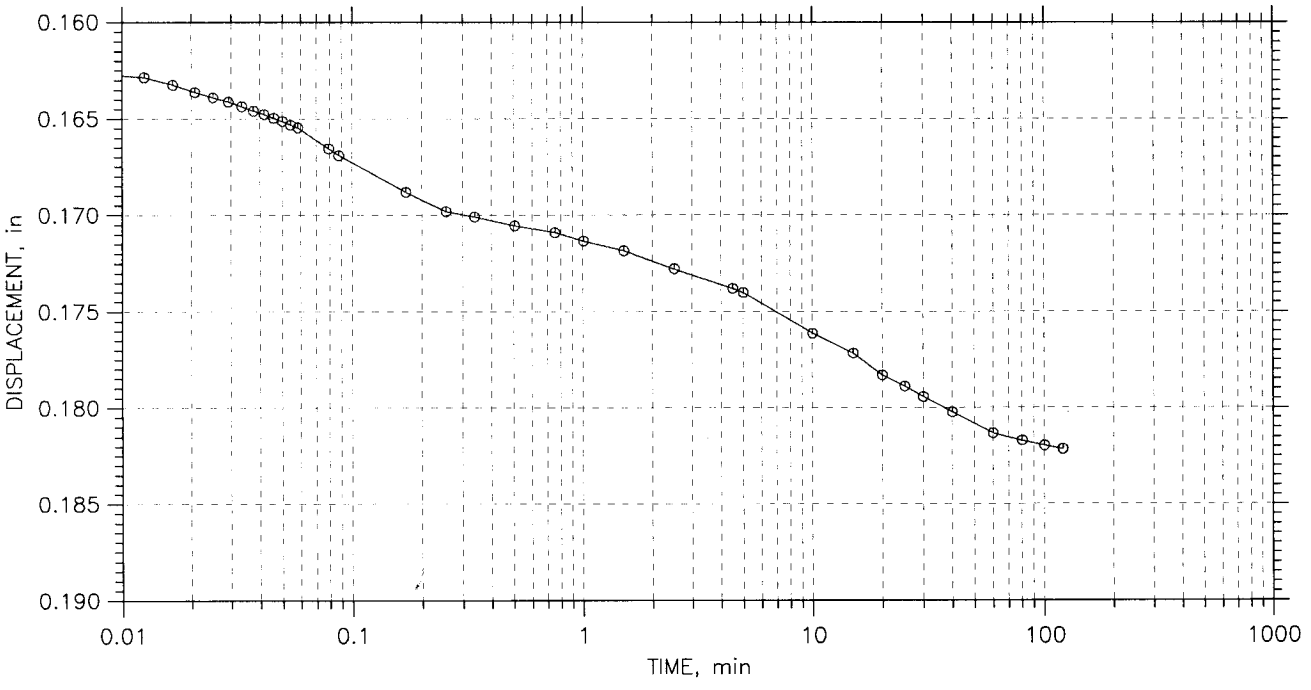
Wed, 17-JUL-2013 10:12:27

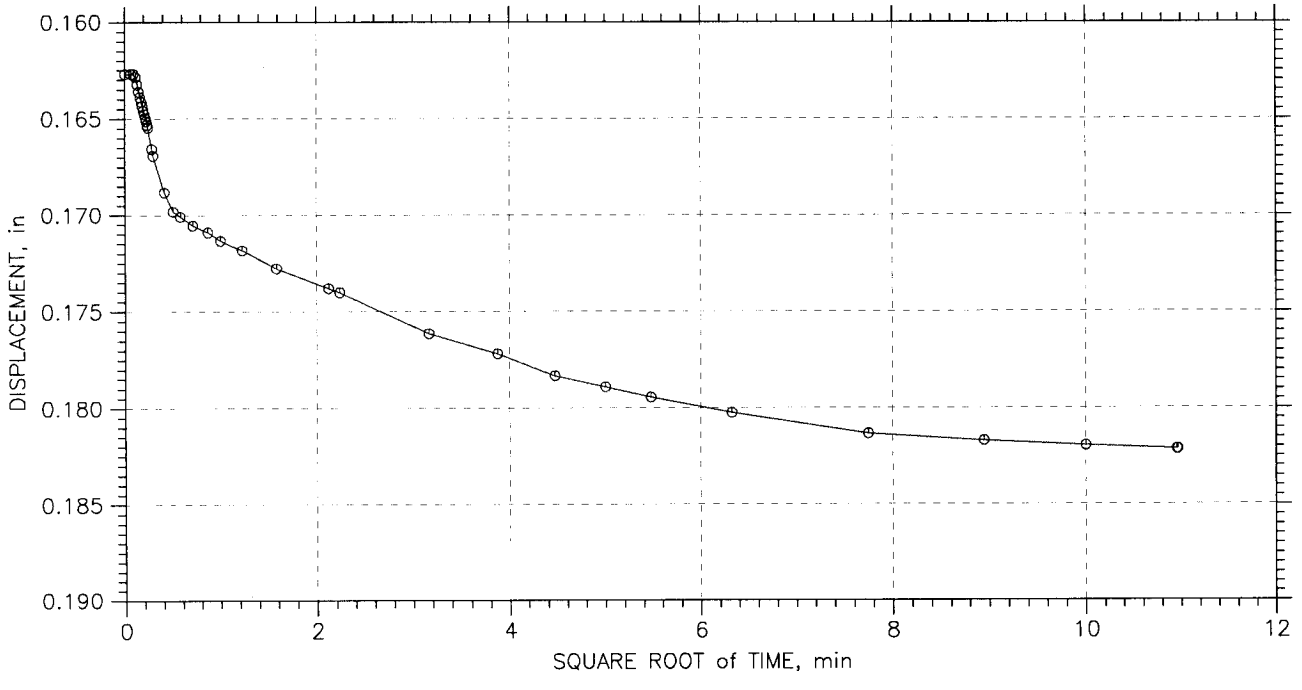
CONSOLIDATION TEST DATA

TIME CURVES

Step: 6 of 11

Stress: 4. tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

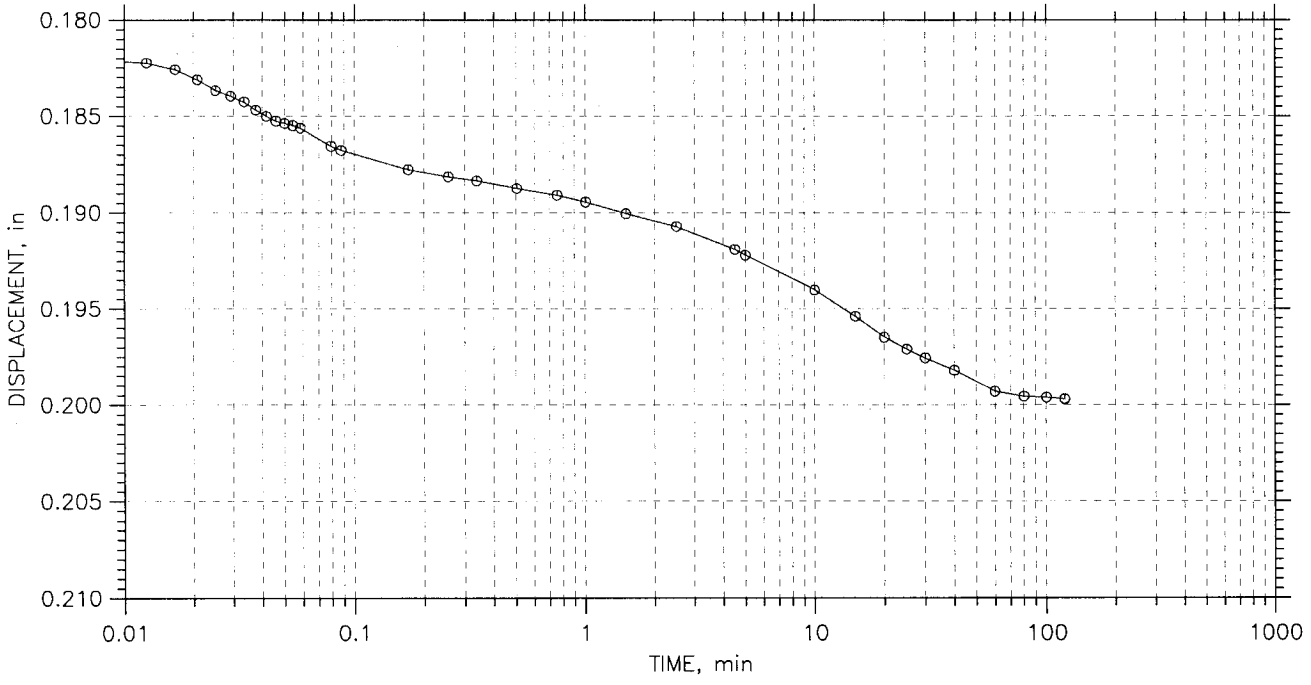
Wed, 17-JUL-2013 10:12:27

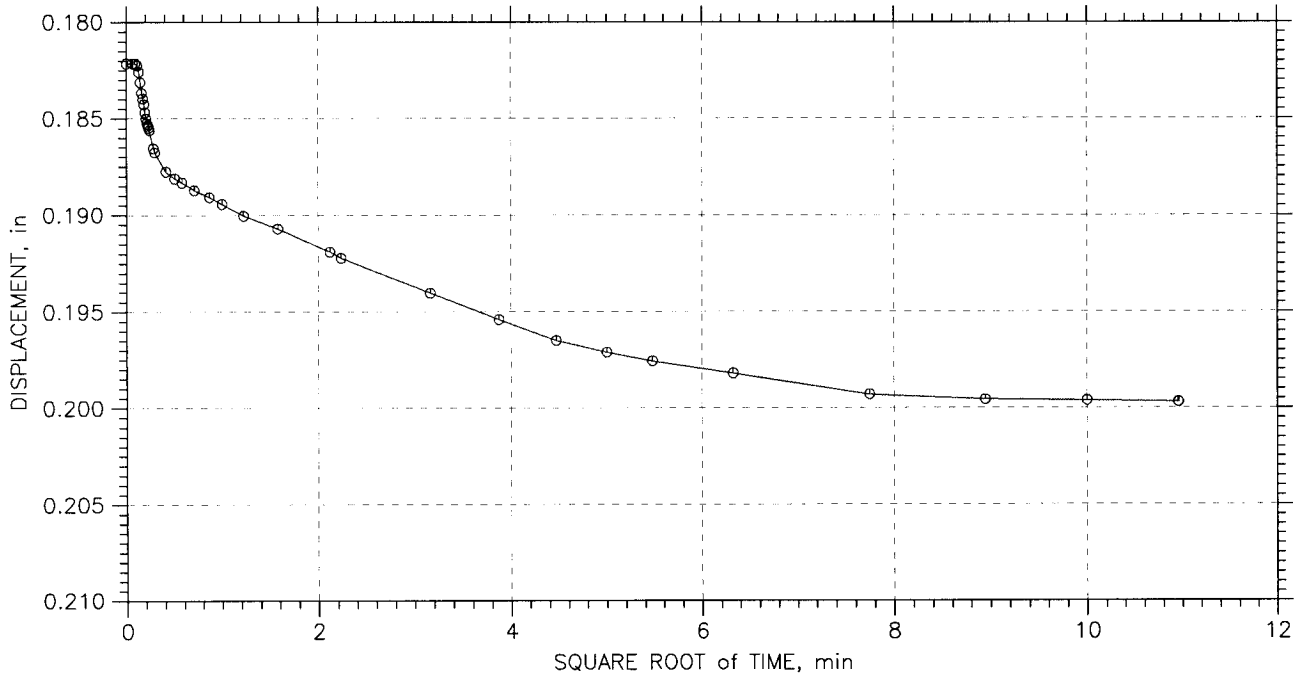
CONSOLIDATION TEST DATA

TIME CURVES

Step: 7 of 11

Stress: 8. tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

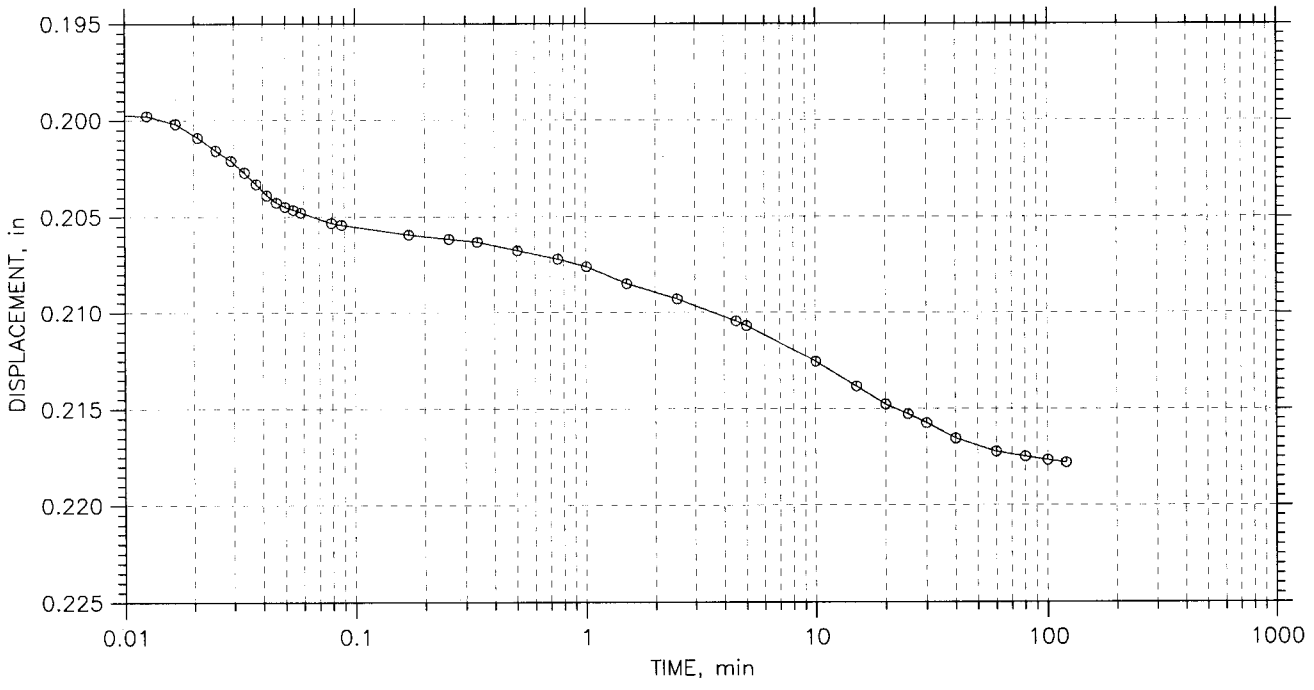
Wed, 17-JUL-2013 10:12:27

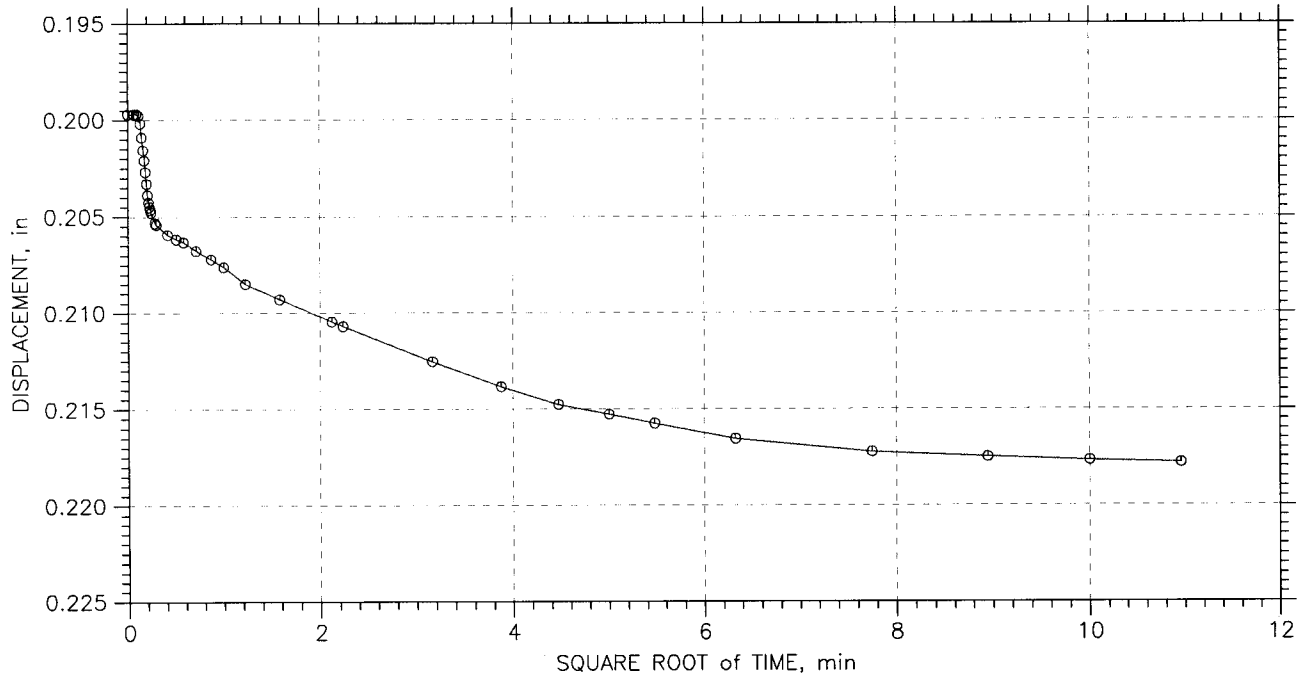
CONSOLIDATION TEST DATA

TIME CURVES

Step: 8 of 11

Stress: 16. tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

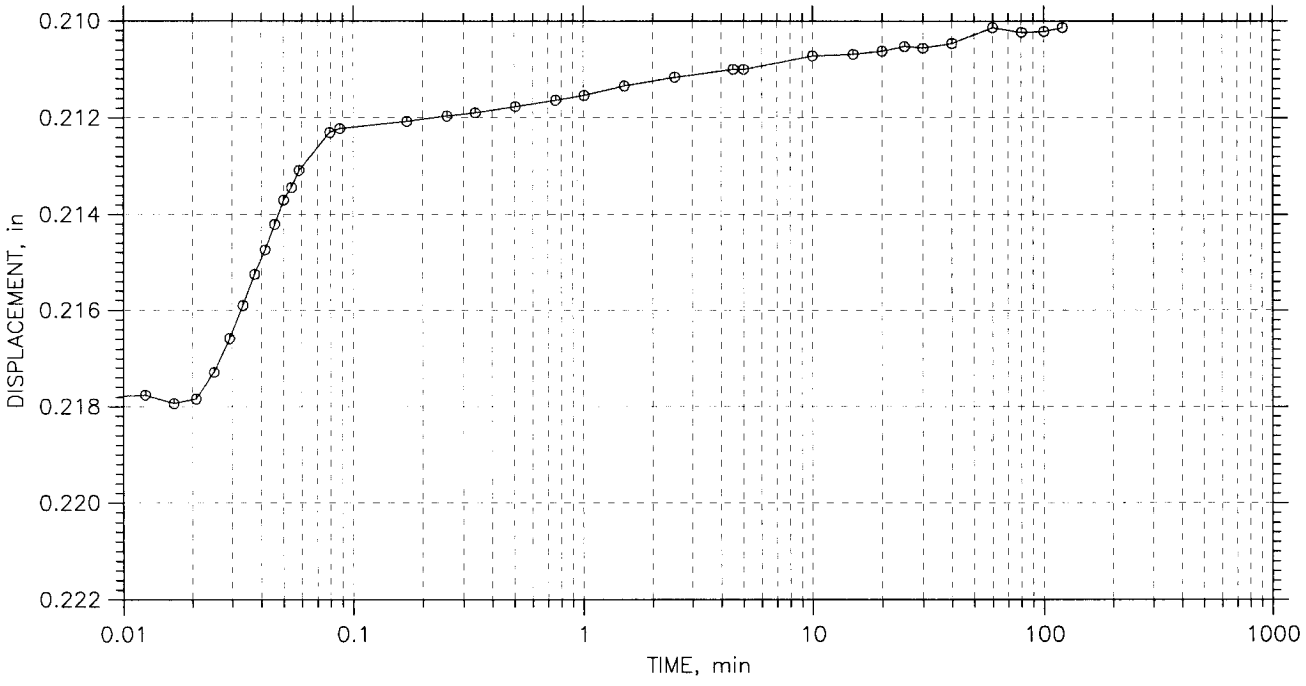
Wed, 17-JUL-2013 10:12:27

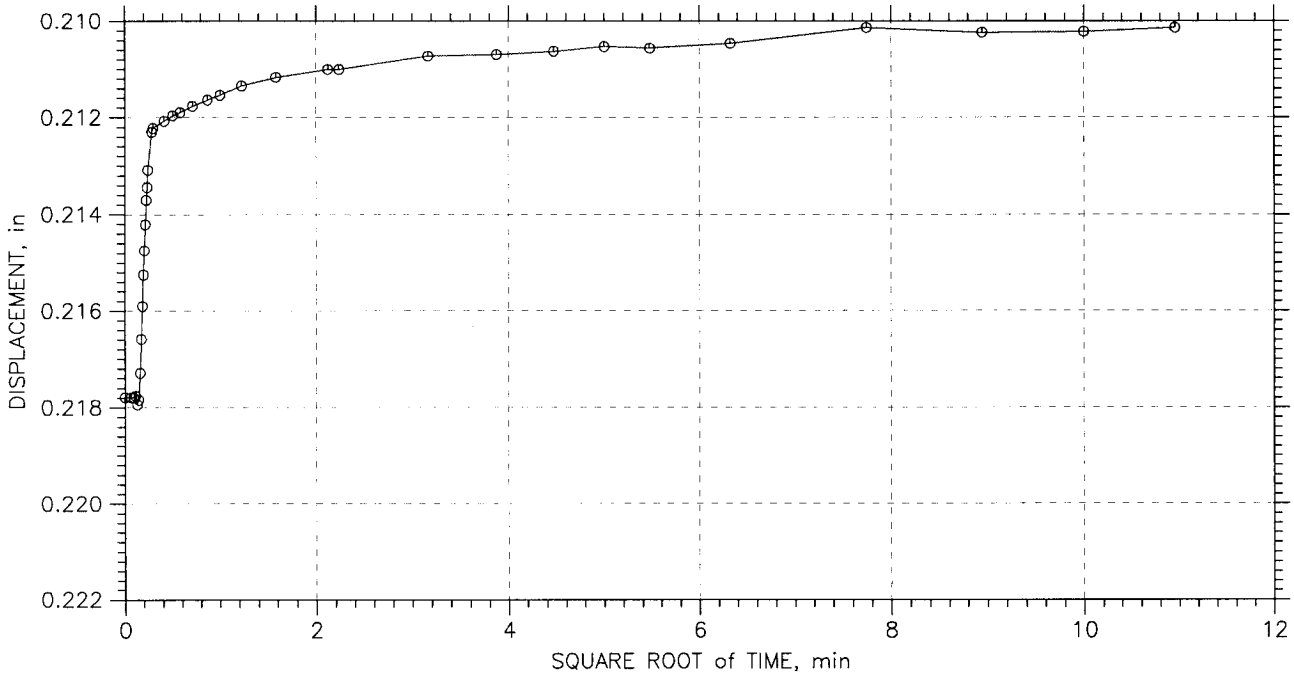
CONSOLIDATION TEST DATA

TIME CURVES

Step: 9 of 11

Stress: 4. tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

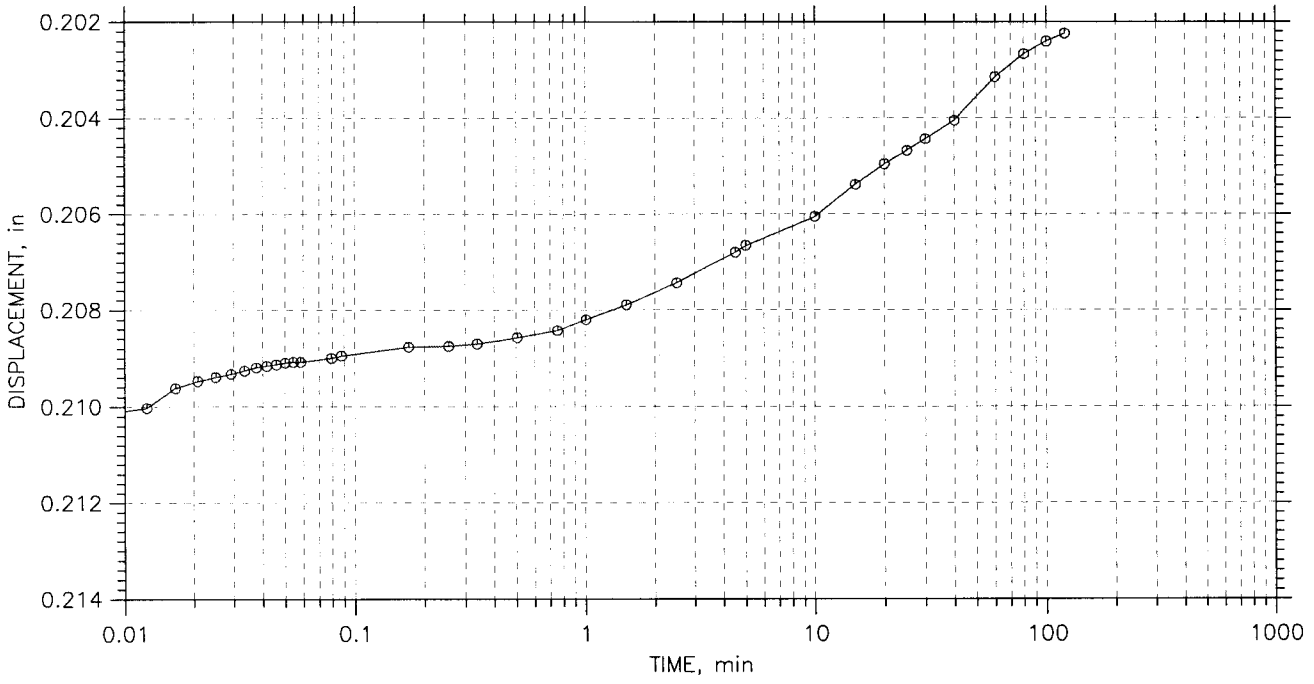
Wed, 17-JUL-2013 10:12:27

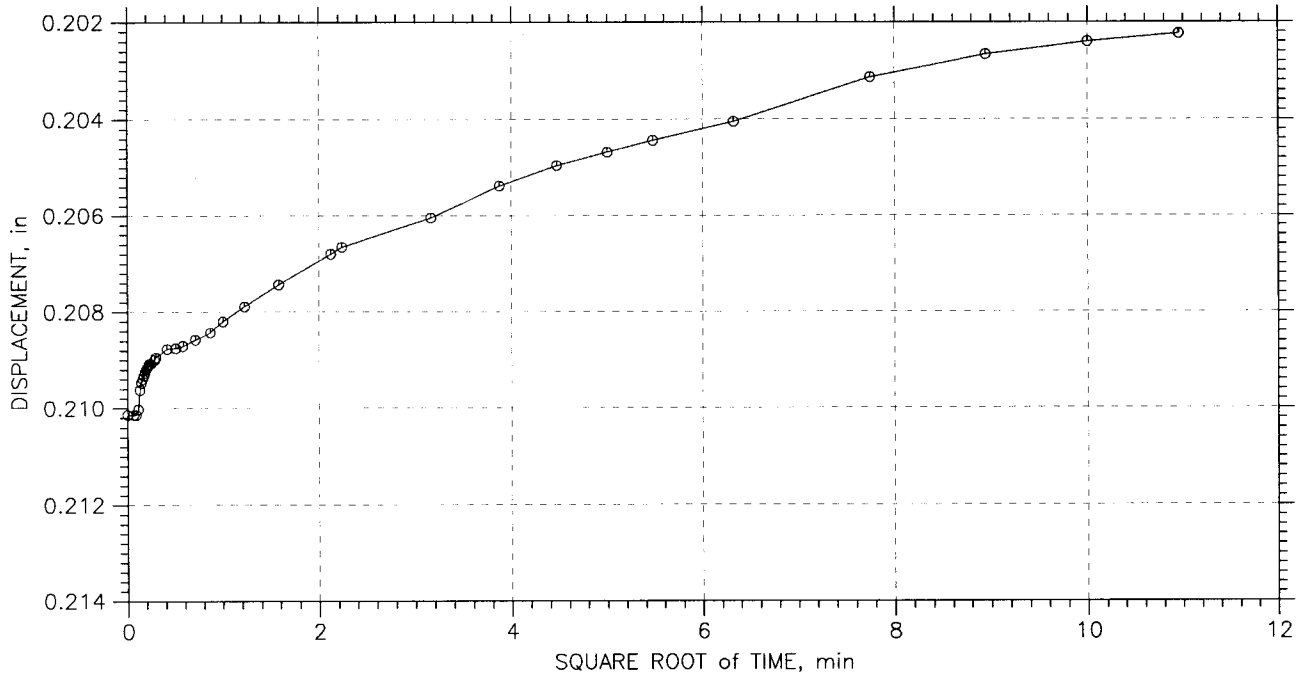
CONSOLIDATION TEST DATA

TIME CURVES

Step: 10 of 11

Stress: 1. tsf





Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

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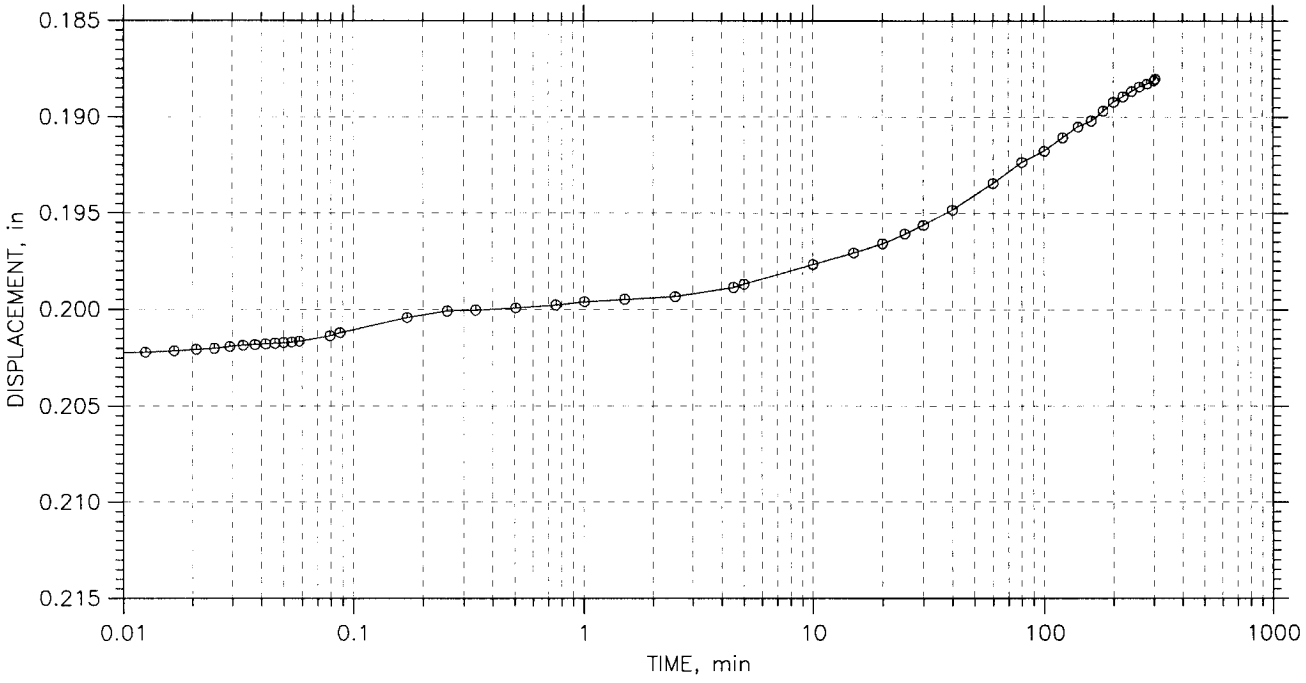
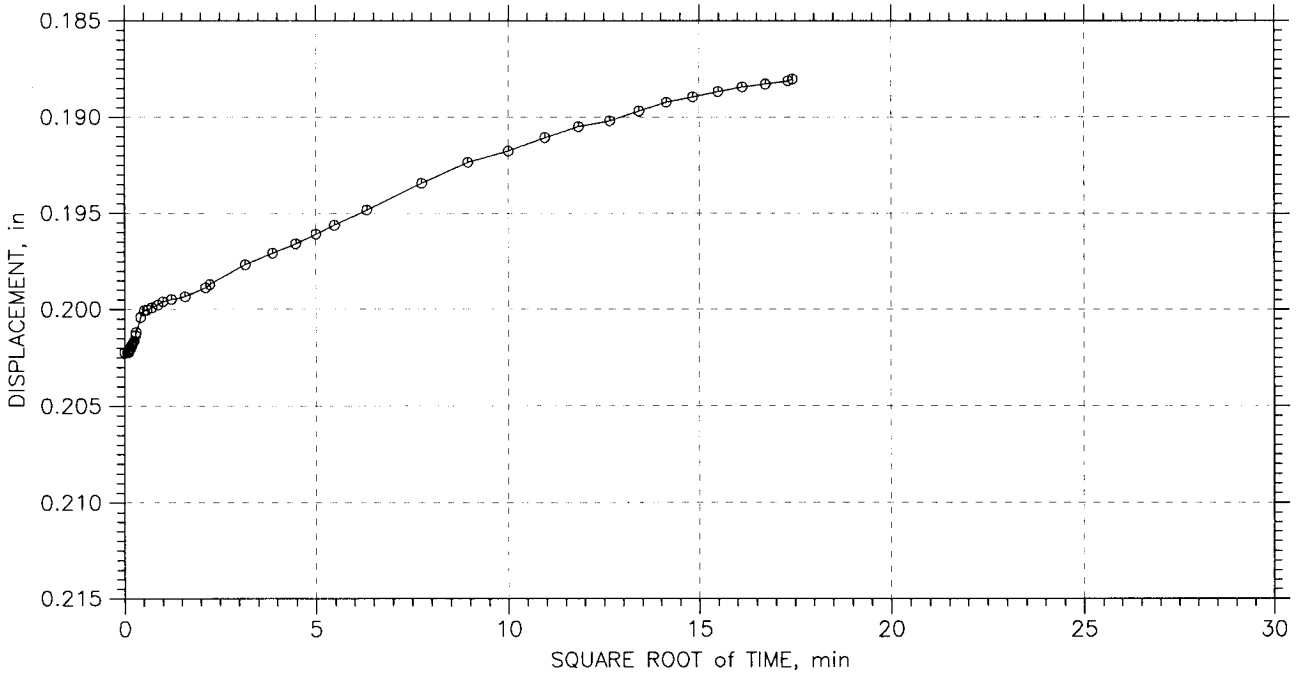
CONSOLIDATION TEST DATA

TIME CURVES

Step: 11 of 11

Stress: 0.25 tsf





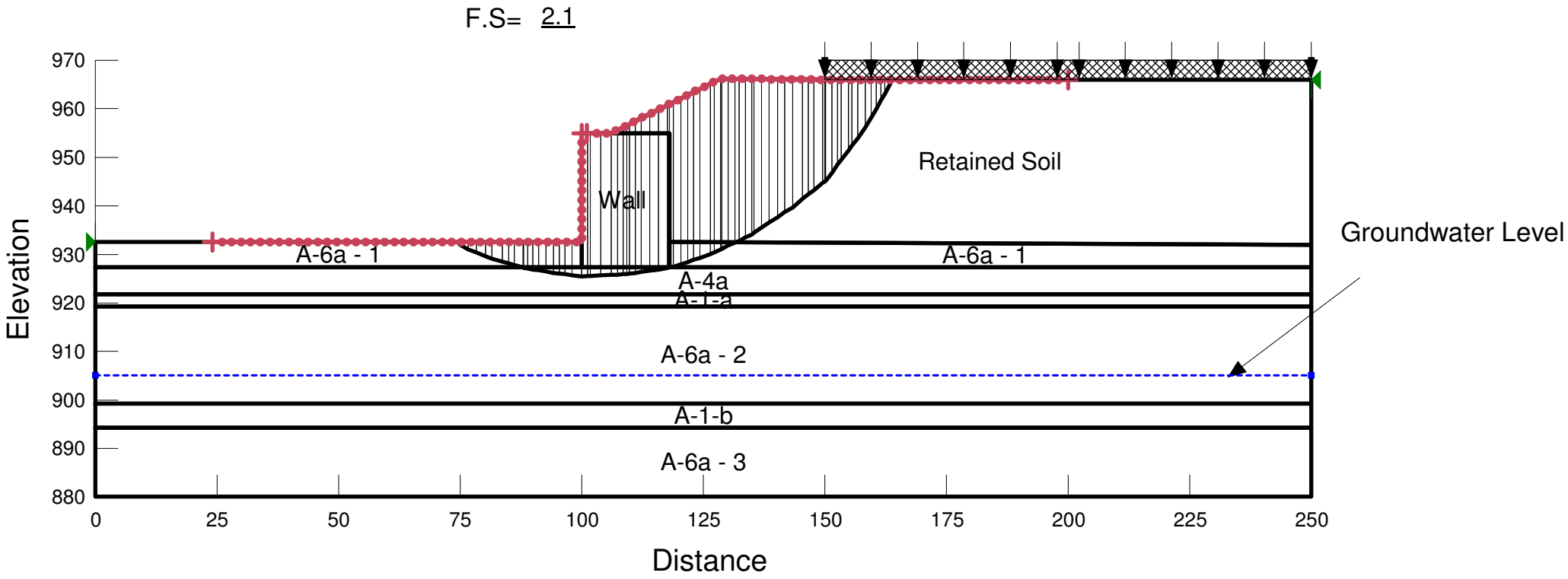
Project: Hayden Run Blvd- Part II	Location: Dublin, Ohio	Project No.: 09050029COL
Boring No.: B-3	Tested By: JD	Checked By: SM
Sample No.: ST	Test Date: 11/01/2012	Depth: 3.0-5.0
Test No.:	Sample Type: Shelby Tube	Elevation:
Description: Gray SILT AND CLAY, moist		
Remarks:		

Wed, 17-JUL-2013 10:12:27

APPENDIX D
SLOPE STABILITY

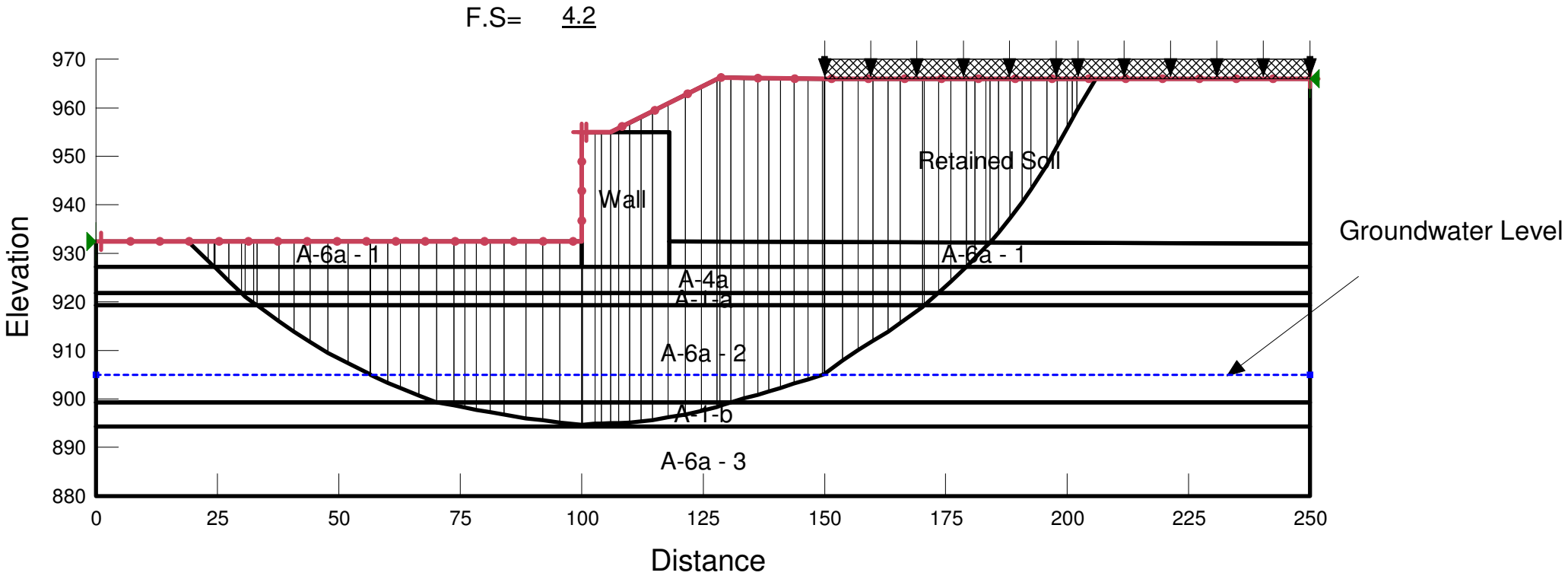
HAYDEN RUN BOULEVARD, MSE WALL ES

Name: Retained Soil Unit Weight: 120 pcf Cohesion': 300 psf Phi': 28 °
Name: Wall Unit Weight: 130 pcf
Name: A-6a - 1 Unit Weight: 120 pcf Cohesion': 750 psf Phi': 22 °
Name: A-4a Unit Weight: 120 pcf Cohesion': 1,000 psf Phi': 24 °
Name: A-1-a Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 °
Name: A-6a - 2 Unit Weight: 120 pcf Cohesion': 500 psf Phi': 22 °
Name: A-1-b Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 °
Name: A-6a - 3 Unit Weight: 120 pcf Cohesion': 1,000 psf Phi': 22 °



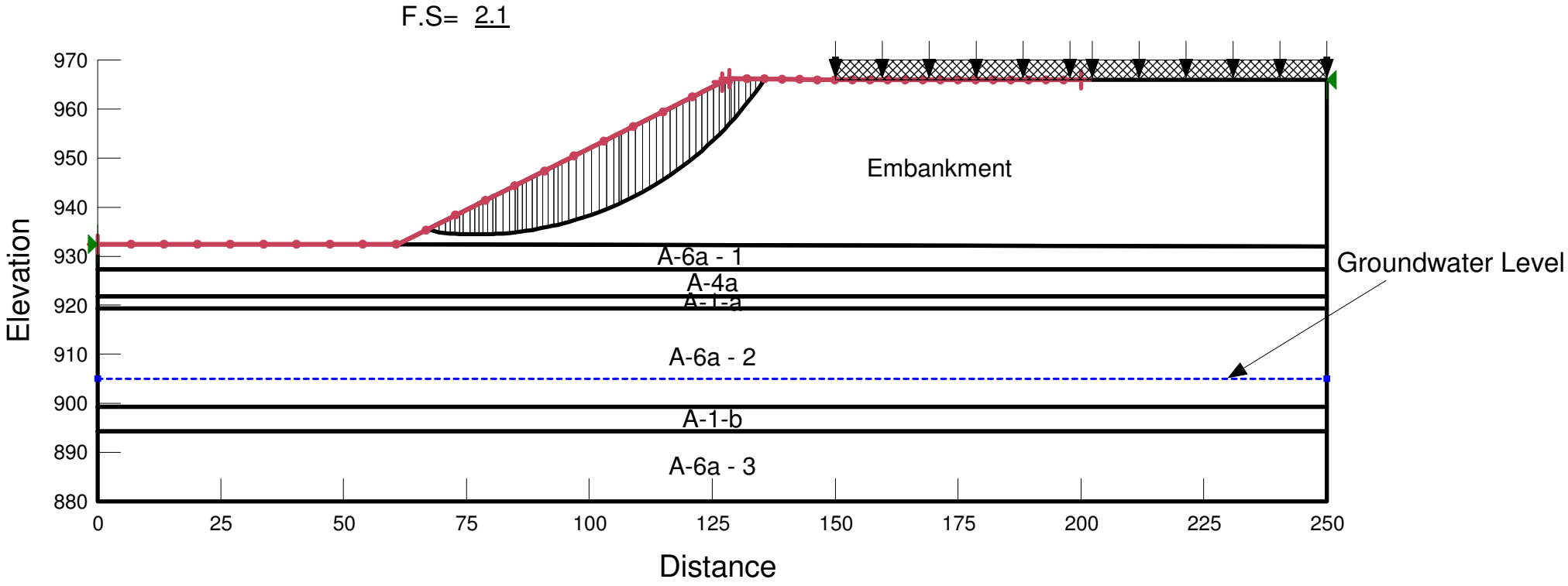
HAYDEN RUN BOULEVARD, MSE WALL TS

Name: Retained Soil Unit Weight: 120 pcf Cohesion': 2,000 psf
Name: Wall Unit Weight: 130 pcf
Name: A-6a - 1 Unit Weight: 120 pcf Cohesion': 5,625 psf
Name: A-4a Unit Weight: 120 pcf Cohesion': 7,562.5 psf
Name: A-1-a Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 °
Name: A-6a - 2 Unit Weight: 120 pcf Cohesion': 3,750 psf
Name: A-1-b Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 °
Name: A-6a - 3 Unit Weight: 120 pcf Cohesion': 6,250 psf



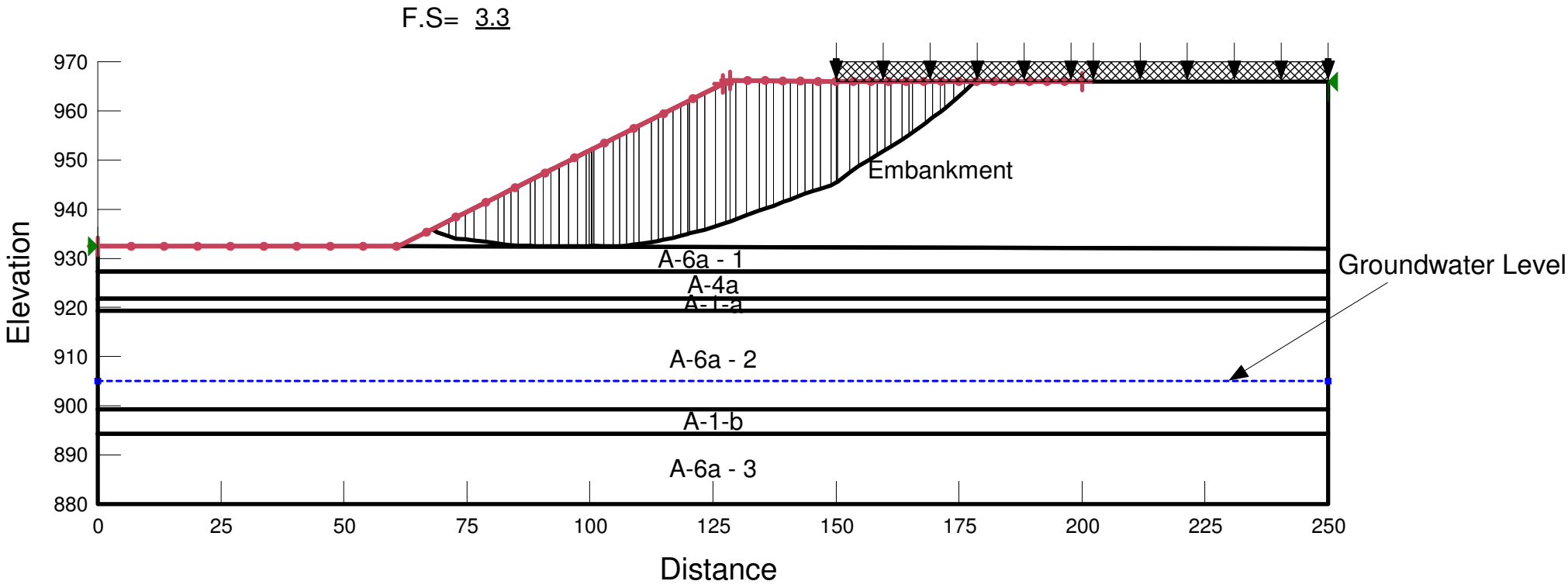
HAYDEN RUN BOULEVARD, EMBANKMENT SLOPE, ES

Name: Embankment Unit Weight: 120 pcf Cohesion': 300 psf Phi': 28 °
Name: A-6a - 1 Unit Weight: 120 pcf Cohesion': 750 psf Phi': 22 °
Name: A-4a Unit Weight: 120 pcf Cohesion': 1,000 psf Phi': 24 °
Name: A-1-a Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 °
Name: A-6a - 2 Unit Weight: 120 pcf Cohesion': 500 psf Phi': 22 °
Name: A-1-b Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 °
Name: A-6a - 3 Unit Weight: 120 pcf Cohesion': 1,000 psf Phi': 22 °



HAYDEN RUN BOULEVARD, EMBANKMENT SLOPE, TS

Name: Embankment Unit Weight: 120 pcf Cohesion': 2,000 psf
Name: A-6a - 1 Unit Weight: 120 pcf Cohesion': 5,625 psf
Name: A-4a Unit Weight: 120 pcf Cohesion': 7,562.5 psf
Name: A-1-a Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 °
Name: A-6a - 2 Unit Weight: 120 pcf Cohesion': 6,250 psf
Name: A-1-b Unit Weight: 125 pcf Cohesion': 0 psf Phi': 32 °
Name: A-6a - 3 Unit Weight: 120 pcf Cohesion': 6,250 psf



APPENDIX E
OTHER STABILITY CHECKS

Structure	Hayden Run Boulevard
Type	MSE at Abutment
Boring	B-1 and B-2

Top of Leveling Pad Elevation	929	
Soils at Foundation Level	A-4b & A-7-6	
$N_{60\ Avg}$	18	bpf
S_u	2250	psf

Location		**Hayden Run Boulevard**		
Wall Type		**MSE at Abutment**		
Wall Dimensions				
Roadway Profile Grade		968		
Top Wall		959		
Top of Leveling Pad		929		
Back Wall to Back Abutment, X		6	feet	
Wall Face Height, H		30.000	feet	
Effective Height, h		39.000	feet	
Reinforcement Length Multiplier		0.70		0.7 to 1.5
Reinforcement Length, L		27.3	feet	8 ft. minimum
Angle of Back Face of Wall, θ		90	Degrees	
Facing Width		0.46	feet	5.5 inches
Reinforced Zone & Facing, B		27.8	feet	
Sloping Backfill				
Slope Rate, β		0	:1 (H:V)	
Effective Slope Rate, β'		0.00	deg	
Soil Data				
Internal	ϕ	34	degrees	
	γ	120	pcf	
Retained	ϕ_r	30	degrees	
	γ_r	120	pcf	
	$\delta_r = \beta$	0.00	degrees	
Foundation	ϕ_f	0	degrees	
	γ_f	120	pcf	
	c_f	2250	psf	

Unfactored Loads

Vertical Earth Pressure, EV			
Weight of Reinforced Zone, V_1	98.28	kips/ft	
Weight of Soil Block Above Reinforced Zone, V_2	23.00	kips/ft	
Horizontal Earth Pressure, EH	30.42	kips/ft	
Γ	2.25		
K_a	0.33		
Horizontal Component, EH_H	30.42	kips/ft	EH * cos(δ_r)
Vertical Component, EH_V	0.00	kips/ft	EH * sin(δ_r)

Live Load Surcharge (Active), LSA			
Equivalent Height of Soil, h_{eq}	2	ft	From Table 3.11.6.4-1 or -2
LSA	3.12	kips/ft	$h_{eq} * \gamma_r * K_a * h$
Horizontal Component, LSA_H	3.12	kips/ft	LSA * cos(δ_r)
Vertical Component, LSA_V	0.00	kips/ft	LSA * sin(δ_r)

Live Load Surchage above Reinf., LSH_V **Use for Bearing Capacity Only**

Loading over Reinforcement (y or n) y

LSH_V 6.55 kips/ft $h_{eq} * \gamma_r * L$

Unfactored Vertical Loads and Resisting Moments

Item	V (kips/ft)	Moment Arm About Pt. C (ft)	Positive/ Negative	Moment about C (kip-ft/ft)
V_1	98.28	0.23	1	22.52
V_2	23.00	3.23	1	74.28
EH_V	0.00	0.00	1	0.00
LSA_V	0.00	0.00	1	0.00
LSH_V	6.55	3.23	1	21.16
TOTAL	127.84			

Unfactored Horizontal Loads and Overturning Moments

Item	H (kips/ft)	Moment Arm About Pt. C (ft)	Positive/ Negative	Moment about C (kip-ft/ft)
EH_H	30.42	13.00	-1	-395.46
LSA_H	3.12	19.50	-1	-60.84
TOTAL	33.54			

Load Factors

Group	γ_{EV}	$\gamma_{EH\ (active)}$	γ_{ES}	γ_{LS}	
Strength Ia	1.00	1.50	0.75	1.75	Tables 3.4.1-1 & 3.4.1-2
Strength Ib	1.35	1.50	1.50	1.75	
Service I	1.00	1.00	1.00	1.00	

Factored Vertical Loads in kips/ft

Group/Item	V_1	V_2	EH_V	LSA_V	LSH_V	Total
V (Unfactored)	98.28	23.004	0.00	0.00	6.55	127.84
Strength Ia	98.28	23.00	0.00	0.00	11.47	132.75
Strength Ib	132.68	31.06	0.00	0.00	11.47	175.20
Service I	98.28	23.00	0.00	0.00	6.55	127.84

Factored Horizontal Loads in kips/ft

Group/Item	EH_H	LSA_H	Total
H (Unfactored)	30.42	3.12	33.54
Strength Ia	45.63	5.46	51.09
Strength Ib	45.63	5.46	51.09
Service I	30.42	3.12	33.54

Factored Moments from Vertical Forces (M_v) in kip-ft/ft

Group/Item	V_1	V_2	EH_V	LSA_V	LSH_V	Total
M_v (Unfactored)	22.52	74.28	0.00	0.00	21.16	117.96
Strength Ia	22.52	74.28	0.00	0.00	37.03	133.83
Strength Ib	30.41	100.28	0.00	0.00	37.03	167.71
Service I	22.52	74.28	0.00	0.00	21.16	117.96

Factored Moment from Horizontal Forces (M_h) in kip-ft/ft

Group/Item	EH_H	LSA_H	Total
M_h (Unfactored)	-395.46	-60.84	-456.30
Strength Ia	-593.19	-106.47	-699.66
Strength Ib	-593.19	-106.47	-699.66
Service I	-395.46	-60.84	-456.30

Eccentricity

Group/Item Units	V_{dl} (kip/ft)	H_{total} (kip/ft)	M_{vdl} (kip-ft/ft)	M_{htotal} (kip-ft/ft)	e (ft)	e_{max} (ft)	$e<=e_{max}$ Check
Strength Ia	121.28	51.09	96.81	-699.66	-4.97	6.94	**OK**

Bearing Resistance

Effective Footing Width, B' = B-2e

Group/Item Units	ΣV (kip/ft)	M_{vtotal} (kip-ft/ft)	M_{htotal} (kip-ft/ft)	e (ft)	B' (ft)	σ_v (ksf)	$q_r>=\sigma_v$ Check
Strength Ib	175.20	167.71	-699.66	-3.04	21.69	8.08	**OK**

Effective Footing Width, B'	21.69	feet	From Table above
Fact. Bearing Resistance, q_r	8.13	ksf	$=\phi_b*q_n$
Resistance Factor, ϕ_b	0.65		Table 11.5.6-1
Nom. Bearing Resistance, q_n	12.52	ksf	$=c_fN_cs_c+\gamma_rD_fN_qs_qd_qC_{Wq}+0.5\gamma_fB'N_\gamma s_\gamma C_{W\gamma}$
N_c	5.14		Table 10.6.3.1.2a-1 or Figures 10.6.3.1.2c-1 or 10.6.3.1.2c-2
N_q	1		
N_γ	0		
s_c	1.05		$=1+(B'/L_f)*(N_q/N_c)$; or 1+(B'/5Lf) for ϕ = 0
s_q	1.00		$=1+(B'/L_f)*\tan\phi_f$; or 1.0 for ϕ = 0
s_γ	1.00		$=1-0.4*(B'/L_f)$; or 1.0 for ϕ = 0
Footing Length, L_f	85	ft	
C_{Wq}	1.00		Table 10.6.3.1.2a-2
$C_{W\gamma}$	0.88		
Footing Depth, D_f	3	ft	
GW Depth, D_W	28	ft	
$1.5B'+D_f$	35.53	ft	
D_f/B'	0.14		
d_q	1.00		Hansen 1970 or Table 10.6.3.1.2a-4

Sliding

ϕ_τ	1.0	Table 11.5.6-1

Group/Item Units	V_{dl} (kip/ft)	R_τ (kip/ft)	ϕ_τ	R_R (kip/ft)	H_{total} (kip/ft)	$R_R>=H_{total}$ Check
Granular Analysis - Strength Ia	121.28	0.00	1.00	0.00	51.09	**NA**
Cohesive Analysis - Strength Ia		60.64	1.00	60.64	51.09	**OK**

Determine Sliding Resistance of Foundations on Clay per Sections C11.10.5.4, 10.6.3.4

S_u =	2.25	ksf
$\sigma'_{v\ avg}$ =	4.37	ksf
$1/2\sigma'_{v\ avg}$ =	2.18	ksf

Structure	Hayden Run Boulevard	
Type	MSE Perpendicular to Road at Station 100+00	
Boring	B-004	
Top of Leveling Pad Elevation	925	
Soils at Foundation Level	A-4a	
$N_{60\ Avg}$	50	bpf
S_u	4500	psf

Location **Hayden Run Boulevard**
Wall Type **MSE Perpendicular to Road at Station 100+00**

Wall Dimensions

Roadway Profile Grade	966		
Top Wall	955		
Top of Leveling Pad	925		
Back Wall to Back Abutment, X	0	feet	
Wall Face Height, H	30.000	feet	
Effective Height, h	41.000	feet	
Reinforcement Length Multiplier	0.70		0.7 to 1.5
Reinforcement Length, L	28.7	feet	8 ft. minimum
Angle of Back Face of Wall, θ	90	Degrees	
Facing Width	0.46	feet	5.5 inches
Reinforced Zone & Facing, B	29.2	feet	

Sloping Backfill

Slope Rate, β	2	:1 (H:V)
Effective Slope Rate, β'	10.39	deg

Soil Data

Internal	ϕ	34	degrees
	γ	120	pcf
Retained	ϕ_r	30	degrees
	γ_r	120	pcf
	$\delta_r = \beta$	10.39	degrees
Foundation	ϕ_f	0	degrees
	γ_f	120	pcf
	c_f	4500	psf

Unfactored Loads

Vertical Earth Pressure, EV

Weight of Reinforced Zone, V_1	103.32	kips/ft	
Weight of Soil Wedge Above Reinforced Zone, V_2	14.52	kips/ft	
Weight of Soil Block Above Reinforced Zone, V_3	8.84	kips/ft	

Horizontal Earth Pressure, EH

	35.39	kips/ft	
Γ	2.17		
K_a	0.35		
Horizontal Component, EH_H	34.81	kips/ft	EH * cos(δ_r)
Vertical Component, EH_V	6.38	kips/ft	EH * sin(δ_r)

Live Load Surcharge (Active), LSA

Equivalent Height of Soil, h_{eq}	2	ft	From Table 3.11.6.4-1 or -2
LSA	3.45	kips/ft	$h_{eq} * \gamma_r * K_a * h$
Horizontal Component, LSA_H	3.40	kips/ft	LSA * cos(δ_r)
Vertical Component, LSA_V	0.62	kips/ft	LSA * sin(δ_r)

Live Load Surchage above Reinf., LSH_V **Use for Bearing Capacity Only**

Loading over Reinforcement (y or n) y

LSH_V 1.61 kips/ft $h_{eq} * \gamma_r * (L-x_2)$

Unfactored Vertical Loads and Resisting Moments

Item	V (kips/ft)	Moment Arm About Pt. C (ft)	Positive/ Negative	Moment about C (kip-ft/ft)
V_1	103.32	0.23	1	23.68
V_2	14.52	25.88	1	375.77
V_3	8.84	9.08	1	80.30
EH_V	6.38	14.58	1	93.04
LSA_V	0.62	14.58	1	9.08
LSH_V	1.61	0.23	1	0.37
TOTAL	135.30			

Unfactored Horizontal Loads and Overturning Moments

Item	H (kips/ft)	Moment Arm About Pt. C (ft)	Positive/ Negative	Moment about C (kip-ft/ft)
EH_H	34.81	13.67	-1	-475.75
LSA_H	3.40	20.50	-1	-69.62
TOTAL	38.21			

Load Factors

Group	γ_{EV}	$\gamma_{EH\ (active)}$	γ_{ES}	γ_{LS}	
Strength Ia	1.00	1.50	0.75	1.75	Tables 3.4.1-1 & 3.4.1-2
Strength Ib	1.35	1.50	1.50	1.75	
Service I	1.00	1.00	1.00	1.00	

Factored Vertical Loads in kips/ft

Group/Item	V_1	V_2	EH_V	LSA_V	LSH_V	Total
V (Unfactored)	103.32	14.52	6.38	0.62	1.61	126.45
Strength Ia	103.32	14.52	9.57	1.09	2.81	131.32
Strength Ib	139.48	19.60	9.57	1.09	2.81	172.56
Service I	103.32	14.52	6.38	0.62	1.61	126.45

Factored Horizontal Loads in kips/ft

Group/Item	EH_H	LSA_H	Total
H (Unfactored)	34.81	3.40	38.21
Strength Ia	52.22	5.94	58.16
Strength Ib	52.22	5.94	58.16
Service I	34.81	3.40	38.21

Factored Moments from Vertical Forces (M_v) in kip-ft/ft

Group/Item	V_1	V_2	EH_V	LSA_V	LSH_V	Total
M_v (Unfactored)	23.68	375.77	93.04	9.08	0.37	501.93
Strength Ia	23.68	375.77	139.57	15.89	0.64	555.54
Strength Ib	31.96	507.28	139.57	15.89	0.64	695.34
Service I	23.68	375.77	93.04	9.08	0.37	501.93

Factored Moment from Horizontal Forces (M_h) in kip-ft/ft

Group/Item	EH_H	LSA_H	Total
M_h (Unfactored)	-475.75	-69.62	-545.37
Strength Ia	-713.62	-121.84	-835.46
Strength Ib	-713.62	-121.84	-835.46
Service I	-475.75	-69.62	-545.37

Eccentricity

Group/Item Units	V_{dl} (kip/ft)	H_{total} (kip/ft)	M_{vdl} (kip-ft/ft)	M_{htotal} (kip-ft/ft)	e (ft)	e_{max} (ft)	$e<=e_{max}$ Check
Strength Ia	128.50	58.16	554.89	-835.46	-2.18	7.29	**OK**

Bearing Resistance

Effective Footing Width, B' = B-2e

Group/Item Units	ΣV (kip/ft)	M_{vtotal} (kip-ft/ft)	M_{htotal} (kip-ft/ft)	e (ft)	B' (ft)	σ_v (ksf)	$q_r>=\sigma_v$ Check
Strength Ib	172.56	695.34	-835.46	-0.81	27.53	6.27	**OK**

Effective Footing Width, B'	27.53	feet	From Table above
Fact. Bearing Resistance, q_r	15.54	ksf	$=\phi_b*q_n$
Resistance Factor, ϕ_b	0.65		Table 11.5.6-1
Nom. Bearing Resistance, q_n	23.91	ksf	$=c_fN_cs_c+\gamma_rD_fN_qs_qd_qC_{Wq}+0.5\gamma_fB'N_\gamma s_\gamma C_{W\gamma}$
N_c	5.14		Table 10.6.3.1.2a-1 or Figures 10.6.3.1.2c-1 or 10.6.3.1.2c-2
N_q	1		
N_γ	0		
s_c	1.02		$=1+(B'/L_f)*(N_q/N_c)$; or 1+(B'/5Lf) for $\phi = 0$
s_q	1.00		$=1+(B'/L_f)*\tan\phi_f$; or 1.0 for $\phi = 0$
s_γ	1.00		$=1-0.4*(B'/L_f)$; or 1.0 for $\phi = 0$
Footing Length, L_f	300	ft	
C_{Wq}	1.00		Table 10.6.3.1.2a-2
$C_{W\gamma}$	0.80		
Footing Depth, D_f	3	ft	
GW Depth, D_W	28	ft	
$1.5B'+D_f$	44.30	ft	
D_f/B'	0.11		
d_q	1.00		Hansen 1970 or Table 10.6.3.1.2a-4

Sliding

ϕ_τ	1.0	Table 11.5.6-1

Group/Item Units	V_{dl} (kip/ft)	R_τ (kip/ft)	ϕ_τ	R_R (kip/ft)	H_{total} (kip/ft)	$R_R>=H_{total}$ Check
Granular Analysis - Strength Ia	128.50	0.00	1.00	0.00	58.16	**NA**
Cohesive Analysis - Strength Ia		64.25	1.00	64.25	58.16	**OK**

Determine Sliding Resistance of Foundations on Clay per Sections C11.10.5.4, 10.6.3.4

S_u =	4.5	ksf
$\sigma'_{v\ avg}$ =	4.41	ksf
$1/2\sigma'_{v\ avg}$ =	2.20	ksf

APPENDIX F
SETTLEMENT ANALYSES

Settlement Parameters

Project: Hayden Run Road
Location: Franklin Co., OH
Boring No.: B-004-0-12
Date: 7/18/13

Layer No.	Top Elev	Bottom Elev	Thickness (feet)	Type	Total Unit Weight (pcf)	N_{60} value (bpf)	Moisture Content (%)	Liquid Limit (LL)	Gs	Bearing Capacity Index (BCI)[1]	Sand Fraction (BCI)	Clay Fraction (BCI)	$e_0 = G_s*w/100$[1]	$C_c = 0.009(LL-10)$[2]	$C_c = w/100$[1]	$C_c = (1+e_0)/BCI$[1]	C_{cAvg}	$C_r = w/1000$[1]	C_v[2] (cm^2/sec)	Ref
1	932.8	927.3	5.5	A-6a	120	45	10	30	2.68				0.86				0.116	0.025	0.0072	3
2	927.3	921.8	5.5	A-4a	120	60.5	11	23	2.7	154.75	1	1	0.3	0.117	0.11	0.008	0.078	0.011	0.0074	
3	921.8	919.3	2.5	A-1-a	125	50	10	0	2.68	190	1		0.27			0.007	0.007	0.007	0.0281	
4	919.3	899.3	20	A-6a	120	30	13	29	2.7	70.8	1	2	0.35	0.171	0.13	0.019	0.107	0.013	0.0052	
5	899.3	894.3	5.0	A-1-b	125	50	10	0	2.7	190	1		0.71			0.009	0.009	0.009	0.0281	
6	894.3	882.8	11.5	A-6a	120	50	12	25	2.68	110.8	1	2	0.32	0.135	0.12	0.012	0.089	0.012	0.0066	

Reference Key

(1) FHWA NHI Course No. 13212
(2) Das, *Principles of Foundation Engineering* , Pg. 40
(3) Consolidation test B-003

ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration

INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION

Project Name	: Hayden Run Road	Client	: EMH&T
File Name	: At Piles	Project Manager	: JG
Date	: 07/18/13	Computed by	: re

Settlement for X = 50.00 (ft) Y = 6.00 (ft)

Embank. slope, x direc. =	2.00 (ft)	Height of fill H =	35.00 (ft)
y direc. =	2.00 (ft)	Unit weight of fill =	125.00 (pcf)
Embankment top width =	100.00 (ft)	p load/unit area =	4375.00 (psf)
Embankment bottom width =	104.00 (ft)	Foundation Elev. =	929.00 (ft)
Ground Surface Elev. =	932.80 (ft)		
Water table Elev. =	921.80 (ft)	Unit weight of Wat. =	62.40 (pcf)

N§.	LAYER TYPE	THICK. (ft)	COEFFICIENT COMP.	RECOMP.	SWELL.	UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	VOID RATIO	Settlement (in.)
1	COMP.	5.5	0.116	0.025	0.025	120.00	2.65	0.86	0.95
2	COMP.	5.5	0.078	0.011	0.011	120.00	2.65	0.30	0.39
3	COMP.	2.5	0.007	0.007	0.007	125.00	2.65	0.27	0.09
4	COMP.	20.0	0.107	0.013	0.013	120.00	2.65	0.35	0.87
5	COMP.	5.0	0.009	0.009	0.009	125.00	2.65	0.71	0.09
6	COMP.	11.5	0.089	0.012	0.012	120.00	2.65	0.32	0.28

Total Settlement = 2.67

N§.	SUBLAYER THICK. (ft)	ELEV. (ft)	SOIL STRESSES INITIAL (psf)	INCREMENT (psf)	MAX.PAST PRESS. (psf)	SETTLEMENT (in.)
1	1.70	928.15	558.00	4370.24	1000.00	0.95
2	5.50	924.55	990.00	4044.03	5341.86	0.39
3	2.50	920.55	1398.25	3531.16	1398.25	0.09
4	20.00	909.30	2052.50	2814.41	7648.59	0.87
5	5.00	896.80	2785.00	2441.76	2785.00	0.09
6	11.50	888.55	3272.70	2248.87	11470.77	0.28

Total Settlement = 2.67 (in.)

Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu

ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿

INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION

Project Name : Hayden Run Road Client : EMH&T
File Name : End Strap Project Manager : JG
Date : 07/18/13 Computed by : re

Settlement for X = 50.00 (ft) Y = 30.00 (ft)

Embank. slope, x direc. = 2.00 (ft) Height of fill H = 35.00 (ft)
y direc. = 2.00 (ft) Unit weight of fill = 125.00 (pcf)
Embankment top width = 100.00 (ft) p load/unit area = 4375.00 (psf)
Embankment bottom width = 104.00 (ft) Foundation Elev. = 929.00 (ft)
Ground Surface Elev. = 932.80 (ft)
Water table Elev. = 921.80 (ft) Unit weight of Wat. = 62.40 (pcf)

N§.	LAYER TYPE	THICK. (ft)	COEFFICIENT COMP.	RECOMP.	SWELL.	UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	VOID RATIO	Settlement (in.)
1	COMP.	5.5	0.116	0.025	0.025	120.00	2.65	0.86	0.95
2	COMP.	5.5	0.078	0.011	0.011	120.00	2.65	0.30	0.41
3	COMP.	2.5	0.007	0.007	0.007	125.00	2.65	0.27	0.10
4	COMP.	20.0	0.107	0.013	0.013	120.00	2.65	0.35	1.11
5	COMP.	5.0	0.009	0.009	0.009	125.00	2.65	0.71	0.12
6	COMP.	11.5	0.089	0.012	0.012	120.00	2.65	0.32	0.38

Total Settlement = 3.07

N§.	SUBLAYER THICK. (ft)	ELEV. (ft)	SOIL STRESSES INITIAL (psf)	INCREMENT (psf)	MAX.PAST PRESS. (psf)	SETTLEMENT (in.)
1	1.70	928.15	558.00	4374.97	1000.00	0.95
2	5.50	924.55	990.00	4370.77	5341.86	0.41
3	2.50	920.55	1398.25	4347.76	1398.25	0.10
4	20.00	909.30	2052.50	4121.62	7648.59	1.11
5	5.00	896.80	2785.00	3667.96	2785.00	0.12
6	11.50	888.55	3272.70	3337.79	11470.77	0.38

Total Settlement = 3.07 (in.)

ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ

ÚÄÄÄÄÄ ONE DIMENSIONAL SETTLEMENT ANALYSIS/Federal Highway Administration ÄÄÄÄÄ¿

INCREMENT OF STRESSES BENEATH THE END OF FILL CONDITION

Project Name : Hayden Run Road Client : EMH&T
File Name : Center Emb Project Manager : JG
Date : 07/18/13 Computed by : re

Settlement for X = 50.00 (ft) Y = 50.00 (ft)

Embank. slope, x direc. = 2.00 (ft) Height of fill H = 35.00 (ft)
y direc. = 2.00 (ft) Unit weight of fill = 125.00 (pcf)
Embankment top width = 100.00 (ft) p load/unit area = 4375.00 (psf)
Embankment bottom width = 104.00 (ft) Foundation Elev. = 932.80 (ft)
Ground Surface Elev. = 932.80 (ft)
Water table Elev. = 921.80 (ft) Unit weight of Wat. = 62.40 (pcf)

N§.	LAYER TYPE	THICK. (ft)	COEFFICIENT COMP.	RECOMP.	SWELL.	UNIT WEIGHT (pcf)	SPECIFIC GRAVITY	VOID RATIO	Settlement (in.)
1	COMP.	5.5	0.116	0.025	0.025	120.00	2.65	0.86	3.20
2	COMP.	5.5	0.078	0.011	0.011	120.00	2.65	0.30	0.41
3	COMP.	2.5	0.007	0.007	0.007	125.00	2.65	0.27	0.10
4	COMP.	20.0	0.107	0.013	0.013	120.00	2.65	0.35	1.11
5	COMP.	5.0	0.009	0.009	0.009	125.00	2.65	0.71	0.12
6	COMP.	11.5	0.089	0.012	0.012	120.00	2.65	0.32	0.40

Total Settlement = 5.34

N§.	SUBLAYER THICK. (ft)	ELEV. (ft)	SOIL STRESSES INITIAL (psf)	INCREMENT (psf)	MAX.PAST PRESS. (psf)	SETTLEMENT (in.)
1	5.50	930.05	330.00	4374.58	1000.00	3.20
2	5.50	924.55	990.00	4363.98	5341.86	0.41
3	2.50	920.55	1398.25	4340.31	1398.25	0.10
4	20.00	909.30	2052.50	4170.29	7648.59	1.11
5	5.00	896.80	2785.00	3818.65	2785.00	0.12
6	11.50	888.55	3272.70	3536.50	11470.77	0.40

Total Settlement = 5.34 (in.)

ÀÄÄÄÄÄ Hit arrow keys to display next screen. <F8> Print. <F10> Main Menu ÄÄÄÄÄÙ

Time Rate of Settlement Determination

Project: **Hayden Run Road**
Location: **Franklin Co., OH**
Boring No.: **B-004-0-12**
Date: **7/18/13**

At End of Wall - Pile Location

Top Elev	Bottom Elev	1 or 2 Sides Drained	Total Settlement (in)	H (feet)	Cv (cm2/sec)	Cv (ft2/day)	t (days)	Tv	U (%)	Settlement Remaining (in)
929	927.3	1	0.95	1.7	0.0072	0.6696	45	10.4263	1.00	0.00
927.3	921.8	2	0.39	2.75	0.0074	0.6900	45	4.105693	1.00	0.00
921.8	919.3	1	0.09	2.5	0.0281	2.6133	45	18.81576	1.00	0.00
919.3	899.3	2	0.87	10	0.0052	0.4875	45	0.21937	0.53	0.41
899.3	894.3	1	0.09	5	0.0281	2.6133	45	4.70394	1.00	0.00
894.3	882.8	2	0.28	5.75	0.0066	0.6145	45	0.836421	0.90	0.03
		Total	2.67	in					Total	0.4 in

At End of Straps

Top Elev	Bottom Elev	1 or 2 Sides Drained	Total Settlement (in)	H (feet)	Cv (cm2/sec)	Cv (ft2/day)	t (days)	Tv	U (%)	Settlement Remaining (in)
929	927.3	1	0.95	1.7	0.0072	0.6696	45	10.4263	1.00	0.00
927.3	921.8	2	0.41	2.75	0.0074	0.6900	45	4.105693	1.00	0.00
921.8	919.3	1	0.10	2.5	0.0281	2.6133	45	18.81576	1.00	0.00
919.3	899.3	2	1.11	10	0.0052	0.4875	45	0.21937	0.53	0.52
899.3	894.3	1	0.12	5	0.0281	2.6133	45	4.70394	1.00	0.00
894.3	882.8	2	0.38	5.75	0.0066	0.6145	45	0.836421	0.90	0.04
		Total	3.07	in					Total	0.6 in

At Center of Embankment

Top Elev	Bottom Elev	1 or 2 Sides Drained	Total Settlement (in)	H (feet)	Cv (cm2/sec)	Cv (ft2/day)	t (days)	Tv	U (%)	Settlement Remaining (in)
932.8	927.3	1	3.20	5.5	0.0072	10.788	15	5.349421	1.00	0.00
927.3	921.8	2	0.41	2.75	0.0074	0.689984	15	1.368564	0.97	0.01
921.8	919.3	1	0.10	2.5	0.0281	2.6133	15	6.27192	1.00	0.00
919.3	899.3	2	1.11	10	0.0052	0.48749	15	0.073123	0.32	0.75
899.3	894.3	1	0.12	5	0.0281	0.3534	15	0.21204	0.52	0.06
894.3	882.8	2	0.40	5.75	0.0066	0.614537	15	0.278807	0.59	0.16
		Total	5.34	in					Total	1.0 in

APPENDIX G
DRIVEN RESULTS

Project: Hayden Run Boulevard
Location: Dublin, Ohio
Boring No.: B-001-0-12 & B-002-0-12
Date: 7/11/13

Pile Foundations - Soil Parameters

Elevation 930 to 905

Average N = (13+14+25+36+26+19+24+17+6+10+19+20+16+21+33)/2
= 20 Bpf
Unit Weight= 125 pcf

qu = 0.25 Average N

qu = 5.0 ksf

cu = qu/2

cu = 2.5 ksf

Below Elevation 905

Average N = (42+50+50+46+59+36+43+57+76+73+53+53+60)/13
= 53.7 Bpf
Unit Weight = 135 pcf

qu = 13.4 ksf

cu = 6.7 ksf

Unconfined Compression, B-002-0-12, SS-8

qu = 20.6 ksf

cu = 10.3 ksf

Use cu = 7.5 ksf

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\PROGRA~1\DRIVEN\HAYDENRA.DVN
Project Name: Hayden Run Road Project Date: 01/16/2013
Project Client: EMHT
Computed By: re
Project Manager: JG

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 3.00 ft
Diameter of Pile: 12.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	35.00 ft
	- Driving/Restrike	35.00 ft
	- Ultimate:	35.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	25.00 ft	17.00%	125.00 pcf	2500.00 psf	T-80 Same
2	Cohesive	35.00 ft	17.00%	135.00 pcf	7500.00 psf	T-80 Same

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	1108.65 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1108.65 psf	20.93 Kips
18.01 ft	Cohesive	N/A	N/A	1216.22 psf	57.35 Kips
24.99 ft	Cohesive	N/A	N/A	1366.09 psf	94.37 Kips
25.01 ft	Cohesive	N/A	N/A	1785.00 psf	94.49 Kips
34.01 ft	Cohesive	N/A	N/A	1785.00 psf	144.96 Kips
43.01 ft	Cohesive	N/A	N/A	1907.15 psf	202.34 Kips
52.01 ft	Cohesive	N/A	N/A	2044.40 psf	267.91 Kips
59.99 ft	Cohesive	N/A	N/A	2166.10 psf	332.54 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
24.99 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
25.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
34.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
43.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	53.01 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
2.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
3.00 ft	0.00 Kips	17.67 Kips	17.67 Kips
9.01 ft	20.93 Kips	17.67 Kips	38.60 Kips
18.01 ft	57.35 Kips	17.67 Kips	75.02 Kips
24.99 ft	94.37 Kips	17.67 Kips	112.05 Kips
25.01 ft	94.49 Kips	53.01 Kips	147.50 Kips
34.01 ft	144.96 Kips	53.01 Kips	197.97 Kips
43.01 ft	202.34 Kips	53.01 Kips	255.35 Kips
52.01 ft	267.91 Kips	53.01 Kips	320.92 Kips
59.99 ft	332.54 Kips	53.01 Kips	385.55 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	1108.65 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1108.65 psf	17.37 Kips
18.01 ft	Cohesive	N/A	N/A	1216.22 psf	47.60 Kips
24.99 ft	Cohesive	N/A	N/A	1366.09 psf	78.33 Kips
25.01 ft	Cohesive	N/A	N/A	1785.00 psf	78.43 Kips
34.01 ft	Cohesive	N/A	N/A	1785.00 psf	120.32 Kips
43.01 ft	Cohesive	N/A	N/A	1907.15 psf	167.94 Kips
52.01 ft	Cohesive	N/A	N/A	2044.40 psf	222.36 Kips
59.99 ft	Cohesive	N/A	N/A	2166.10 psf	276.01 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
24.99 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
25.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
34.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
43.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	53.01 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
2.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
3.00 ft	0.00 Kips	17.67 Kips	17.67 Kips
9.01 ft	17.37 Kips	17.67 Kips	35.05 Kips
18.01 ft	47.60 Kips	17.67 Kips	65.27 Kips
24.99 ft	78.33 Kips	17.67 Kips	96.00 Kips
25.01 ft	78.43 Kips	53.01 Kips	131.44 Kips
34.01 ft	120.32 Kips	53.01 Kips	173.33 Kips
43.01 ft	167.94 Kips	53.01 Kips	220.96 Kips
52.01 ft	222.36 Kips	53.01 Kips	275.38 Kips
59.99 ft	276.01 Kips	53.01 Kips	329.02 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	1108.65 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1108.65 psf	20.93 Kips
18.01 ft	Cohesive	N/A	N/A	1216.22 psf	57.35 Kips
24.99 ft	Cohesive	N/A	N/A	1366.09 psf	94.37 Kips
25.01 ft	Cohesive	N/A	N/A	1785.00 psf	94.49 Kips
34.01 ft	Cohesive	N/A	N/A	1785.00 psf	144.96 Kips
43.01 ft	Cohesive	N/A	N/A	1907.15 psf	202.34 Kips
52.01 ft	Cohesive	N/A	N/A	2044.40 psf	267.91 Kips
59.99 ft	Cohesive	N/A	N/A	2166.10 psf	332.54 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
24.99 ft	Cohesive	N/A	N/A	N/A	17.67 Kips
25.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
34.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
43.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	53.01 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	53.01 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
2.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
3.00 ft	0.00 Kips	17.67 Kips	17.67 Kips
9.01 ft	20.93 Kips	17.67 Kips	38.60 Kips
18.01 ft	57.35 Kips	17.67 Kips	75.02 Kips
24.99 ft	94.37 Kips	17.67 Kips	112.05 Kips
25.01 ft	94.49 Kips	53.01 Kips	147.50 Kips
34.01 ft	144.96 Kips	53.01 Kips	197.97 Kips
43.01 ft	202.34 Kips	53.01 Kips	255.35 Kips
52.01 ft	267.91 Kips	53.01 Kips	320.92 Kips
59.99 ft	332.54 Kips	53.01 Kips	385.55 Kips

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\PROGRA~1\DRIVEN\HAYDENRA.DVN
Project Name: Hayden Run Road Project Date: 01/16/2013
Project Client: EMHT
Computed By: re
Project Manager: JG

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 3.00 ft
Diameter of Pile: 14.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	35.00 ft
	- Driving/Restrike	35.00 ft
	- Ultimate:	35.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	25.00 ft	17.00%	125.00 pcf	2500.00 psf	T-80 Same
2	Cohesive	35.00 ft	17.00%	135.00 pcf	7500.00 psf	T-80 Same

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	1108.65 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1108.65 psf	24.42 Kips
18.01 ft	Cohesive	N/A	N/A	1170.18 psf	64.38 Kips
24.99 ft	Cohesive	N/A	N/A	1298.64 psf	104.67 Kips
25.01 ft	Cohesive	N/A	N/A	1785.00 psf	104.80 Kips
34.01 ft	Cohesive	N/A	N/A	1785.00 psf	163.68 Kips
43.01 ft	Cohesive	N/A	N/A	1867.92 psf	228.03 Kips
52.01 ft	Cohesive	N/A	N/A	1985.56 psf	301.29 Kips
59.99 ft	Cohesive	N/A	N/A	2089.87 psf	372.74 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
24.99 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
25.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
34.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
43.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	72.16 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
2.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
3.00 ft	0.00 Kips	24.05 Kips	24.05 Kips
9.01 ft	24.42 Kips	24.05 Kips	48.47 Kips
18.01 ft	64.38 Kips	24.05 Kips	88.43 Kips
24.99 ft	104.67 Kips	24.05 Kips	128.72 Kips
25.01 ft	104.80 Kips	72.16 Kips	176.95 Kips
34.01 ft	163.68 Kips	72.16 Kips	235.83 Kips
43.01 ft	228.03 Kips	72.16 Kips	300.19 Kips
52.01 ft	301.29 Kips	72.16 Kips	373.45 Kips
59.99 ft	372.74 Kips	72.16 Kips	444.90 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	1108.65 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1108.65 psf	20.27 Kips
18.01 ft	Cohesive	N/A	N/A	1170.18 psf	53.43 Kips
24.99 ft	Cohesive	N/A	N/A	1298.64 psf	86.87 Kips
25.01 ft	Cohesive	N/A	N/A	1785.00 psf	86.98 Kips
34.01 ft	Cohesive	N/A	N/A	1785.00 psf	135.85 Kips
43.01 ft	Cohesive	N/A	N/A	1867.92 psf	189.27 Kips
52.01 ft	Cohesive	N/A	N/A	1985.56 psf	250.07 Kips
59.99 ft	Cohesive	N/A	N/A	2089.87 psf	309.38 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
24.99 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
25.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
34.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
43.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	72.16 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
2.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
3.00 ft	0.00 Kips	24.05 Kips	24.05 Kips
9.01 ft	20.27 Kips	24.05 Kips	44.32 Kips
18.01 ft	53.43 Kips	24.05 Kips	77.49 Kips
24.99 ft	86.87 Kips	24.05 Kips	110.93 Kips
25.01 ft	86.98 Kips	72.16 Kips	159.14 Kips
34.01 ft	135.85 Kips	72.16 Kips	208.01 Kips
43.01 ft	189.27 Kips	72.16 Kips	261.42 Kips
52.01 ft	250.07 Kips	72.16 Kips	322.23 Kips
59.99 ft	309.38 Kips	72.16 Kips	381.54 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	1108.65 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1108.65 psf	24.42 Kips
18.01 ft	Cohesive	N/A	N/A	1170.18 psf	64.38 Kips
24.99 ft	Cohesive	N/A	N/A	1298.64 psf	104.67 Kips
25.01 ft	Cohesive	N/A	N/A	1785.00 psf	104.80 Kips
34.01 ft	Cohesive	N/A	N/A	1785.00 psf	163.68 Kips
43.01 ft	Cohesive	N/A	N/A	1867.92 psf	228.03 Kips
52.01 ft	Cohesive	N/A	N/A	1985.56 psf	301.29 Kips
59.99 ft	Cohesive	N/A	N/A	2089.87 psf	372.74 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
24.99 ft	Cohesive	N/A	N/A	N/A	24.05 Kips
25.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
34.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
43.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	72.16 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	72.16 Kips

ULTIMATE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
2.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
3.00 ft	0.00 Kips	24.05 Kips	24.05 Kips
9.01 ft	24.42 Kips	24.05 Kips	48.47 Kips
18.01 ft	64.38 Kips	24.05 Kips	88.43 Kips
24.99 ft	104.67 Kips	24.05 Kips	128.72 Kips
25.01 ft	104.80 Kips	72.16 Kips	176.95 Kips
34.01 ft	163.68 Kips	72.16 Kips	235.83 Kips
43.01 ft	228.03 Kips	72.16 Kips	300.19 Kips
52.01 ft	301.29 Kips	72.16 Kips	373.45 Kips
59.99 ft	372.74 Kips	72.16 Kips	444.90 Kips

DRIVEN 1.2

GENERAL PROJECT INFORMATION

Filename: C:\PROGRA~1\DRIVEN\HAYDENRA.DVN
Project Name: Hayden Run Road Project Date: 01/16/2013
Project Client: EMHT
Computed By: re
Project Manager: JG

PILE INFORMATION

Pile Type: Pipe Pile - Closed End
Top of Pile: 3.00 ft
Diameter of Pile: 16.00 in

ULTIMATE CONSIDERATIONS

Water Table Depth At Time Of:	- Drilling:	35.00 ft
	- Driving/Restrike	35.00 ft
	- Ultimate:	35.00 ft
Ultimate Considerations:	- Local Scour:	0.00 ft
	- Long Term Scour:	0.00 ft
	- Soft Soil:	0.00 ft

ULTIMATE PROFILE

Layer	Type	Thickness	Driving Loss	Unit Weight	Strength	Ultimate Curve
1	Cohesive	25.00 ft	17.00%	125.00 pcf	2500.00 psf	T-80 Same
2	Cohesive	35.00 ft	17.00%	135.00 pcf	7500.00 psf	T-80 Same

RESTRIKE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	1108.65 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1108.65 psf	27.91 Kips
18.01 ft	Cohesive	N/A	N/A	1135.65 psf	71.40 Kips
24.99 ft	Cohesive	N/A	N/A	1248.05 psf	114.96 Kips
25.01 ft	Cohesive	N/A	N/A	1785.00 psf	115.10 Kips
34.01 ft	Cohesive	N/A	N/A	1785.00 psf	182.39 Kips
43.01 ft	Cohesive	N/A	N/A	1838.49 psf	253.72 Kips
52.01 ft	Cohesive	N/A	N/A	1941.43 psf	334.68 Kips
59.99 ft	Cohesive	N/A	N/A	2032.70 psf	412.95 Kips

RESTRIKE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
24.99 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
25.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
34.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
43.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	94.25 Kips

RESTRIKE - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
2.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
3.00 ft	0.00 Kips	31.42 Kips	31.42 Kips
9.01 ft	27.91 Kips	31.42 Kips	59.33 Kips
18.01 ft	71.40 Kips	31.42 Kips	102.82 Kips
24.99 ft	114.96 Kips	31.42 Kips	146.38 Kips
25.01 ft	115.10 Kips	94.25 Kips	209.35 Kips
34.01 ft	182.39 Kips	94.25 Kips	276.64 Kips
43.01 ft	253.72 Kips	94.25 Kips	347.97 Kips
52.01 ft	334.68 Kips	94.25 Kips	428.93 Kips
59.99 ft	412.95 Kips	94.25 Kips	507.20 Kips

DRIVING - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	1108.65 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1108.65 psf	23.17 Kips
18.01 ft	Cohesive	N/A	N/A	1135.65 psf	59.26 Kips
24.99 ft	Cohesive	N/A	N/A	1248.05 psf	95.42 Kips
25.01 ft	Cohesive	N/A	N/A	1785.00 psf	95.53 Kips
34.01 ft	Cohesive	N/A	N/A	1785.00 psf	151.39 Kips
43.01 ft	Cohesive	N/A	N/A	1838.49 psf	210.59 Kips
52.01 ft	Cohesive	N/A	N/A	1941.43 psf	277.78 Kips
59.99 ft	Cohesive	N/A	N/A	2032.70 psf	342.75 Kips

DRIVING - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
24.99 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
25.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
34.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
43.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	94.25 Kips

DRIVING - SUMMARY OF CAPACITIES

Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
2.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
3.00 ft	0.00 Kips	31.42 Kips	31.42 Kips
9.01 ft	23.17 Kips	31.42 Kips	54.58 Kips
18.01 ft	59.26 Kips	31.42 Kips	90.68 Kips
24.99 ft	95.42 Kips	31.42 Kips	126.83 Kips
25.01 ft	95.53 Kips	94.25 Kips	189.78 Kips
34.01 ft	151.39 Kips	94.25 Kips	245.64 Kips
43.01 ft	210.59 Kips	94.25 Kips	304.84 Kips
52.01 ft	277.78 Kips	94.25 Kips	372.03 Kips
59.99 ft	342.75 Kips	94.25 Kips	437.00 Kips

ULTIMATE - SKIN FRICTION

Depth	Soil Type	Effective Stress At Midpoint	Sliding Friction Angle	Adhesion	Skin Friction
0.01 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	0.00 psf	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	1108.65 psf	0.00 Kips
9.01 ft	Cohesive	N/A	N/A	1108.65 psf	27.91 Kips
18.01 ft	Cohesive	N/A	N/A	1135.65 psf	71.40 Kips
24.99 ft	Cohesive	N/A	N/A	1248.05 psf	114.96 Kips
25.01 ft	Cohesive	N/A	N/A	1785.00 psf	115.10 Kips
34.01 ft	Cohesive	N/A	N/A	1785.00 psf	182.39 Kips
43.01 ft	Cohesive	N/A	N/A	1838.49 psf	253.72 Kips
52.01 ft	Cohesive	N/A	N/A	1941.43 psf	334.68 Kips
59.99 ft	Cohesive	N/A	N/A	2032.70 psf	412.95 Kips

ULTIMATE - END BEARING

Depth	Soil Type	Effective Stress At Tip	Bearing Cap. Factor	Limiting End Bearing	End Bearing
0.01 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
2.99 ft	Cohesive	N/A	N/A	N/A	0.00 Kips
3.00 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
9.01 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
18.01 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
24.99 ft	Cohesive	N/A	N/A	N/A	31.42 Kips
25.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
34.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
43.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
52.01 ft	Cohesive	N/A	N/A	N/A	94.25 Kips
59.99 ft	Cohesive	N/A	N/A	N/A	94.25 Kips

ULTIMATE - SUMMARY OF CAPACITIES

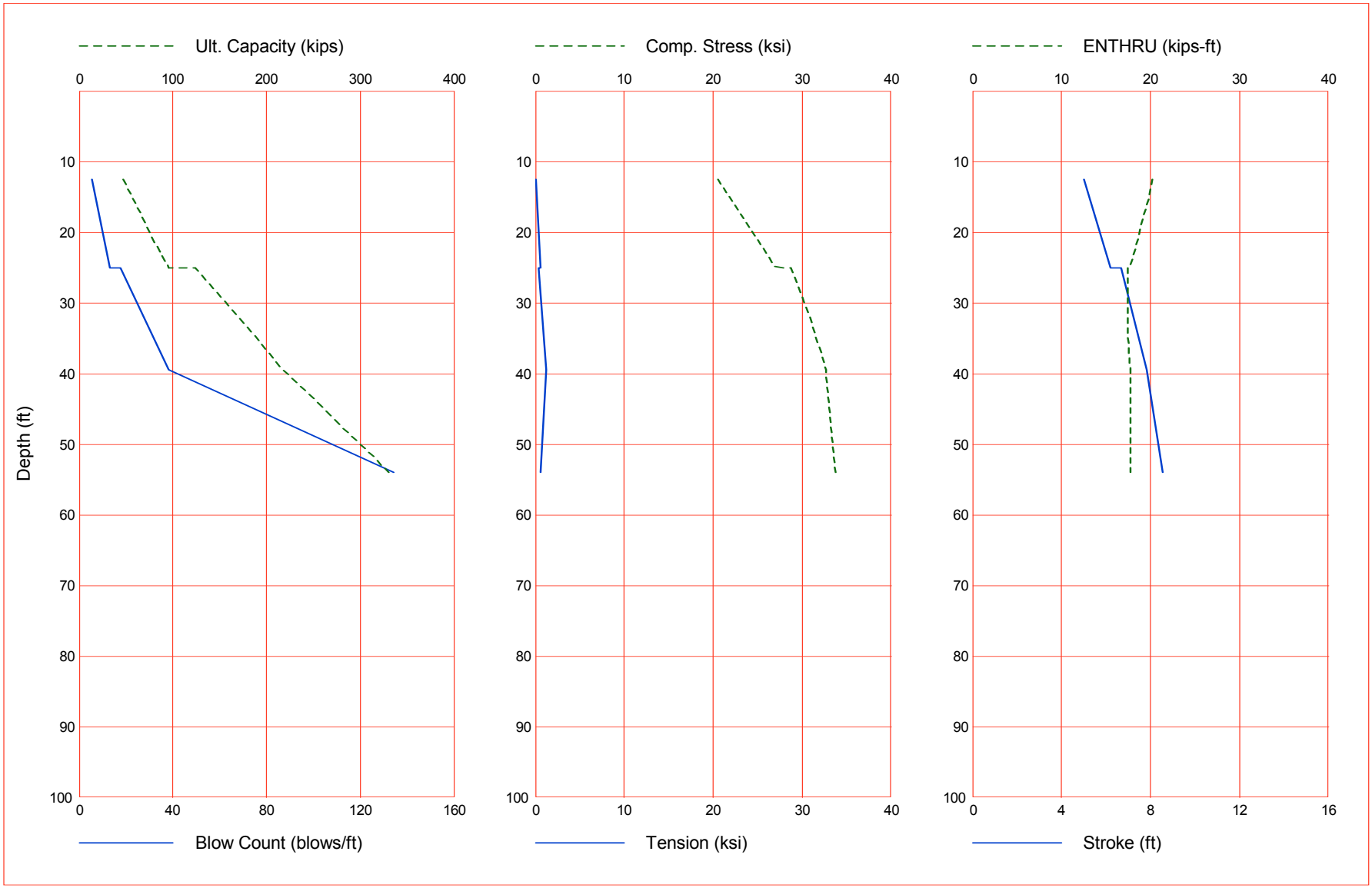
Depth	Skin Friction	End Bearing	Total Capacity
0.01 ft	0.00 Kips	0.00 Kips	0.00 Kips
2.99 ft	0.00 Kips	0.00 Kips	0.00 Kips
3.00 ft	0.00 Kips	31.42 Kips	31.42 Kips
9.01 ft	27.91 Kips	31.42 Kips	59.33 Kips
18.01 ft	71.40 Kips	31.42 Kips	102.82 Kips
24.99 ft	114.96 Kips	31.42 Kips	146.38 Kips
25.01 ft	115.10 Kips	94.25 Kips	209.35 Kips
34.01 ft	182.39 Kips	94.25 Kips	276.64 Kips
43.01 ft	253.72 Kips	94.25 Kips	347.97 Kips
52.01 ft	334.68 Kips	94.25 Kips	428.93 Kips
59.99 ft	412.95 Kips	94.25 Kips	507.20 Kips

APPENDIX H
GRL WEAP ANALYSES

CTL Engineering Inc
Hayden Run 12" CIP-0.375" Wall 43 Kipft

Jul 11 2013
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
12.5	47.2	33.3	13.9	5.3	20.549	0.000	5.01	20.2
25.0	96.0	82.1	13.9	13.0	27.017	-0.563	6.19	17.6
25.0	123.9	82.3	41.6	17.6	28.737	-0.383	6.66	17.4
39.5	217.4	175.8	41.6	38.3	32.662	-1.264	7.82	17.8
54.0	330.3	288.7	41.6	134.2	33.784	-0.603	8.56	17.8

Total Continuous Driving Time 43.00 minutes; Total Number of Blows 1805

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local non-axial stresses and prestress effects must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: C:\2013\9529.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (3/21/2012)

Input File Contents

Hayden Run 12" CIP-0.375" Wall 43 Kipft

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size		Pile Type		
32.170	32.170	113.090	12.000		Pipe		

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.700	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
60.000	13.69	29000.0	492.000	3.141	0	0.850	0.010

Manufac Hmr Name HmrType No Seg-s
DELMAG D 19-42 1 5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.100	0.150	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
3.00	1.11	13.88	0.10	0.10	0.20	0.15	1.21	0.00	0.0
9.01	1.11	13.88	0.10	0.10	0.20	0.15	1.21	0.00	0.0
18.01	1.22	13.88	0.10	0.10	0.20	0.15	1.21	0.00	0.0
24.99	1.37	13.88	0.10	0.10	0.20	0.15	1.21	0.00	0.0
25.01	2.00	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
34.01	2.00	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
43.01	2.50	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
52.01	2.50	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
59.99	2.50	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
60.00	2.50	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0

Gain/Loss factors: shaft and toe

1.00000	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
12.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
39.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
54.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1	0	10.81000	11.86000	

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

Hayden Run 12" CIP-0.375" Wall 43 Kipft

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.700	60155.0	0.800	0.0100	5.8
Combined Pile Top		9925.2			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

Depth (ft) 12.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 47.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	50.00	3.1	13.7
16	0.156	9925	0.000	0.000	1.00	9.9	0.200	0.100	53.33	3.1	13.7
17	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	56.67	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	11.8	0.200	0.100	60.00	3.1	13.7
Toe						13.9	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:
Uniform pile Pile Segments: Automatic
No. of Slacks/Splices 0 Pile Damping (%) 1
Pile Damping Fact.(k/ft/s) 0.481

Driveability Analysis
Soil Damping Option Smith
Max No Analysis Iterations 0 Time Increment/Critical 160
Output Time Interval 1 Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
12.50	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
47.2	5.3	5.01	4.99	0.00	1	0	20.55	15	5	20.2	52.7
41.0	4.4	4.80	4.78	0.00	1	0	19.19	9	4	20.7	53.9
41.5	4.5	4.82	4.80	0.00	1	0	19.34	9	4	20.7	53.8
42.1	4.6	4.84	4.82	0.00	1	0	19.47	9	4	20.7	53.7
42.7	4.7	4.86	4.84	0.00	1	0	19.58	9	4	20.6	53.6
1		0	10.81000		11.86000						

Hayden Run 12" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 96.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.1	13.7
11	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.1	13.7
12	0.156	9925	0.000	0.000	1.00	6.9	0.200	0.100	40.00	3.1	13.7
13	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	43.33	3.1	13.7
14	0.156	9925	0.000	0.000	1.00	11.7	0.200	0.100	46.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	12.1	0.200	0.100	50.00	3.1	13.7
16	0.156	9925	0.000	0.000	1.00	12.6	0.200	0.100	53.33	3.1	13.7
17	0.156	9925	0.000	0.000	1.00	13.2	0.200	0.100	56.67	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	13.9	0.200	0.100	60.00	3.1	13.7
Toe						13.9	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.98	10.81	1.00	0.800

Rut	Bl Ct	Stroke (ft)		Ten Str	i	t	Comp Str	i	t	ENTHRU	Bl Rt
kips	b/ft	down	up	ksi			ksi			kip-ft	b/min
96.0	13.0	6.19	6.21	-0.56	12	39	27.02	12	4	17.6	47.3
80.6	10.4	5.88	5.90	-0.81	12	45	25.56	12	4	18.1	48.5
82.0	10.7	5.91	5.93	-0.79	12	45	25.67	12	4	18.1	48.4
83.4	10.9	5.94	5.96	-0.75	12	45	25.85	12	4	18.0	48.2
84.8	11.1	5.97	5.98	-0.68	12	44	26.00	12	4	18.0	48.1

1 0 10.81000 11.86000

Hayden Run 12" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L	b Top	Area	E-Mod	Spec Wt	Perim	C Index	Wave Sp	EA/c
	ft	in2	ksi	lb/ft3	ft		ft/s	k/ft/s
	0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
	60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 123.9

No.	Weight	Stiffn	C-Slk	T-Slk	CoR	Soil-S	Soil-D	Quake	LbTop	Perim	Area
	kips	k/in	ft	ft		kips	s/ft	inch	ft	ft	in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.1	13.7
11	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.1	13.7
12	0.156	9925	0.000	0.000	1.00	7.1	0.200	0.100	40.00	3.1	13.7
13	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	43.33	3.1	13.7
14	0.156	9925	0.000	0.000	1.00	11.7	0.200	0.100	46.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	12.2	0.200	0.100	50.00	3.1	13.7
16	0.156	9925	0.000	0.000	1.00	12.6	0.200	0.100	53.33	3.1	13.7
17	0.156	9925	0.000	0.000	1.00	13.2	0.200	0.100	56.67	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	14.0	0.200	0.100	60.00	3.1	13.7
Toe						41.6	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

Depth	Stroke	Pressure	Efficy
ft	ft	Ratio	
25.02	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
123.9	17.6	6.66	6.63	-0.38	12	34	28.74	12	4	17.4	45.7
108.5	14.6	6.41	6.35	-0.64	12	38	27.56	12	4	17.7	46.6
109.9	14.9	6.44	6.38	-0.61	12	38	27.65	12	4	17.6	46.5
111.3	15.1	6.46	6.41	-0.58	12	38	27.76	12	4	17.6	46.4
112.7	15.4	6.48	6.44	-0.55	12	38	27.87	12	4	17.5	46.3
1		0	10.81000		11.86000						

Hayden Run 12" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 39.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 217.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.1	13.7
7	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	23.33	3.1	13.7
8	0.156	9925	0.000	0.000	1.00	11.0	0.200	0.100	26.67	3.1	13.7
9	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	30.00	3.1	13.7
10	0.156	9925	0.000	0.000	1.00	11.9	0.200	0.100	33.33	3.1	13.7
11	0.156	9925	0.000	0.000	1.00	12.3	0.200	0.100	36.67	3.1	13.7
12	0.156	9925	0.000	0.000	1.00	12.7	0.200	0.100	40.00	3.1	13.7
13	0.156	9925	0.000	0.000	1.00	13.4	0.200	0.100	43.33	3.1	13.7
14	0.156	9925	0.000	0.000	1.00	16.4	0.200	0.100	46.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	20.9	0.200	0.100	50.00	3.1	13.7
17	0.156	9925	0.000	0.000	1.00	21.3	0.200	0.100	56.67	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	23.2	0.200	0.100	60.00	3.1	13.7
Toe						41.6	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
39.49	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
217.4	38.3	7.82	7.79	-1.26	8	43	32.66	8	3	17.8	42.2
184.6	30.5	7.43	7.47	-0.51	8	48	31.07	8	3	17.1	43.2
187.6	31.1	7.47	7.50	-0.60	8	47	31.25	8	3	17.2	43.1
190.5	31.8	7.51	7.53	-0.67	8	47	31.37	8	3	17.2	43.0
193.5	32.4	7.54	7.56	-0.75	8	46	31.53	8	3	17.3	42.9
1		0	10.81000		11.86000						

Hayden Run 12" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 54.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 330.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	6.67	3.1	13.7
3	0.156	9925	0.000	0.000	1.00	3.5	0.200	0.100	10.00	3.1	13.7
4	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	13.33	3.1	13.7
5	0.156	9925	0.000	0.000	1.00	11.7	0.200	0.100	16.67	3.1	13.7
6	0.156	9925	0.000	0.000	1.00	12.0	0.200	0.100	20.00	3.1	13.7
7	0.156	9925	0.000	0.000	1.00	12.4	0.200	0.100	23.33	3.1	13.7
8	0.156	9925	0.000	0.000	1.00	13.0	0.200	0.100	26.67	3.1	13.7
9	0.156	9925	0.000	0.000	1.00	13.7	0.200	0.100	30.00	3.1	13.7
10	0.156	9925	0.000	0.000	1.00	18.9	0.200	0.100	33.33	3.1	13.7
11	0.156	9925	0.000	0.000	1.00	20.9	0.200	0.100	36.67	3.1	13.7
13	0.156	9925	0.000	0.000	1.00	21.9	0.200	0.100	43.33	3.1	13.7
14	0.156	9925	0.000	0.000	1.00	23.8	0.200	0.100	46.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	25.7	0.200	0.100	50.00	3.1	13.7
16	0.156	9925	0.000	0.000	1.00	26.2	0.200	0.100	53.33	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	26.2	0.200	0.100	60.00	3.1	13.7
Toe						41.6	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
54.00	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
330.3	134.2	8.56	8.55	-0.60	3	33	33.78	4	2	17.8	40.4
276.3	70.9	8.22	8.21	-0.38	3	36	32.55	4	2	17.4	41.2
281.2	74.6	8.26	8.25	-0.39	3	36	32.67	4	2	17.4	41.1
286.1	78.6	8.29	8.29	-0.40	3	35	32.82	4	2	17.4	41.1
291.0	82.7	8.32	8.32	-0.43	3	35	32.92	4	2	17.5	41.0

Hayden Run 12" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	47.2	33.3	13.9	5.3	20.549	0.000	5.01	20.2
25.0	96.0	82.1	13.9	13.0	27.017	-0.563	6.19	17.6
25.0	123.9	82.3	41.6	17.6	28.737	-0.383	6.66	17.4
39.5	217.4	175.8	41.6	38.3	32.662	-1.264	7.82	17.8
54.0	330.3	288.7	41.6	134.2	33.784	-0.603	8.56	17.8

Total Driving Time 43 minutes; Total No. of Blows 1805

G/L at Shaft and Toe: 0.813 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	41.0	27.1	13.9	4.4	19.185	0.000	4.80	20.7
25.0	80.6	66.7	13.9	10.4	25.555	-0.812	5.88	18.1
25.0	108.5	66.9	41.6	14.6	27.564	-0.639	6.41	17.7
39.5	184.6	142.9	41.6	30.5	31.069	-0.513	7.43	17.1
54.0	276.3	234.7	41.6	70.9	32.553	-0.375	8.22	17.4

Total Driving Time 27 minutes; Total No. of Blows 1182

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	41.5	27.7	13.9	4.5	19.338	0.000	4.82	20.7
25.0	82.0	68.1	13.9	10.7	25.669	-0.785	5.91	18.1
25.0	109.9	68.3	41.6	14.9	27.653	-0.614	6.44	17.6
39.5	187.6	145.9	41.6	31.1	31.248	-0.601	7.47	17.2
54.0	281.2	239.6	41.6	74.6	32.675	-0.389	8.26	17.4

Total Driving Time 28 minutes; Total No. of Blows 1223

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	42.1	28.2	13.9	4.6	19.468	0.000	4.84	20.7
25.0	83.4	69.5	13.9	10.9	25.850	-0.746	5.94	18.0
25.0	111.3	69.7	41.6	15.1	27.760	-0.584	6.46	17.6
39.5	190.5	148.9	41.6	31.8	31.368	-0.665	7.51	17.2
54.0	286.1	244.5	41.6	78.6	32.818	-0.405	8.29	17.4

Total Driving Time 29 minutes; Total No. of Blows 1268

Hayden Run 12" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	42.7	28.8	13.9	4.7	19.578	0.000	4.86	20.6
25.0	84.8	70.9	13.9	11.1	26.001	-0.676	5.97	18.0
25.0	112.7	71.1	41.6	15.4	27.873	-0.551	6.48	17.5
39.5	193.5	151.9	41.6	32.4	31.530	-0.746	7.54	17.3
54.0	291.0	249.4	41.6	82.7	32.916	-0.426	8.32	17.5

Total Driving Time 31 minutes; Total No. of Blows 1309

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
12.50	60.00	0.00	10.81	1.00	0.80	1.00	1.00
24.98	60.00	0.00	10.81	1.00	0.80	1.00	1.00
25.02	60.00	0.00	10.81	1.00	0.80	1.00	1.00
39.49	60.00	0.00	10.81	1.00	0.80	1.00	1.00
54.00	60.00	0.00	10.81	1.00	0.80	1.00	1.00

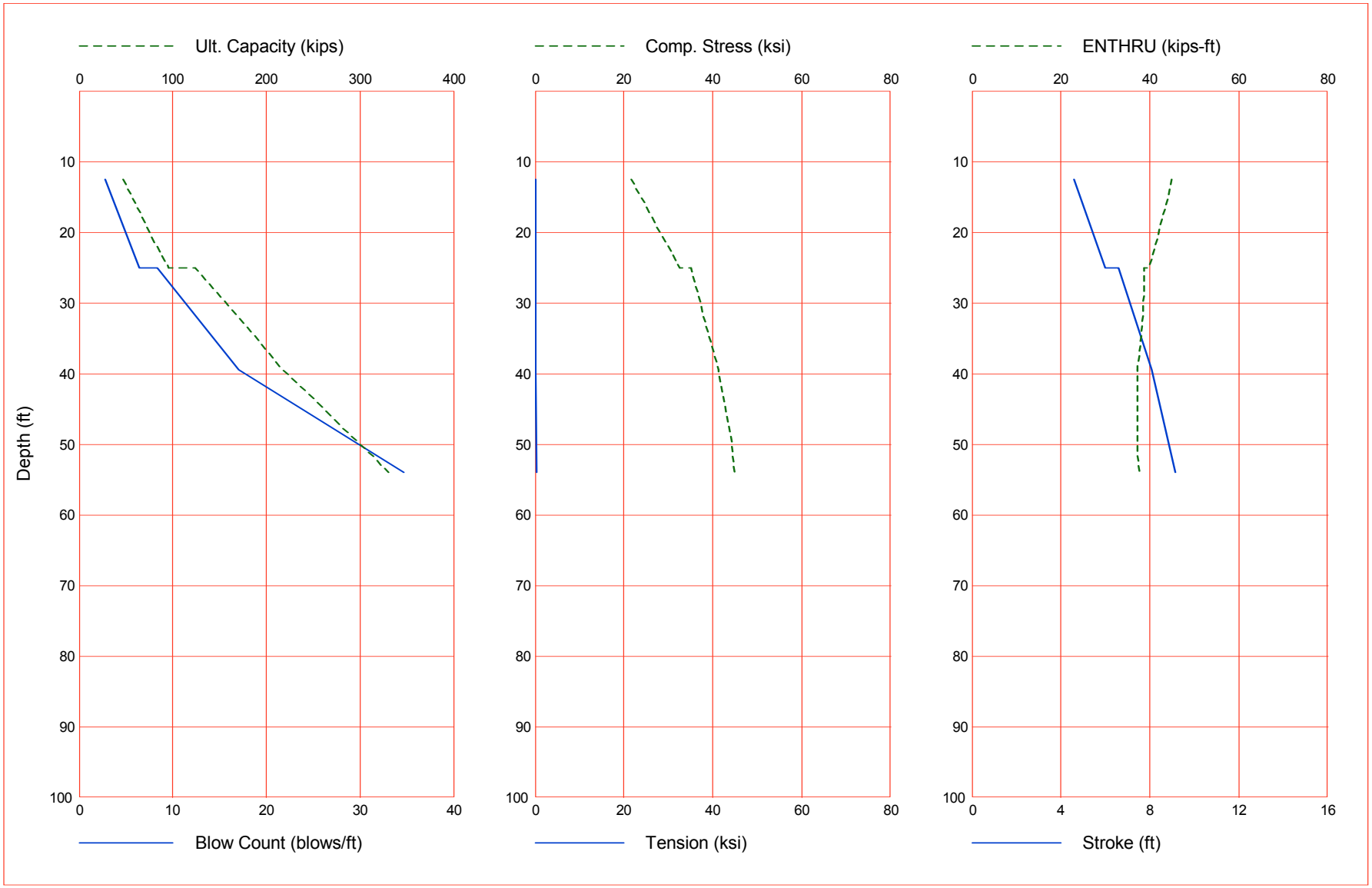
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
3.00	1.11	13.88	0.100	0.100	0.200	0.150	1.000	0.000	0.000
9.01	1.11	13.88	0.100	0.100	0.200	0.150	1.000	0.000	0.000
18.01	1.22	13.88	0.100	0.100	0.200	0.150	1.000	0.000	0.000
24.99	1.37	13.88	0.100	0.100	0.200	0.150	1.000	0.000	0.000
25.01	2.00	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
34.01	2.00	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
43.01	2.50	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
52.01	2.50	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
59.99	2.50	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
60.00	2.50	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000

CTL Engineering Inc
Hayden Run 12" CIP-0.375" Wall 72 Kipft

Jul 11 2013
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
12.5	47.2	33.3	13.9	2.8	21.680	0.000	4.60	45.0
25.0	96.0	82.1	13.9	6.4	32.437	-0.107	6.00	39.8
25.0	123.9	82.3	41.6	8.4	35.037	0.000	6.59	38.8
39.5	217.4	175.8	41.6	17.1	41.303	0.000	8.10	37.3
54.0	330.3	288.7	41.6	34.7	44.914	-0.399	9.15	37.7

Total Continuous Driving Time 15.00 minutes; Total Number of Blows 634

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local non-axial stresses and prestress effects must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: C:\2013\9529.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (3/21/2012)

Input File Contents

Hayden Run 12" CIP-0.375" Wall 72 Kipft

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	01251		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size		Pile Type		
32.170	32.170	113.090	12.000		Pipe		
W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp	
1.700	227.000	530.0	2.000	0.800	0.010	0.0	
A Cu	E Cu	T Cu	CoR	ROut	StCu		
0.000	0.0	0.000	0.000	0.000	0.0		
LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
60.000	13.69	29000.0	492.000	3.141	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s			
ICE	I-30 V2	1	5			
Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy	
6.61	123.20	16.51	13.70	10.84	0.80	
IB. Wt	IB. L	IB.Dia	IB CoR	IB RO		
1.43	28.10	16.50	0.900	0.010		

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
17.68	214.60	309.10	0.001	0.002	1.250	0.00	0.00
P atm	P1	P2	P3	P4	P5		
14.70	1436.00	1292.00	1163.00	1045.00	0.00		
Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000
Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.100	0.150	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
3.00	1.11	13.88	0.10	0.10	0.20	0.15	1.21	0.00	0.0
9.01	1.11	13.88	0.10	0.10	0.20	0.15	1.21	0.00	0.0
18.01	1.22	13.88	0.10	0.10	0.20	0.15	1.21	0.00	0.0
24.99	1.37	13.88	0.10	0.10	0.20	0.15	1.21	0.00	0.0
25.01	2.00	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
34.01	2.00	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
43.01	2.50	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
52.01	2.50	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
59.99	2.50	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0
60.00	2.50	41.63	0.10	0.10	0.20	0.15	1.21	0.00	0.0

Gain/Loss factors: shaft and toe

1.00000	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
12.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
39.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
54.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1	0	10.81000	13.70000	

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

Hayden Run 12" CIP-0.375" Wall 72 Kipft

Hammer Model: I-30 V2 Made by: ICE

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	1.323				
2	1.323	251965.7	1.000	0.0100	
3	1.323	251965.7	1.000	0.0100	
4	1.323	251965.7	1.000	0.0100	
5	1.323	251965.7	1.000	0.0100	
Imp Block	1.430	117641.7	0.900	0.0100	
Helmet	1.700	60155.0	0.800	0.0100	9.6
Combined Pile Top		9925.2			

HAMMER OPTIONS:

Hammer File ID No.	1251	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	6.61	Ram Length	(inch)	123.20
Maximum Stroke	(ft)	13.70			
Rated Stroke	(ft)	10.84	Efficiency		0.800
Maximum Pressure	(psi)	1436.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	16.51			
Combustion Delay	(s)	0.00050	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

Depth (ft) 12.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 47.2

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	50.00	3.1	13.7
16	0.156	9925	0.000	0.000	1.00	9.9	0.200	0.100	53.33	3.1	13.7
17	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	56.67	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	11.8	0.200	0.100	60.00	3.1	13.7
Toe						13.9	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:
Uniform pile Pile Segments: Automatic
No. of Slacks/Splices 0 Pile Damping (%) 1
Pile Damping Fact.(k/ft/s) 0.481

Driveability Analysis
Soil Damping Option Smith
Max No Analysis Iterations 0 Time Increment/Critical 160
Output Time Interval 1 Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
12.50	10.81	1.06	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
47.2	2.8	4.60	4.64	0.00	1	0	21.68	2	2	45.0	55.0
41.0	2.3	4.42	4.39	-0.11	16	84	20.52	1	4	46.6	56.3
41.5	2.4	4.42	4.42	-0.07	16	82	20.55	1	4	46.3	56.2
42.1	2.4	4.42	4.45	-0.01	16	81	20.60	1	4	46.0	56.1
42.7	2.4	4.48	4.46	0.00	1	0	20.89	1	4	46.2	55.9
1		0	10.81000		13.70000						

Hayden Run 12" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 96.0

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.1	13.7
11	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.1	13.7
12	0.156	9925	0.000	0.000	1.00	6.9	0.200	0.100	40.00	3.1	13.7
13	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	43.33	3.1	13.7
14	0.156	9925	0.000	0.000	1.00	11.7	0.200	0.100	46.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	12.1	0.200	0.100	50.00	3.1	13.7
16	0.156	9925	0.000	0.000	1.00	12.6	0.200	0.100	53.33	3.1	13.7
17	0.156	9925	0.000	0.000	1.00	13.2	0.200	0.100	56.67	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	13.9	0.200	0.100	60.00	3.1	13.7
Toe						13.9	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.98	10.81	1.06	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
96.0	6.4	6.00	6.03	-0.11	12	50	32.44	12	4	39.8	47.9
80.6	5.2	5.65	5.64	0.00	1	0	30.28	12	4	41.1	49.5
82.0	5.3	5.69	5.68	0.00	1	0	30.53	12	4	41.0	49.3
83.4	5.4	5.68	5.73	0.00	1	0	30.53	12	4	40.6	49.3
84.8	5.5	5.71	5.76	0.00	1	0	30.74	12	4	40.5	49.1

1 0 10.81000 13.70000

Hayden Run 12" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 123.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.1	13.7
11	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.1	13.7
12	0.156	9925	0.000	0.000	1.00	7.1	0.200	0.100	40.00	3.1	13.7
13	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	43.33	3.1	13.7
14	0.156	9925	0.000	0.000	1.00	11.7	0.200	0.100	46.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	12.2	0.200	0.100	50.00	3.1	13.7
16	0.156	9925	0.000	0.000	1.00	12.6	0.200	0.100	53.33	3.1	13.7
17	0.156	9925	0.000	0.000	1.00	13.2	0.200	0.100	56.67	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	14.0	0.200	0.100	60.00	3.1	13.7
Toe						41.6	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.02	10.81	1.06	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
123.9	8.4	6.59	6.53	0.00	1	0	35.04	12	4	38.8	45.9
108.5	7.1	6.19	6.21	0.00	1	0	33.00	12	4	39.3	47.2
109.9	7.2	6.22	6.24	0.00	1	0	33.21	12	4	39.3	47.1
111.3	7.4	6.26	6.27	0.00	1	0	33.39	12	4	39.2	47.0
112.7	7.5	6.29	6.30	0.00	1	0	33.50	12	4	39.1	46.9
1		0	10.81000		13.70000						

Hayden Run 12" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 39.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 217.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.1	13.7
7	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	23.33	3.1	13.7
8	0.156	9925	0.000	0.000	1.00	11.0	0.200	0.100	26.67	3.1	13.7
9	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	30.00	3.1	13.7
10	0.156	9925	0.000	0.000	1.00	11.9	0.200	0.100	33.33	3.1	13.7
11	0.156	9925	0.000	0.000	1.00	12.3	0.200	0.100	36.67	3.1	13.7
12	0.156	9925	0.000	0.000	1.00	12.7	0.200	0.100	40.00	3.1	13.7
13	0.156	9925	0.000	0.000	1.00	13.4	0.200	0.100	43.33	3.1	13.7
14	0.156	9925	0.000	0.000	1.00	16.4	0.200	0.100	46.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	20.9	0.200	0.100	50.00	3.1	13.7
17	0.156	9925	0.000	0.000	1.00	21.3	0.200	0.100	56.67	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	23.2	0.200	0.100	60.00	3.1	13.7
Toe						41.6	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
39.49	10.81	1.06	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
217.4	17.1	8.10	8.06	0.00	1	0	41.30	8	3	37.3	41.4
184.6	14.3	7.60	7.63	0.00	1	0	39.08	8	3	36.5	42.6
187.6	14.5	7.66	7.67	0.00	1	0	39.34	8	3	36.5	42.5
190.5	14.8	7.71	7.71	0.00	1	0	39.58	8	3	36.6	42.4
193.5	15.0	7.75	7.75	0.00	1	0	39.76	8	3	36.7	42.3

1 0 10.81000 13.70000

Hayden Run 12" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 54.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 113.090 Pile Type Pipe
Pile Size (inch) 12.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	13.69	29000.	492.0	3.1	0	16524.	24.0
60.0	13.69	29000.	492.0	3.1	0	16524.	24.0

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 330.3

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.156	9925	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.1	13.7
2	0.156	9925	0.000	0.000	1.00	0.0	0.200	0.100	6.67	3.1	13.7
3	0.156	9925	0.000	0.000	1.00	3.5	0.200	0.100	10.00	3.1	13.7
4	0.156	9925	0.000	0.000	1.00	11.6	0.200	0.100	13.33	3.1	13.7
5	0.156	9925	0.000	0.000	1.00	11.7	0.200	0.100	16.67	3.1	13.7
6	0.156	9925	0.000	0.000	1.00	12.0	0.200	0.100	20.00	3.1	13.7
7	0.156	9925	0.000	0.000	1.00	12.4	0.200	0.100	23.33	3.1	13.7
8	0.156	9925	0.000	0.000	1.00	13.0	0.200	0.100	26.67	3.1	13.7
9	0.156	9925	0.000	0.000	1.00	13.7	0.200	0.100	30.00	3.1	13.7
10	0.156	9925	0.000	0.000	1.00	18.9	0.200	0.100	33.33	3.1	13.7
11	0.156	9925	0.000	0.000	1.00	20.9	0.200	0.100	36.67	3.1	13.7
13	0.156	9925	0.000	0.000	1.00	21.9	0.200	0.100	43.33	3.1	13.7
14	0.156	9925	0.000	0.000	1.00	23.8	0.200	0.100	46.67	3.1	13.7
15	0.156	9925	0.000	0.000	1.00	25.7	0.200	0.100	50.00	3.1	13.7
16	0.156	9925	0.000	0.000	1.00	26.2	0.200	0.100	53.33	3.1	13.7
18	0.156	9925	0.000	0.000	1.00	26.2	0.200	0.100	60.00	3.1	13.7
Toe						41.6	0.150	0.100			

2.806 kips total unreduced pile weight (g= 32.17 ft/s2)
2.806 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
54.00	10.81	1.06	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
330.3	34.7	9.15	9.15	-0.40	3	38	44.91	4	6	37.7	39.1
276.3	25.3	8.68	8.69	0.00	1	0	42.33	4	2	36.7	40.0
281.2	26.0	8.73	8.73	0.00	1	0	42.47	4	2	36.8	40.0
286.1	26.7	8.78	8.78	-0.08	3	41	42.71	4	2	36.9	39.8
291.0	27.5	8.82	8.82	-0.15	3	41	42.88	4	6	37.0	39.8

Hayden Run 12" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	47.2	33.3	13.9	2.8	21.680	0.000	4.60	45.0
25.0	96.0	82.1	13.9	6.4	32.437	-0.107	6.00	39.8
25.0	123.9	82.3	41.6	8.4	35.037	0.000	6.59	38.8
39.5	217.4	175.8	41.6	17.1	41.303	0.000	8.10	37.3
54.0	330.3	288.7	41.6	34.7	44.914	-0.399	9.15	37.7

Total Driving Time 15 minutes; Total No. of Blows 634

G/L at Shaft and Toe: 0.813 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	41.0	27.1	13.9	2.3	20.517	-0.108	4.42	46.6
25.0	80.6	66.7	13.9	5.2	30.277	0.000	5.65	41.1
25.0	108.5	66.9	41.6	7.1	32.998	0.000	6.19	39.3
39.5	184.6	142.9	41.6	14.3	39.081	0.000	7.60	36.5
54.0	276.3	234.7	41.6	25.3	42.328	0.000	8.68	36.7

Total Driving Time 12 minutes; Total No. of Blows 504

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	41.5	27.7	13.9	2.4	20.554	-0.071	4.42	46.3
25.0	82.0	68.1	13.9	5.3	30.529	0.000	5.69	41.0
25.0	109.9	68.3	41.6	7.2	33.212	0.000	6.22	39.3
39.5	187.6	145.9	41.6	14.5	39.337	0.000	7.66	36.5
54.0	281.2	239.6	41.6	26.0	42.468	0.000	8.73	36.8

Total Driving Time 12 minutes; Total No. of Blows 514

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	42.1	28.2	13.9	2.4	20.596	-0.012	4.42	46.0
25.0	83.4	69.5	13.9	5.4	30.532	0.000	5.68	40.6
25.0	111.3	69.7	41.6	7.4	33.388	0.000	6.26	39.2
39.5	190.5	148.9	41.6	14.8	39.584	0.000	7.71	36.6
54.0	286.1	244.5	41.6	26.7	42.706	-0.079	8.78	36.9

Total Driving Time 12 minutes; Total No. of Blows 525

Hayden Run 12" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	42.7	28.8	13.9	2.4	20.886	0.000	4.48	46.2
25.0	84.8	70.9	13.9	5.5	30.740	0.000	5.71	40.5
25.0	112.7	71.1	41.6	7.5	33.502	0.000	6.29	39.1
39.5	193.5	151.9	41.6	15.0	39.759	0.000	7.75	36.7
54.0	291.0	249.4	41.6	27.5	42.885	-0.147	8.82	37.0

Total Driving Time 13 minutes; Total No. of Blows 536

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
12.50	60.00	0.00	10.81	1.06	0.80	1.00	1.00
24.98	60.00	0.00	10.81	1.06	0.80	1.00	1.00
25.02	60.00	0.00	10.81	1.06	0.80	1.00	1.00
39.49	60.00	0.00	10.81	1.06	0.80	1.00	1.00
54.00	60.00	0.00	10.81	1.06	0.80	1.00	1.00

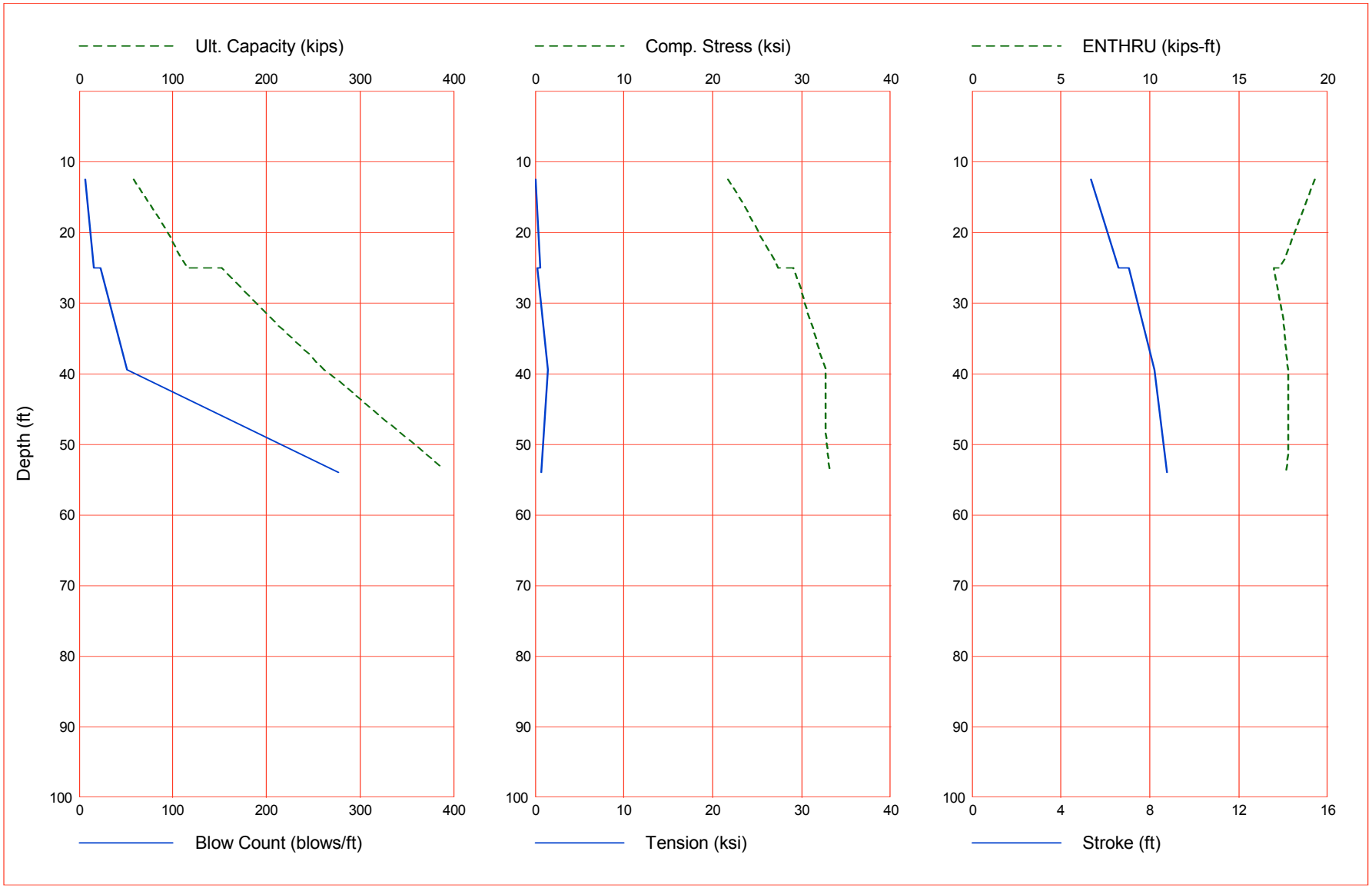
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
3.00	1.11	13.88	0.100	0.100	0.200	0.150	1.000	0.000	0.000
9.01	1.11	13.88	0.100	0.100	0.200	0.150	1.000	0.000	0.000
18.01	1.22	13.88	0.100	0.100	0.200	0.150	1.000	0.000	0.000
24.99	1.37	13.88	0.100	0.100	0.200	0.150	1.000	0.000	0.000
25.01	2.00	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
34.01	2.00	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
43.01	2.50	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
52.01	2.50	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
59.99	2.50	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000
60.00	2.50	41.63	0.100	0.100	0.200	0.150	1.000	0.000	0.000

CTL Engineering Inc
Hayden Run 14" CIP-0.375" Wall 43 Kipft

Jul 11 2013
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
12.5	57.8	38.9	18.9	6.6	21.660	0.000	5.36	19.3
25.0	114.7	95.8	18.9	16.1	27.370	-0.552	6.60	17.3
25.0	152.7	96.0	56.7	22.9	29.037	-0.264	7.08	17.0
39.5	261.8	205.1	56.7	51.3	32.652	-1.475	8.21	17.8
54.0	393.5	336.8	56.7	276.6	33.150	-0.683	8.78	17.7

Total Continuous Driving Time 76.00 minutes; Total Number of Blows 3101

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local non-axial stresses and prestress effects must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: C:\2013\9529.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (3/21/2012)

Input File Contents

Hayden Run 14" CIP-0.375" Wall 43 Kipft

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size	Pile Type
32.170	32.170	153.930	14.000	Pipe

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.700	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
60.000	16.05	29000.0	492.000	3.665	0	0.850	0.010

Manufac Hmr Name HmrType No Seg-s
DELMAG D 19-42 1 5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
0.75	25.30	12.60	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1520.00	1368.00	1231.00	1108.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.100	0.150	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
3.00	1.11	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
9.01	1.11	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
18.01	1.22	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
24.99	1.37	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
25.01	2.00	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
34.01	2.00	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
43.01	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
52.01	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
59.99	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
60.00	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0

Gain/Loss factors: shaft and toe

1.00000	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
12.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
39.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
54.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1	0	10.81000	11.86000	

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

Hayden Run 14" CIP-0.375" Wall 43 Kipft

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.700	60155.0	0.800	0.0100	5.8
Combined Pile Top		11636.2			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight (kips)	4.00	Ram Length (inch)	129.10
Maximum Stroke (ft)	11.86		
Rated Stroke (ft)	10.81	Efficiency	0.800
Maximum Pressure (psi)	1520.00	Actual Pressure (psi)	1520.00
Compression Exponent	1.350	Expansion Exponent	1.250
Ram Diameter (inch)	12.60		
Combustion Delay (s)	0.00200	Ignition Duration (s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION		PILE CUSHION	
Cross Sect. Area (in2)	227.00	Cross Sect. Area (in2)	0.00
Elastic-Modulus (ksi)	530.0	Elastic-Modulus (ksi)	0.0
Thickness (inch)	2.00	Thickness (inch)	0.00
Coeff of Restitution	0.8	Coeff of Restitution	1.0
RoundOut (ft)	0.0	RoundOut (ft)	0.0
Stiffness (kips/in)	60155.0	Stiffness (kips/in)	0.0

Depth (ft) 12.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 57.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	50.00	3.7	16.0
16	0.183	11636	0.000	0.000	1.00	11.5	0.200	0.100	53.33	3.7	16.0
17	0.183	11636	0.000	0.000	1.00	13.5	0.200	0.100	56.67	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	13.8	0.200	0.100	60.00	3.7	16.0
Toe						18.9	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:
Uniform pile Pile Segments: Automatic
No. of Slacks/Splices 0 Pile Damping (%) 1
Pile Damping Fact.(k/ft/s) 0.563

Driveability Analysis
Soil Damping Option Smith
Max No Analysis Iterations 0 Time Increment/Critical 160
Output Time Interval 1 Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
12.50	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
57.8	6.6	5.36	5.35	0.00	1	0	21.66	15	5	19.3	50.9
50.5	5.6	5.16	5.15	0.00	1	0	20.39	15	5	19.8	52.0
51.2	5.7	5.19	5.16	0.00	1	0	20.52	15	5	19.8	51.9
51.8	5.8	5.20	5.19	0.00	1	0	20.62	15	5	19.7	51.7
52.5	5.9	5.22	5.20	0.00	1	0	20.78	15	5	19.7	51.6
1		0	10.81000		11.86000						

Hayden Run 14" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 114.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	16.0
11	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.7	16.0
12	0.183	11636	0.000	0.000	1.00	8.1	0.200	0.100	40.00	3.7	16.0
13	0.183	11636	0.000	0.000	1.00	13.5	0.200	0.100	43.33	3.7	16.0
14	0.183	11636	0.000	0.000	1.00	13.7	0.200	0.100	46.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	14.2	0.200	0.100	50.00	3.7	16.0
16	0.183	11636	0.000	0.000	1.00	14.7	0.200	0.100	53.33	3.7	16.0
17	0.183	11636	0.000	0.000	1.00	15.4	0.200	0.100	56.67	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	16.2	0.200	0.100	60.00	3.7	16.0
Toe						18.9	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.98	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
114.7	16.1	6.60	6.55	-0.55	12	39	27.37	12	4	17.3	45.9
96.8	12.9	6.23	6.24	-0.59	12	39	25.82	12	4	17.5	47.2
98.4	13.1	6.26	6.28	-0.64	12	39	25.95	12	4	17.4	47.0
100.0	13.4	6.29	6.30	-0.68	12	39	26.10	12	4	17.5	47.0
101.6	13.6	6.38	6.32	-0.70	12	39	26.43	12	4	17.6	46.7
1		0	10.81000		11.86000						

Hayden Run 14" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 152.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	16.0
11	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.7	16.0
12	0.183	11636	0.000	0.000	1.00	8.2	0.200	0.100	40.00	3.7	16.0
13	0.183	11636	0.000	0.000	1.00	13.5	0.200	0.100	43.33	3.7	16.0
14	0.183	11636	0.000	0.000	1.00	13.7	0.200	0.100	46.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	14.2	0.200	0.100	50.00	3.7	16.0
16	0.183	11636	0.000	0.000	1.00	14.7	0.200	0.100	53.33	3.7	16.0
17	0.183	11636	0.000	0.000	1.00	15.4	0.200	0.100	56.67	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	16.3	0.200	0.100	60.00	3.7	16.0
Toe						56.7	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.02	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
152.7	22.9	7.08	7.07	-0.26	12	32	29.04	12	4	17.0	44.3
134.7	19.3	6.83	6.80	-0.62	12	34	27.93	12	4	17.2	45.1
136.4	19.6	6.85	6.83	-0.59	12	33	28.02	12	4	17.1	45.0
138.0	20.0	6.87	6.86	-0.57	12	33	28.11	12	4	17.1	45.0
139.6	20.3	6.89	6.88	-0.56	12	32	28.23	12	4	17.1	44.9
1		0	10.81000		11.86000						

Hayden Run 14" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 39.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 261.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	16.0
7	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	23.33	3.7	16.1
8	0.183	11636	0.000	0.000	1.00	12.9	0.200	0.100	26.67	3.7	16.1
9	0.183	11636	0.000	0.000	1.00	13.6	0.200	0.100	30.00	3.7	16.1
10	0.183	11636	0.000	0.000	1.00	13.9	0.200	0.100	33.33	3.7	16.1
11	0.183	11636	0.000	0.000	1.00	14.3	0.200	0.100	36.67	3.7	16.0
12	0.183	11636	0.000	0.000	1.00	14.9	0.200	0.100	40.00	3.7	16.0
13	0.183	11636	0.000	0.000	1.00	15.7	0.200	0.100	43.33	3.7	16.0
14	0.183	11636	0.000	0.000	1.00	19.2	0.200	0.100	46.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	24.4	0.200	0.100	50.00	3.7	16.0
17	0.183	11636	0.000	0.000	1.00	24.9	0.200	0.100	56.67	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	27.0	0.200	0.100	60.00	3.7	16.0
Toe						56.7	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
39.49	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
261.8	51.3	8.21	8.14	-1.48	8	40	32.65	8	3	17.8	41.3
223.4	39.5	7.82	7.82	-0.81	8	44	31.15	8	3	17.2	42.2
226.9	40.2	7.86	7.84	-0.88	8	44	31.27	8	3	17.3	42.1
230.4	41.3	7.89	7.87	-0.94	8	43	31.40	8	3	17.3	42.0
233.9	42.4	7.93	7.91	-1.00	8	43	31.58	8	3	17.3	41.9
	1		0	10.81000			11.86000				

Hayden Run 14" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 54.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 393.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	6.67	3.7	16.0
3	0.183	11636	0.000	0.000	1.00	4.1	0.200	0.100	10.00	3.7	16.1
4	0.183	11636	0.000	0.000	1.00	13.5	0.200	0.100	13.33	3.7	16.0
5	0.183	11636	0.000	0.000	1.00	13.6	0.200	0.100	16.67	3.7	16.0
6	0.183	11636	0.000	0.000	1.00	14.0	0.200	0.100	20.00	3.7	16.1
7	0.183	11636	0.000	0.000	1.00	14.5	0.200	0.100	23.33	3.7	16.1
8	0.183	11636	0.000	0.000	1.00	15.1	0.200	0.100	26.67	3.7	16.1
9	0.183	11636	0.000	0.000	1.00	16.0	0.200	0.100	30.00	3.7	16.1
10	0.183	11636	0.000	0.000	1.00	22.1	0.200	0.100	33.33	3.7	16.1
11	0.183	11636	0.000	0.000	1.00	24.4	0.200	0.100	36.67	3.7	16.0
13	0.183	11636	0.000	0.000	1.00	25.6	0.200	0.100	43.33	3.7	16.0
14	0.183	11636	0.000	0.000	1.00	27.8	0.200	0.100	46.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	30.0	0.200	0.100	50.00	3.7	16.0
16	0.183	11636	0.000	0.000	1.00	30.5	0.200	0.100	53.33	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	30.5	0.200	0.100	60.00	3.7	16.0
Toe						56.7	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
54.00	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
393.5	276.6	8.78	8.78	-0.68	3	31	33.15	4	2	17.7	39.9
330.5	109.5	8.50	8.49	-0.42	3	34	32.11	4	2	17.4	40.6
336.2	117.5	8.53	8.53	-0.43	3	33	32.24	4	2	17.3	40.5
342.0	125.0	8.56	8.55	-0.45	3	33	32.32	4	2	17.4	40.5
347.7	134.8	8.58	8.58	-0.47	3	33	32.43	4	2	17.4	40.4

Hayden Run 14" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	57.8	38.9	18.9	6.6	21.660	0.000	5.36	19.3
25.0	114.7	95.8	18.9	16.1	27.370	-0.552	6.60	17.3
25.0	152.7	96.0	56.7	22.9	29.037	-0.264	7.08	17.0
39.5	261.8	205.1	56.7	51.3	32.652	-1.475	8.21	17.8
54.0	393.5	336.8	56.7	276.6	33.150	-0.683	8.78	17.7

Total Driving Time 76 minutes; Total No. of Blows 3101

G/L at Shaft and Toe: 0.813 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	50.5	31.6	18.9	5.6	20.387	0.000	5.16	19.8
25.0	96.8	77.9	18.9	12.9	25.816	-0.590	6.23	17.5
25.0	134.7	78.1	56.7	19.3	27.932	-0.622	6.83	17.2
39.5	223.4	166.8	56.7	39.5	31.150	-0.807	7.82	17.2
54.0	330.5	273.8	56.7	109.5	32.114	-0.424	8.50	17.4

Total Driving Time 39 minutes; Total No. of Blows 1657

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	51.2	32.3	18.9	5.7	20.518	0.000	5.19	19.8
25.0	98.4	79.5	18.9	13.1	25.955	-0.640	6.26	17.4
25.0	136.4	79.7	56.7	19.6	28.018	-0.589	6.85	17.1
39.5	226.9	170.3	56.7	40.2	31.270	-0.884	7.86	17.3
54.0	336.2	279.6	56.7	117.5	32.236	-0.430	8.53	17.3

Total Driving Time 41 minutes; Total No. of Blows 1732

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	51.8	32.9	18.9	5.8	20.623	0.000	5.20	19.7
25.0	100.0	81.1	18.9	13.4	26.098	-0.680	6.29	17.5
25.0	138.0	81.3	56.7	20.0	28.109	-0.571	6.87	17.1
39.5	230.4	173.8	56.7	41.3	31.404	-0.941	7.89	17.3
54.0	342.0	285.3	56.7	125.0	32.315	-0.455	8.56	17.4

Total Driving Time 43 minutes; Total No. of Blows 1806

Hayden Run 14" CIP-0.375" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	52.5	33.6	18.9	5.9	20.777	0.000	5.22	19.7
25.0	101.6	82.7	18.9	13.6	26.432	-0.699	6.38	17.6
25.0	139.6	83.0	56.7	20.3	28.227	-0.562	6.89	17.1
39.5	233.9	177.2	56.7	42.4	31.577	-0.998	7.93	17.3
54.0	347.7	291.0	56.7	134.8	32.430	-0.474	8.58	17.4

Total Driving Time 45 minutes; Total No. of Blows 1900

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
12.50	60.00	0.00	10.81	1.00	0.80	1.00	1.00
24.98	60.00	0.00	10.81	1.00	0.80	1.00	1.00
25.02	60.00	0.00	10.81	1.00	0.80	1.00	1.00
39.49	60.00	0.00	10.81	1.00	0.80	1.00	1.00
54.00	60.00	0.00	10.81	1.00	0.80	1.00	1.00

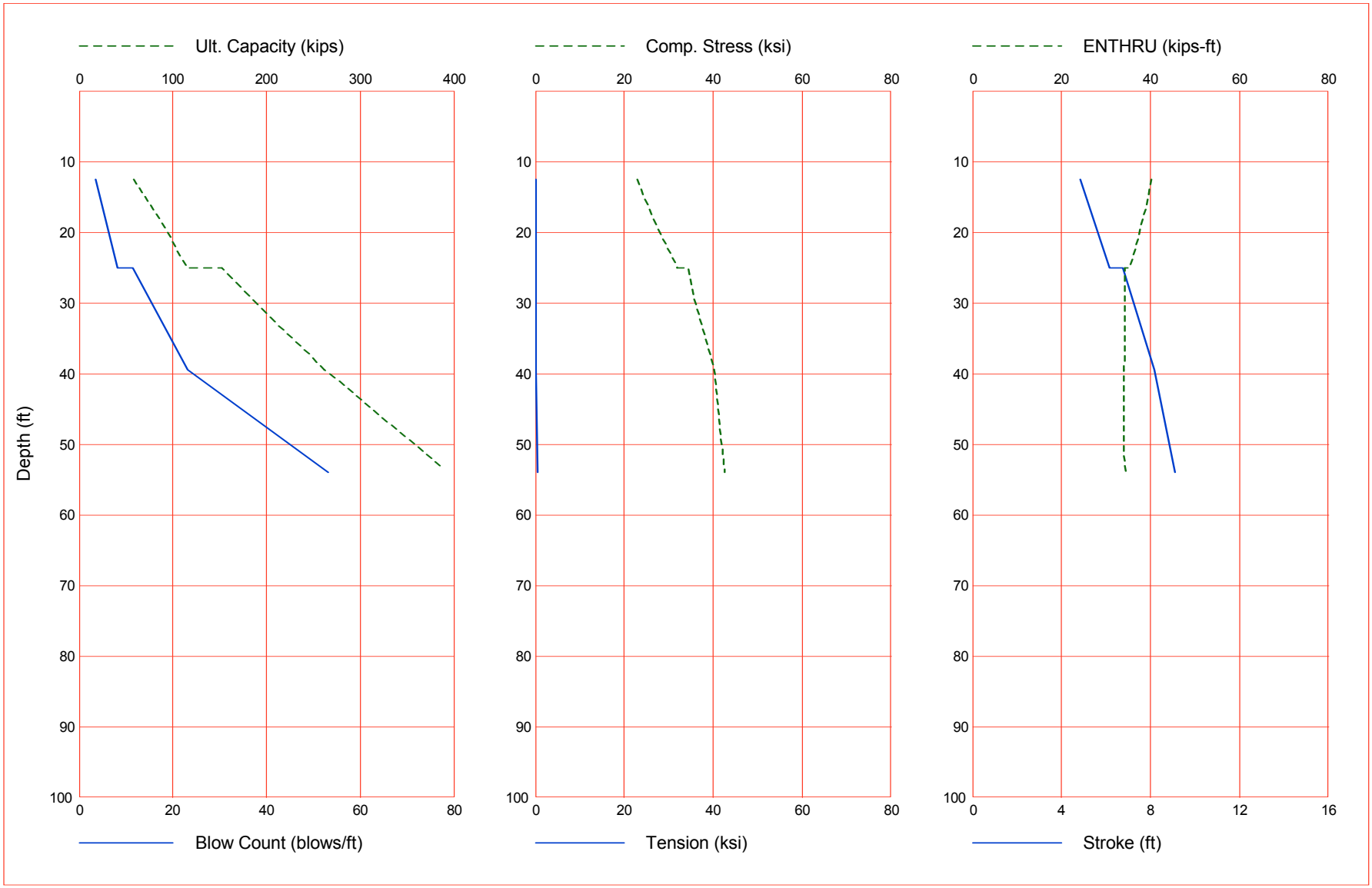
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
3.00	1.11	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
9.01	1.11	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
18.01	1.22	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
24.99	1.37	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
25.01	2.00	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
34.01	2.00	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
43.01	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
52.01	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
59.99	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
60.00	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000

CTL Engineering Inc
Hayden Run 14" CIP-0.375" Wall 72 Kipft

Jul 11 2013
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
12.5	57.8	38.9	18.9	3.6	23.015	0.000	4.83	40.2
25.0	114.7	95.8	18.9	8.3	31.990	0.000	6.17	35.3
25.0	152.7	96.0	56.7	11.4	34.533	0.000	6.77	34.3
39.5	261.8	205.1	56.7	23.2	40.116	-0.181	8.15	34.0
54.0	393.5	336.8	56.7	53.1	42.615	-0.446	9.11	34.5

Total Continuous Driving Time 22.00 minutes; Total Number of Blows 900

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local non-axial stresses and prestress effects must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: C:\2013\9529.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (3/21/2012)

Input File Contents

Hayden Run 14" CIP-0.375" Wall 72 Kipft

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	01251		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size		Pile Type		
32.170	32.170	153.930	14.000		Pipe		
W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp	
1.700	227.000	530.0	2.000	0.800	0.010	0.0	
A Cu	E Cu	T Cu	CoR	ROut	StCu		
0.000	0.0	0.000	0.000	0.000	0.0		
LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
60.000	16.05	29000.0	492.000	3.665	0	0.850	0.010

Manufac Hmr Name HmrType No Seg-s
ICE I-30 V2 1 5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
6.61	123.20	16.51	13.70	10.84	0.80
IB. Wt	IB. L	IB.Dia	IB CoR	IB RO	
1.43	28.10	16.50	0.900	0.010	

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
17.68	214.60	309.10	0.001	0.002	1.250	0.00	0.00
P atm	P1	P2	P3	P4	P5		
14.70	1436.00	1292.00	1163.00	1045.00	0.00		

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8400	0.8000	1436.0000	0.0000	0.0000	0.0000	0.0100	0.0000
Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.100	0.150	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
3.00	1.11	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
9.01	1.11	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
18.01	1.22	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
24.99	1.37	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
25.01	2.00	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
34.01	2.00	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
43.01	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
52.01	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
59.99	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
60.00	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0

Gain/Loss factors: shaft and toe

1.00000	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
12.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
39.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
54.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1	0	10.84000	13.70000	

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

Hayden Run 14" CIP-0.375" Wall 72 Kipft

Hammer Model: I-30 V2 Made by: ICE

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	1.323				
2	1.323	251965.7	1.000	0.0100	
3	1.323	251965.7	1.000	0.0100	
4	1.323	251965.7	1.000	0.0100	
5	1.323	251965.7	1.000	0.0100	
Imp Block	1.430	117641.7	0.900	0.0100	
Helmet	1.700	60155.0	0.800	0.0100	9.6
Combined Pile Top		11636.2			

HAMMER OPTIONS:

Hammer File ID No.	1251	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight (kips)	6.61	Ram Length (inch)	123.20
Maximum Stroke (ft)	13.70		
Rated Stroke (ft)	10.84	Efficiency	0.800
Maximum Pressure (psi)	1436.00	Actual Pressure (psi)	1436.00
Compression Exponent	1.350	Expansion Exponent	1.250
Ram Diameter (inch)	16.51		
Combustion Delay (s)	0.00050	Ignition Duration (s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION		PILE CUSHION	
Cross Sect. Area (in2)	227.00	Cross Sect. Area (in2)	0.00
Elastic-Modulus (ksi)	530.0	Elastic-Modulus (ksi)	0.0
Thickness (inch)	2.00	Thickness (inch)	0.00
Coeff of Restitution	0.8	Coeff of Restitution	1.0
RoundOut (ft)	0.0	RoundOut (ft)	0.0
Stiffness (kips/in)	60155.0	Stiffness (kips/in)	0.0

Depth (ft) 12.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 57.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	50.00	3.7	16.0
16	0.183	11636	0.000	0.000	1.00	11.5	0.200	0.100	53.33	3.7	16.0
17	0.183	11636	0.000	0.000	1.00	13.5	0.200	0.100	56.67	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	13.8	0.200	0.100	60.00	3.7	16.0
Toe						18.9	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:
Uniform pile Pile Segments: Automatic
No. of Slacks/Splices 0 Pile Damping (%) 1
Pile Damping Fact.(k/ft/s) 0.563

Driveability Analysis
Soil Damping Option Smith
Max No Analysis Iterations 0 Time Increment/Critical 160
Output Time Interval 1 Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
12.50	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
57.8	3.6	4.83	4.81	0.00	1	0	23.01	4	2	40.2	53.7
50.5	3.1	4.57	4.60	0.00	1	0	21.00	3	2	41.0	55.2
51.2	3.1	4.59	4.62	0.00	1	0	21.14	2	2	40.9	55.0
51.8	3.2	4.61	4.64	0.00	1	0	21.36	3	2	40.8	54.9
52.5	3.2	4.62	4.67	0.00	1	0	21.48	2	2	40.6	54.8
1		0	10.84000		13.70000						

Hayden Run 14" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 114.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	16.0
11	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.7	16.0
12	0.183	11636	0.000	0.000	1.00	8.1	0.200	0.100	40.00	3.7	16.0
13	0.183	11636	0.000	0.000	1.00	13.5	0.200	0.100	43.33	3.7	16.0
14	0.183	11636	0.000	0.000	1.00	13.7	0.200	0.100	46.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	14.2	0.200	0.100	50.00	3.7	16.0
16	0.183	11636	0.000	0.000	1.00	14.7	0.200	0.100	53.33	3.7	16.0
17	0.183	11636	0.000	0.000	1.00	15.4	0.200	0.100	56.67	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	16.2	0.200	0.100	60.00	3.7	16.0
Toe						18.9	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.98	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
114.7	8.3	6.17	6.18	0.00	1	0	31.99	12	4	35.3	47.3
96.8	6.7	5.79	5.82	-0.29	12	50	29.89	12	4	36.3	48.8
98.4	6.9	5.82	5.85	-0.32	12	50	30.11	12	4	36.2	48.6
100.0	7.0	5.86	5.89	-0.33	12	50	30.34	12	4	36.1	48.5
101.6	7.2	5.89	5.92	-0.32	12	49	30.48	12	4	36.0	48.3
1		0	10.84000		13.70000						

Hayden Run 14" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 152.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	16.0
11	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.7	16.0
12	0.183	11636	0.000	0.000	1.00	8.2	0.200	0.100	40.00	3.7	16.0
13	0.183	11636	0.000	0.000	1.00	13.5	0.200	0.100	43.33	3.7	16.0
14	0.183	11636	0.000	0.000	1.00	13.7	0.200	0.100	46.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	14.2	0.200	0.100	50.00	3.7	16.0
16	0.183	11636	0.000	0.000	1.00	14.7	0.200	0.100	53.33	3.7	16.0
17	0.183	11636	0.000	0.000	1.00	15.4	0.200	0.100	56.67	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	16.3	0.200	0.100	60.00	3.7	16.0
Toe						56.7	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.02	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
152.7	11.4	6.77	6.75	0.00	1	0	34.53	12	4	34.3	45.2
134.7	9.6	6.49	6.44	0.00	1	0	33.06	12	4	35.0	46.2
136.4	9.8	6.51	6.46	0.00	1	0	33.20	12	4	35.0	46.2
138.0	10.0	6.54	6.50	0.00	1	0	33.34	12	4	34.8	46.1
139.6	10.1	6.57	6.53	0.00	1	0	33.49	12	4	34.8	45.9
	1		0	10.84000			13.70000				

Hayden Run 14" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 39.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 261.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	16.0
7	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	23.33	3.7	16.1
8	0.183	11636	0.000	0.000	1.00	12.9	0.200	0.100	26.67	3.7	16.1
9	0.183	11636	0.000	0.000	1.00	13.6	0.200	0.100	30.00	3.7	16.1
10	0.183	11636	0.000	0.000	1.00	13.9	0.200	0.100	33.33	3.7	16.1
11	0.183	11636	0.000	0.000	1.00	14.3	0.200	0.100	36.67	3.7	16.0
12	0.183	11636	0.000	0.000	1.00	14.9	0.200	0.100	40.00	3.7	16.0
13	0.183	11636	0.000	0.000	1.00	15.7	0.200	0.100	43.33	3.7	16.0
14	0.183	11636	0.000	0.000	1.00	19.2	0.200	0.100	46.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	24.4	0.200	0.100	50.00	3.7	16.0
17	0.183	11636	0.000	0.000	1.00	24.9	0.200	0.100	56.67	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	27.0	0.200	0.100	60.00	3.7	16.0
Toe						56.7	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
39.49	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
261.8	23.2	8.15	8.15	-0.18	8	45	40.12	8	3	34.0	41.3
223.4	19.0	7.81	7.76	0.00	1	0	38.55	8	3	33.5	42.2
226.9	19.3	7.86	7.80	0.00	1	0	38.65	8	3	33.5	42.1
230.4	19.6	7.90	7.83	0.00	1	0	38.93	8	3	33.7	42.0
233.9	20.0	7.94	7.87	0.00	1	0	39.06	8	3	33.7	41.9
	1		0	10.84000			13.70000				

Hayden Run 14" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 54.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	16.05	29000.	492.0	3.7	0	16524.	28.2
60.0	16.05	29000.	492.0	3.7	0	16524.	28.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 393.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.183	11636	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	16.0
2	0.183	11636	0.000	0.000	1.00	0.0	0.200	0.100	6.67	3.7	16.0
3	0.183	11636	0.000	0.000	1.00	4.1	0.200	0.100	10.00	3.7	16.1
4	0.183	11636	0.000	0.000	1.00	13.5	0.200	0.100	13.33	3.7	16.0
5	0.183	11636	0.000	0.000	1.00	13.6	0.200	0.100	16.67	3.7	16.0
6	0.183	11636	0.000	0.000	1.00	14.0	0.200	0.100	20.00	3.7	16.1
7	0.183	11636	0.000	0.000	1.00	14.5	0.200	0.100	23.33	3.7	16.1
8	0.183	11636	0.000	0.000	1.00	15.1	0.200	0.100	26.67	3.7	16.1
9	0.183	11636	0.000	0.000	1.00	16.0	0.200	0.100	30.00	3.7	16.1
10	0.183	11636	0.000	0.000	1.00	22.1	0.200	0.100	33.33	3.7	16.1
11	0.183	11636	0.000	0.000	1.00	24.4	0.200	0.100	36.67	3.7	16.0
13	0.183	11636	0.000	0.000	1.00	25.6	0.200	0.100	43.33	3.7	16.0
14	0.183	11636	0.000	0.000	1.00	27.8	0.200	0.100	46.67	3.7	16.0
15	0.183	11636	0.000	0.000	1.00	30.0	0.200	0.100	50.00	3.7	16.0
16	0.183	11636	0.000	0.000	1.00	30.5	0.200	0.100	53.33	3.7	16.0
18	0.183	11636	0.000	0.000	1.00	30.5	0.200	0.100	60.00	3.7	16.0
Toe						56.7	0.150	0.100			

3.290 kips total unreduced pile weight (g= 32.17 ft/s2)
3.290 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
54.00	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
393.5	53.1	9.11	9.09	-0.45	3	35	42.61	4	2	34.5	39.1
330.5	36.4	8.69	8.68	-0.09	3	39	41.02	4	2	33.6	40.0
336.2	37.6	8.73	8.71	-0.17	3	38	41.12	4	2	33.7	40.0
342.0	38.9	8.77	8.76	-0.20	3	38	41.33	4	2	33.7	39.9
347.7	40.1	8.81	8.79	-0.26	3	38	41.47	4	2	33.9	39.8

Hayden Run 14" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	57.8	38.9	18.9	3.6	23.015	0.000	4.83	40.2
25.0	114.7	95.8	18.9	8.3	31.990	0.000	6.17	35.3
25.0	152.7	96.0	56.7	11.4	34.533	0.000	6.77	34.3
39.5	261.8	205.1	56.7	23.2	40.116	-0.181	8.15	34.0
54.0	393.5	336.8	56.7	53.1	42.615	-0.446	9.11	34.5

Total Driving Time 22 minutes; Total No. of Blows 900

G/L at Shaft and Toe: 0.813 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	50.5	31.6	18.9	3.1	21.004	0.000	4.57	41.0
25.0	96.8	77.9	18.9	6.7	29.887	-0.292	5.79	36.3
25.0	134.7	78.1	56.7	9.6	33.060	0.000	6.49	35.0
39.5	223.4	166.8	56.7	19.0	38.549	0.000	7.81	33.5
54.0	330.5	273.8	56.7	36.4	41.015	-0.092	8.69	33.6

Total Driving Time 16 minutes; Total No. of Blows 689

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	51.2	32.3	18.9	3.1	21.145	0.000	4.59	40.9
25.0	98.4	79.5	18.9	6.9	30.108	-0.318	5.82	36.2
25.0	136.4	79.7	56.7	9.8	33.202	0.000	6.51	35.0
39.5	226.9	170.3	56.7	19.3	38.655	0.000	7.86	33.5
54.0	336.2	279.6	56.7	37.6	41.118	-0.166	8.73	33.7

Total Driving Time 17 minutes; Total No. of Blows 705

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	51.8	32.9	18.9	3.2	21.357	0.000	4.61	40.8
25.0	100.0	81.1	18.9	7.0	30.335	-0.328	5.86	36.1
25.0	138.0	81.3	56.7	10.0	33.338	0.000	6.54	34.8
39.5	230.4	173.8	56.7	19.6	38.929	0.000	7.90	33.7
54.0	342.0	285.3	56.7	38.9	41.326	-0.204	8.77	33.7

Total Driving Time 17 minutes; Total No. of Blows 722

Hayden Run 14" CIP-0.375" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	52.5	33.6	18.9	3.2	21.481	0.000	4.62	40.6
25.0	101.6	82.7	18.9	7.2	30.478	-0.324	5.89	36.0
25.0	139.6	83.0	56.7	10.1	33.486	0.000	6.57	34.8
39.5	233.9	177.2	56.7	20.0	39.061	0.000	7.94	33.7
54.0	347.7	291.0	56.7	40.1	41.474	-0.257	8.81	33.9

Total Driving Time 17 minutes; Total No. of Blows 739

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
12.50	60.00	0.00	10.84	1.00	0.80	1.00	1.00
24.98	60.00	0.00	10.84	1.00	0.80	1.00	1.00
25.02	60.00	0.00	10.84	1.00	0.80	1.00	1.00
39.49	60.00	0.00	10.84	1.00	0.80	1.00	1.00
54.00	60.00	0.00	10.84	1.00	0.80	1.00	1.00

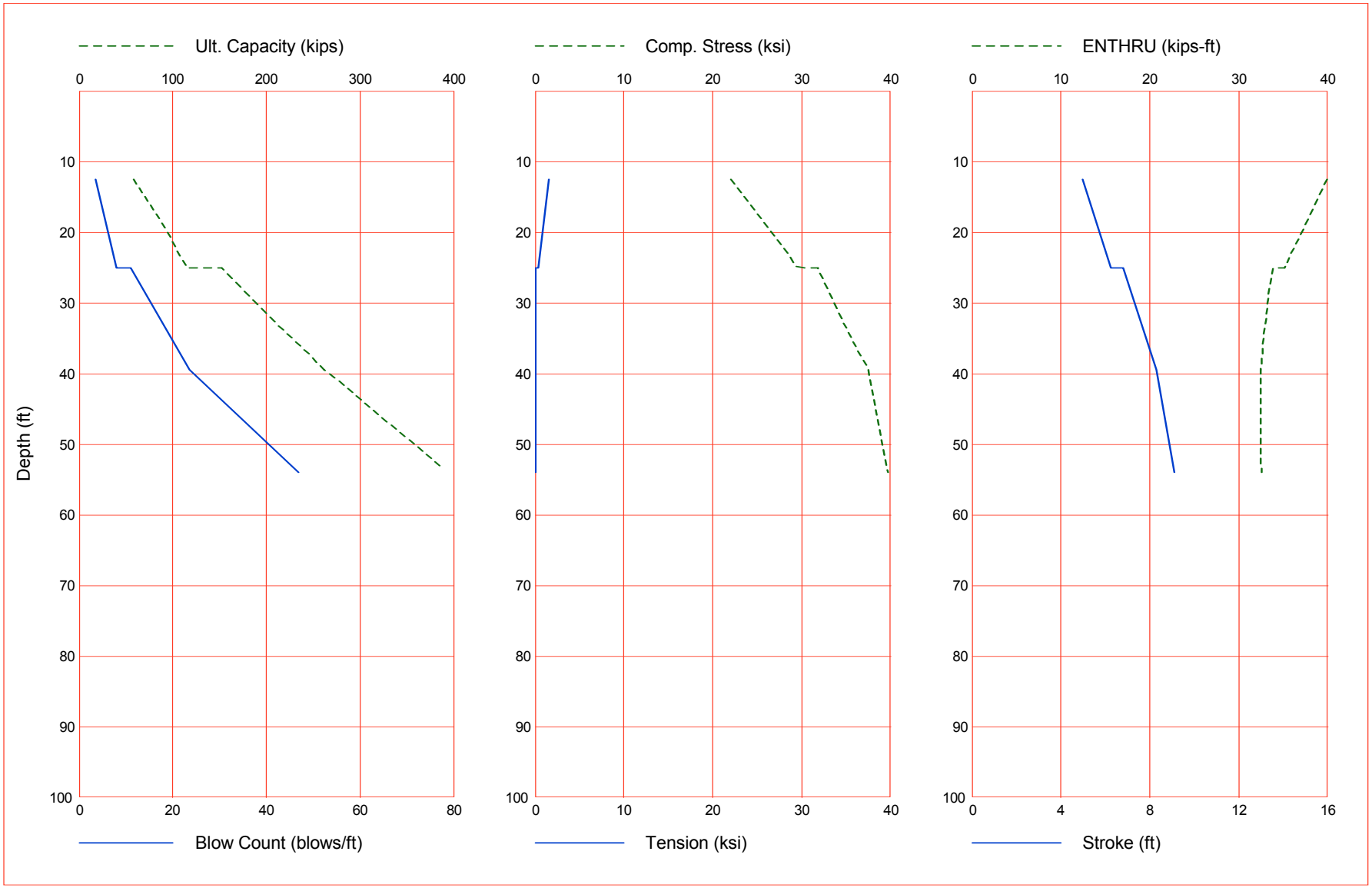
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
3.00	1.11	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
9.01	1.11	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
18.01	1.22	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
24.99	1.37	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
25.01	2.00	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
34.01	2.00	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
43.01	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
52.01	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
59.99	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
60.00	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000

CTL Engineering Inc
Hayden Run 14" CIP-0.5" Wall 72 Kipft

Jul 11 2013
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
12.5	57.8	38.9	18.9	3.5	21.996	-1.541	4.96	39.9
25.0	114.7	95.8	18.9	8.1	29.516	-0.350	6.23	35.1
25.0	152.7	96.0	56.7	11.1	31.893	0.000	6.81	33.9
39.5	261.8	205.1	56.7	23.6	37.531	0.000	8.29	32.5
54.0	393.5	336.8	56.7	46.9	39.737	0.000	9.12	32.6

Total Continuous Driving Time 21.00 minutes; Total Number of Blows 856

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local non-axial stresses and prestress effects must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: C:\2013\9529.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (3/21/2012)

Input File Contents

Hayden Run 14" CIP-0.5" Wall 72 Kipft

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	01251		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size		Pile Type		
32.170	32.170	153.930	14.000		Pipe		

W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.700	227.000	530.0	2.000	0.800	0.010	0.0

A Cu	E Cu	T Cu	CoR	ROut	StCu
0.000	0.0	0.000	0.000	0.000	0.0

LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
60.000	21.20	29000.0	492.000	3.665	0	0.850	0.010

Manufac | Hmr Name | HmrType | No Seg-s
ICE | I-30 V2 | 1 | 5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
6.61	123.20	16.51	13.70	10.84	0.80

IB. Wt	IB. L	IB.Dia	IB CoR	IB RO
1.43	28.10	16.50	0.900	0.010

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
17.68	214.60	309.10	0.001	0.002	1.250	0.00	0.00

P atm	P1	P2	P3	P4	P5
14.70	1436.00	1292.00	1163.00	1045.00	0.00

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8400	0.8000	1436.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.100	0.150	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
3.00	1.11	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
9.01	1.11	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
18.01	1.22	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
24.99	1.37	18.89	0.10	0.10	0.20	0.15	1.21	0.00	0.0
25.01	2.00	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
34.01	2.00	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
43.01	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
52.01	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
59.99	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
60.00	2.50	56.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0

Gain/Loss factors: shaft and toe

1.00000	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
12.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
39.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
54.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1	0	10.84000		13.70000

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

Hayden Run 14" CIP-0.5" Wall 72 Kipft

Hammer Model: I-30 V2 Made by: ICE

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	1.323				
2	1.323	251965.7	1.000	0.0100	
3	1.323	251965.7	1.000	0.0100	
4	1.323	251965.7	1.000	0.0100	
5	1.323	251965.7	1.000	0.0100	
Imp Block	1.430	117641.7	0.900	0.0100	
Helmet	1.700	60155.0	0.800	0.0100	9.6
Combined Pile Top		15370.0			

HAMMER OPTIONS:

Hammer File ID No.	1251	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight (kips)	6.61	Ram Length (inch)	123.20
Maximum Stroke (ft)	13.70		
Rated Stroke (ft)	10.84	Efficiency	0.800
Maximum Pressure (psi)	1436.00	Actual Pressure (psi)	1436.00
Compression Exponent	1.350	Expansion Exponent	1.250
Ram Diameter (inch)	16.51		
Combustion Delay (s)	0.00050	Ignition Duration (s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION		PILE CUSHION	
Cross Sect. Area (in2)	227.00	Cross Sect. Area (in2)	0.00
Elastic-Modulus (ksi)	530.0	Elastic-Modulus (ksi)	0.0
Thickness (inch)	2.00	Thickness (inch)	0.00
Coeff of Restitution	0.8	Coeff of Restitution	1.0
RoundOut (ft)	0.0	RoundOut (ft)	0.0
Stiffness (kips/in)	60155.0	Stiffness (kips/in)	0.0

Depth (ft) 12.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.20	29000.	492.0	3.7	0	16524.	37.2
60.0	21.20	29000.	492.0	3.7	0	16524.	37.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 57.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.241	15370	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	21.2
2	0.241	15370	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	21.2
15	0.241	15370	0.000	0.000	1.00	0.0	0.200	0.100	50.00	3.7	21.2
16	0.241	15370	0.000	0.000	1.00	11.5	0.200	0.100	53.33	3.7	21.2
17	0.241	15370	0.000	0.000	1.00	13.5	0.200	0.100	56.67	3.7	21.2
18	0.241	15370	0.000	0.000	1.00	13.8	0.200	0.100	60.00	3.7	21.2
Toe						18.9	0.150	0.100			

4.346 kips total unreduced pile weight (g= 32.17 ft/s2)
4.346 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:
Uniform pile Pile Segments: Automatic
No. of Slacks/Splices 0 Pile Damping (%) 1
Pile Damping Fact.(k/ft/s) 0.744

Driveability Analysis
Soil Damping Option Smith
Max No Analysis Iterations 0 Time Increment/Critical 160
Output Time Interval 1 Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
12.50	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
57.8	3.5	4.96	4.95	-1.54	3	11	22.00	4	2	39.9	53.1
50.5	3.0	4.70	4.74	-1.67	3	11	20.18	3	2	40.7	54.4
51.2	3.0	4.72	4.76	-1.65	3	11	20.34	3	2	40.5	54.3
51.8	3.1	4.74	4.78	-1.64	3	11	20.52	3	2	40.4	54.2
52.5	3.1	4.80	4.79	-1.62	3	11	20.88	2	2	40.6	54.0
1		0	10.84000		13.70000						

Hayden Run 14" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.20	29000.	492.0	3.7	0	16524.	37.2
60.0	21.20	29000.	492.0	3.7	0	16524.	37.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 114.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.241	15370	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	21.2
2	0.241	15370	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	21.2
11	0.241	15370	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.7	21.2
12	0.241	15370	0.000	0.000	1.00	8.1	0.200	0.100	40.00	3.7	21.2
13	0.241	15370	0.000	0.000	1.00	13.5	0.200	0.100	43.33	3.7	21.2
14	0.241	15370	0.000	0.000	1.00	13.7	0.200	0.100	46.67	3.7	21.2
15	0.241	15370	0.000	0.000	1.00	14.2	0.200	0.100	50.00	3.7	21.2
16	0.241	15370	0.000	0.000	1.00	14.7	0.200	0.100	53.33	3.7	21.2
17	0.241	15370	0.000	0.000	1.00	15.4	0.200	0.100	56.67	3.7	21.2
18	0.241	15370	0.000	0.000	1.00	16.2	0.200	0.100	60.00	3.7	21.2
Toe						18.9	0.150	0.100			

4.346 kips total unreduced pile weight (g= 32.17 ft/s2)
4.346 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.98	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
114.7	8.1	6.23	6.25	-0.35	12	50	29.52	12	4	35.1	47.1
96.8	6.6	5.86	5.89	-0.11	12	50	27.73	12	4	36.1	48.5
98.4	6.7	5.89	5.93	-0.19	12	50	27.90	12	4	36.0	48.4
100.0	6.8	5.93	5.96	-0.27	12	50	28.04	12	4	35.8	48.2
101.6	7.0	5.96	5.99	-0.32	12	50	28.27	12	4	35.8	48.1
1		0	10.84000		13.70000						

Hayden Run 14" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.20	29000.	492.0	3.7	0	16524.	37.2
60.0	21.20	29000.	492.0	3.7	0	16524.	37.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 152.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.241	15370	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	21.2
2	0.241	15370	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	21.2
11	0.241	15370	0.000	0.000	1.00	0.0	0.200	0.100	36.67	3.7	21.2
12	0.241	15370	0.000	0.000	1.00	8.2	0.200	0.100	40.00	3.7	21.2
13	0.241	15370	0.000	0.000	1.00	13.5	0.200	0.100	43.33	3.7	21.2
14	0.241	15370	0.000	0.000	1.00	13.7	0.200	0.100	46.67	3.7	21.2
15	0.241	15370	0.000	0.000	1.00	14.2	0.200	0.100	50.00	3.7	21.2
16	0.241	15370	0.000	0.000	1.00	14.7	0.200	0.100	53.33	3.7	21.2
17	0.241	15370	0.000	0.000	1.00	15.4	0.200	0.100	56.67	3.7	21.2
18	0.241	15370	0.000	0.000	1.00	16.3	0.200	0.100	60.00	3.7	21.2
Toe						56.7	0.150	0.100			

4.346 kips total unreduced pile weight (g= 32.17 ft/s2)
4.346 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.02	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
152.7	11.1	6.81	6.78	0.00	1	0	31.89	12	4	33.9	45.1
134.7	9.5	6.49	6.50	-0.48	12	44	30.47	12	4	34.5	46.2
136.4	9.6	6.58	6.52	-0.45	12	44	30.81	12	4	34.8	46.0
138.0	9.8	6.61	6.55	-0.41	12	44	30.91	12	4	34.7	45.9
139.6	9.9	6.63	6.58	-0.36	12	43	31.04	12	4	34.6	45.8
1		0	10.84000		13.70000						

Hayden Run 14" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 39.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.20	29000.	492.0	3.7	0	16524.	37.2
60.0	21.20	29000.	492.0	3.7	0	16524.	37.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 261.8

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.241	15370	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	21.2
2	0.241	15370	0.000	0.000	1.00	0.0	0.000	0.100	6.67	3.7	21.2
7	0.241	15370	0.000	0.000	1.00	0.0	0.200	0.100	23.33	3.7	21.2
8	0.241	15370	0.000	0.000	1.00	12.9	0.200	0.100	26.67	3.7	21.2
9	0.241	15370	0.000	0.000	1.00	13.6	0.200	0.100	30.00	3.7	21.2
10	0.241	15370	0.000	0.000	1.00	13.9	0.200	0.100	33.33	3.7	21.2
11	0.241	15370	0.000	0.000	1.00	14.3	0.200	0.100	36.67	3.7	21.2
12	0.241	15370	0.000	0.000	1.00	14.9	0.200	0.100	40.00	3.7	21.2
13	0.241	15370	0.000	0.000	1.00	15.7	0.200	0.100	43.33	3.7	21.2
14	0.241	15370	0.000	0.000	1.00	19.2	0.200	0.100	46.67	3.7	21.2
15	0.241	15370	0.000	0.000	1.00	24.4	0.200	0.100	50.00	3.7	21.2
17	0.241	15370	0.000	0.000	1.00	24.9	0.200	0.100	56.67	3.7	21.2
18	0.241	15370	0.000	0.000	1.00	27.0	0.200	0.100	60.00	3.7	21.2
Toe						56.7	0.150	0.100			

4.346 kips total unreduced pile weight (g= 32.17 ft/s2)
4.346 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
39.49	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
261.8	23.6	8.29	8.21	0.00	1	0	37.53	8	3	32.5	41.1
223.4	19.7	7.84	7.84	0.00	1	0	35.75	8	3	32.1	42.1
226.9	20.1	7.90	7.87	0.00	1	0	35.94	8	3	32.1	42.0
230.4	20.4	7.95	7.91	0.00	1	0	36.18	8	3	32.1	41.8
233.9	20.8	8.00	7.95	0.00	1	0	36.34	8	3	32.1	41.7
	1		0	10.84000			13.70000				

Hayden Run 14" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 54.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 153.930 Pile Type Pipe
Pile Size (inch) 14.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	21.20	29000.	492.0	3.7	0	16524.	37.2
60.0	21.20	29000.	492.0	3.7	0	16524.	37.2

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 393.5

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.241	15370	0.010	0.000	0.85	0.0	0.000	0.100	3.33	3.7	21.2
2	0.241	15370	0.000	0.000	1.00	0.0	0.200	0.100	6.67	3.7	21.2
3	0.241	15370	0.000	0.000	1.00	4.1	0.200	0.100	10.00	3.7	21.2
4	0.241	15370	0.000	0.000	1.00	13.5	0.200	0.100	13.33	3.7	21.2
5	0.241	15370	0.000	0.000	1.00	13.6	0.200	0.100	16.67	3.7	21.2
6	0.241	15370	0.000	0.000	1.00	14.0	0.200	0.100	20.00	3.7	21.2
7	0.241	15370	0.000	0.000	1.00	14.5	0.200	0.100	23.33	3.7	21.2
8	0.241	15370	0.000	0.000	1.00	15.1	0.200	0.100	26.67	3.7	21.2
9	0.241	15370	0.000	0.000	1.00	16.0	0.200	0.100	30.00	3.7	21.2
10	0.241	15370	0.000	0.000	1.00	22.1	0.200	0.100	33.33	3.7	21.2
11	0.241	15370	0.000	0.000	1.00	24.4	0.200	0.100	36.67	3.7	21.2
13	0.241	15370	0.000	0.000	1.00	25.6	0.200	0.100	43.33	3.7	21.2
14	0.241	15370	0.000	0.000	1.00	27.8	0.200	0.100	46.67	3.7	21.2
15	0.241	15370	0.000	0.000	1.00	30.0	0.200	0.100	50.00	3.7	21.2
16	0.241	15370	0.000	0.000	1.00	30.5	0.200	0.100	53.33	3.7	21.2
18	0.241	15370	0.000	0.000	1.00	30.5	0.200	0.100	60.00	3.7	21.2
Toe						56.7	0.150	0.100			

4.346 kips total unreduced pile weight (g= 32.17 ft/s2)
4.346 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
54.00	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
393.5	46.9	9.12	9.11	0.00	1	0	39.74	4	2	32.6	39.1
330.5	34.4	8.74	8.74	0.00	1	0	38.33	4	2	31.7	39.9
336.2	35.4	8.77	8.77	0.00	1	0	38.47	4	2	31.8	39.9
342.0	36.3	8.81	8.80	0.00	1	0	38.64	4	2	31.9	39.8
347.7	37.3	8.85	8.84	0.00	1	0	38.77	4	2	32.0	39.7

Hayden Run 14" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	57.8	38.9	18.9	3.5	21.996	-1.541	4.96	39.9
25.0	114.7	95.8	18.9	8.1	29.516	-0.350	6.23	35.1
25.0	152.7	96.0	56.7	11.1	31.893	0.000	6.81	33.9
39.5	261.8	205.1	56.7	23.6	37.531	0.000	8.29	32.5
54.0	393.5	336.8	56.7	46.9	39.737	0.000	9.12	32.6

Total Driving Time 21 minutes; Total No. of Blows 856

G/L at Shaft and Toe: 0.813 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	50.5	31.6	18.9	3.0	20.184	-1.666	4.70	40.7
25.0	96.8	77.9	18.9	6.6	27.732	-0.112	5.86	36.1
25.0	134.7	78.1	56.7	9.5	30.475	-0.477	6.49	34.5
39.5	223.4	166.8	56.7	19.7	35.745	0.000	7.84	32.1
54.0	330.5	273.8	56.7	34.4	38.329	0.000	8.74	31.7

Total Driving Time 16 minutes; Total No. of Blows 681

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	51.2	32.3	18.9	3.0	20.337	-1.648	4.72	40.5
25.0	98.4	79.5	18.9	6.7	27.902	-0.188	5.89	36.0
25.0	136.4	79.7	56.7	9.6	30.810	-0.447	6.58	34.8
39.5	226.9	170.3	56.7	20.1	35.938	0.000	7.90	32.1
54.0	336.2	279.6	56.7	35.4	38.474	0.000	8.77	31.8

Total Driving Time 16 minutes; Total No. of Blows 697

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	51.8	32.9	18.9	3.1	20.517	-1.639	4.74	40.4
25.0	100.0	81.1	18.9	6.8	28.037	-0.266	5.93	35.8
25.0	138.0	81.3	56.7	9.8	30.908	-0.413	6.61	34.7
39.5	230.4	173.8	56.7	20.4	36.181	0.000	7.95	32.1
54.0	342.0	285.3	56.7	36.3	38.643	0.000	8.81	31.9

Total Driving Time 17 minutes; Total No. of Blows 711

Hayden Run 14" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	52.5	33.6	18.9	3.1	20.878	-1.616	4.80	40.6
25.0	101.6	82.7	18.9	7.0	28.266	-0.325	5.96	35.8
25.0	139.6	83.0	56.7	9.9	31.037	-0.364	6.63	34.6
39.5	233.9	177.2	56.7	20.8	36.337	0.000	8.00	32.1
54.0	347.7	291.0	56.7	37.3	38.770	0.000	8.85	32.0

Total Driving Time 17 minutes; Total No. of Blows 727

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
12.50	60.00	0.00	10.84	1.00	0.80	1.00	1.00
24.98	60.00	0.00	10.84	1.00	0.80	1.00	1.00
25.02	60.00	0.00	10.84	1.00	0.80	1.00	1.00
39.49	60.00	0.00	10.84	1.00	0.80	1.00	1.00
54.00	60.00	0.00	10.84	1.00	0.80	1.00	1.00

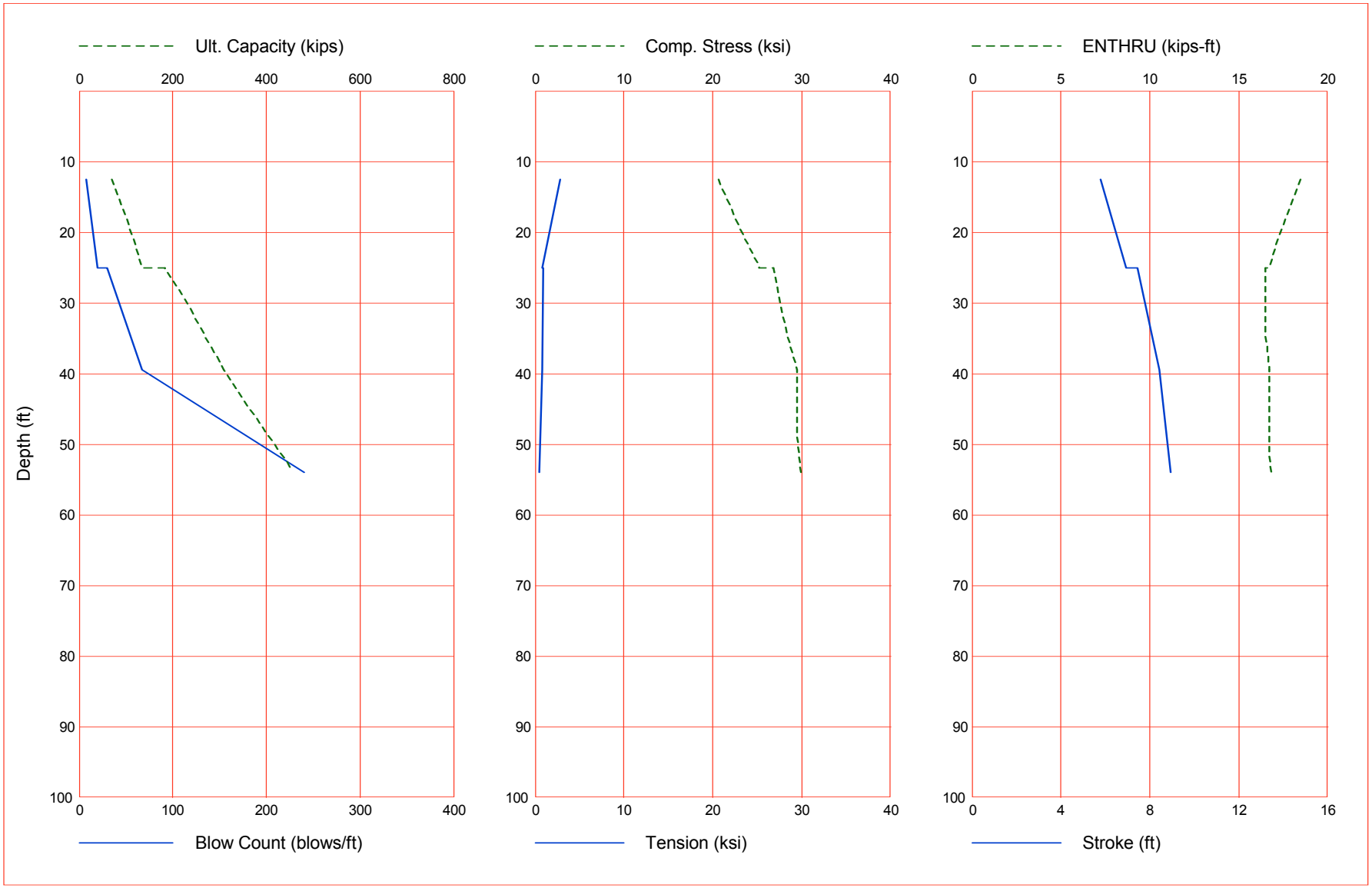
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
3.00	1.11	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
9.01	1.11	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
18.01	1.22	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
24.99	1.37	18.89	0.100	0.100	0.200	0.150	1.000	0.000	0.000
25.01	2.00	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
34.01	2.00	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
43.01	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
52.01	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
59.99	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
60.00	2.50	56.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000

CTL Engineering Inc
Hayden Run 16" CIP-0.5" Wall 43 Kipft

Jul 11 2013
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
12.5	69.1	44.4	24.7	8.0	20.683	-2.869	5.79	18.5
25.0	134.1	109.4	24.7	19.6	25.271	-0.810	6.95	16.7
25.0	183.7	109.7	74.0	29.7	26.834	-0.942	7.46	16.5
39.5	308.4	234.4	74.0	67.8	29.519	-0.782	8.42	16.7
54.0	458.9	384.9	74.0	240.4	29.898	-0.481	8.94	16.8

Total Continuous Driving Time 78.00 minutes; Total Number of Blows 3164

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local non-axial stresses and prestress effects must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: C:\2013\9529.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (3/21/2012)

Input File Contents

Hayden Run 16" CIP-0.5" Wall 43 Kipft

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	0	41	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size		Pile Type	
32.170	32.170	201.060	16.000		Pipe	
W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp
1.700	227.000	530.0	2.000	0.800	0.010	0.0
A Cu	E Cu	T Cu	CoR	ROut	StCu	
0.000	0.0	0.000	0.000	0.000	0.0	
LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
60.000	24.34	29000.0	492.000	4.188	0	0.850	0.010

Manufac Hmr Name HmrType No Seg-s
DELMAG D 19-42 1 5

Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy
4.00	129.10	12.60	11.86	10.81	0.80
IB. Wt	IB. L	IB.Dia	IB CoR	IB RO	
0.75	25.30	12.60	0.900	0.010	

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
16.65	124.70	157.70	0.002	0.002	1.250	0.00	0.00
P atm	P1	P2	P3	P4	P5		
14.70	1520.00	1368.00	1231.00	1108.00	0.00		

Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8100	0.8000	1520.0000	0.0000	0.0000	0.0000	0.0100	0.0000

Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.100	0.150	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
3.00	1.11	24.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
9.01	1.11	24.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
18.01	1.22	24.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
24.99	1.37	24.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
25.01	2.00	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
34.01	2.00	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
43.01	2.50	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
52.01	2.50	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
59.99	2.50	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
60.00	2.50	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0

Gain/Loss factors: shaft and toe

1.00000	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
12.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
39.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
54.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1	0	10.81000	11.86000	

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

Hayden Run 16" CIP-0.5" Wall 43 Kipft

Hammer Model: D 19-42 Made by: DELMAG

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	0.800				
2	0.800	140046.7	1.000	0.0100	
3	0.800	140046.7	1.000	0.0100	
4	0.800	140046.7	1.000	0.0100	
5	0.800	140046.7	1.000	0.0100	
Imp Block	0.753	70735.6	0.900	0.0100	
Helmet	1.700	60155.0	0.800	0.0100	5.8
Combined Pile Top		17646.5			

HAMMER OPTIONS:

Hammer File ID No.	41	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	4.00	Ram Length	(inch)	129.10
Maximum Stroke	(ft)	11.86			
Rated Stroke	(ft)	10.81	Efficiency		0.800
Maximum Pressure	(psi)	1520.00	Actual Pressure	(psi)	1520.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	12.60			
Combustion Delay	(s)	0.00200	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

Depth (ft) 12.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 201.060 Pile Type Pipe
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 69.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.000	0.100	6.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	0.0	0.200	0.100	50.00	4.2	24.3
16	0.277	17647	0.000	0.000	1.00	13.2	0.200	0.100	53.33	4.2	24.3
17	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	56.67	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	15.8	0.200	0.100	60.00	4.2	24.3
Toe						24.7	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:
Uniform pile Pile Segments: Automatic
No. of Slacks/Splices 0 Pile Damping (%) 1
Pile Damping Fact.(k/ft/s) 0.854

Driveability Analysis
Soil Damping Option Smith
Max No Analysis Iterations 0 Time Increment/Critical 160
Output Time Interval 1 Analysis Time-Input (ms) 0
Output Level: Normal
Gravity Mass, Pile, Hammer: 32.170 32.170 32.170
Output Segment Generation: Automatic

Depth ft	Stroke ft	Pressure Ratio	Efficy
12.50	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
69.1	8.0	5.79	5.82	-2.87	5	8	20.68	15	5	18.5	49.0
60.8	6.8	5.60	5.64	-3.47	5	8	19.87	15	5	18.8	49.8
61.6	6.9	5.62	5.66	-3.42	5	8	19.94	15	5	18.8	49.8
62.3	7.0	5.64	5.67	-3.34	5	8	20.03	15	5	18.8	49.6
63.1	7.2	5.66	5.69	-3.31	5	8	20.09	15	5	18.7	49.6
1		0	10.81000		11.86000						

Hayden Run 16" CIP-0.5" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 201.060 Pile Type Pipe
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 134.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.000	0.100	6.67	4.2	24.3
11	0.277	17647	0.000	0.000	1.00	0.0	0.200	0.100	36.67	4.2	24.3
12	0.277	17647	0.000	0.000	1.00	9.2	0.200	0.100	40.00	4.2	24.3
13	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	43.33	4.2	24.3
14	0.277	17647	0.000	0.000	1.00	15.7	0.200	0.100	46.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	16.2	0.200	0.100	50.00	4.2	24.3
16	0.277	17647	0.000	0.000	1.00	16.8	0.200	0.100	53.33	4.2	24.3
17	0.277	17647	0.000	0.000	1.00	17.6	0.200	0.100	56.67	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	18.6	0.200	0.100	60.00	4.2	24.3
Toe						24.7	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.98	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
134.1	19.6	6.95	6.93	-0.81	12	34	25.27	12	4	16.7	44.8
113.6	15.4	6.68	6.64	-1.38	11	40	24.20	12	4	17.0	45.7
115.5	15.7	6.71	6.67	-1.34	11	40	24.36	12	4	17.0	45.6
117.4	16.1	6.74	6.70	-1.30	11	40	24.45	12	4	17.0	45.5
119.2	16.4	6.76	6.72	-1.26	11	40	24.54	12	4	16.9	45.5
	1	0	10.81000		11.86000						

Hayden Run 16" CIP-0.5" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 201.060 Pile Type Pipe
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 183.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.000	0.100	6.67	4.2	24.3
11	0.277	17647	0.000	0.000	1.00	0.0	0.200	0.100	36.67	4.2	24.3
12	0.277	17647	0.000	0.000	1.00	9.4	0.200	0.100	40.00	4.2	24.3
13	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	43.33	4.2	24.3
14	0.277	17647	0.000	0.000	1.00	15.7	0.200	0.100	46.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	16.2	0.200	0.100	50.00	4.2	24.3
16	0.277	17647	0.000	0.000	1.00	16.8	0.200	0.100	53.33	4.2	24.3
17	0.277	17647	0.000	0.000	1.00	17.6	0.200	0.100	56.67	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	18.6	0.200	0.100	60.00	4.2	24.3
Toe						74.0	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.02	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
183.7	29.7	7.46	7.45	-0.94	12	28	26.83	12	4	16.5	43.2
163.2	24.5	7.23	7.22	-0.89	12	33	25.98	12	4	16.6	43.9
165.1	25.0	7.25	7.24	-0.88	12	33	26.04	12	4	16.6	43.8
167.0	25.5	7.27	7.26	-0.86	12	33	26.14	12	4	16.6	43.8
168.8	25.9	7.29	7.28	-0.83	12	33	26.23	12	4	16.6	43.7
1		0	10.81000		11.86000						

Hayden Run 16" CIP-0.5" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 39.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 201.060 Pile Type Pipe
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 308.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.000	0.100	6.67	4.2	24.3
7	0.277	17646	0.000	0.000	1.00	0.0	0.200	0.100	23.33	4.2	24.3
8	0.277	17646	0.000	0.000	1.00	14.7	0.200	0.100	26.67	4.2	24.3
9	0.277	17646	0.000	0.000	1.00	15.5	0.200	0.100	30.00	4.2	24.3
10	0.277	17646	0.000	0.000	1.00	15.8	0.200	0.100	33.33	4.2	24.3
11	0.277	17647	0.000	0.000	1.00	16.4	0.200	0.100	36.67	4.2	24.3
12	0.277	17647	0.000	0.000	1.00	17.0	0.200	0.100	40.00	4.2	24.3
13	0.277	17647	0.000	0.000	1.00	17.9	0.200	0.100	43.33	4.2	24.3
14	0.277	17647	0.000	0.000	1.00	21.9	0.200	0.100	46.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	27.9	0.200	0.100	50.00	4.2	24.3
17	0.277	17647	0.000	0.000	1.00	28.5	0.200	0.100	56.67	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	30.9	0.200	0.100	60.00	4.2	24.3
Toe						74.0	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
39.49	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	Stroke (ft) up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
308.4	67.8	8.42	8.36	-0.78	8	40	29.52	8	3	16.7	40.8
264.6	52.4	8.14	8.11	-0.50	8	43	28.52	8	3	16.2	41.5
268.6	53.5	8.16	8.13	-0.57	8	43	28.63	8	3	16.3	41.4
272.6	54.6	8.19	8.15	-0.64	8	43	28.77	8	3	16.3	41.4
276.6	56.1	8.22	8.18	-0.69	8	42	28.82	8	3	16.3	41.3
	1		0	10.81000			11.86000				

Hayden Run 16" CIP-0.5" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 54.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 201.060 Pile Type Pipe
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 458.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.200	0.100	6.67	4.2	24.3
3	0.277	17646	0.000	0.000	1.00	4.7	0.200	0.100	10.00	4.2	24.3
4	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	13.33	4.2	24.3
5	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	16.67	4.2	24.3
6	0.277	17646	0.000	0.000	1.00	16.0	0.200	0.100	20.00	4.2	24.3
7	0.277	17646	0.000	0.000	1.00	16.6	0.200	0.100	23.33	4.2	24.3
8	0.277	17646	0.000	0.000	1.00	17.3	0.200	0.100	26.67	4.2	24.3
9	0.277	17646	0.000	0.000	1.00	18.3	0.200	0.100	30.00	4.2	24.3
10	0.277	17646	0.000	0.000	1.00	25.2	0.200	0.100	33.33	4.2	24.3
11	0.277	17647	0.000	0.000	1.00	27.9	0.200	0.100	36.67	4.2	24.3
13	0.277	17647	0.000	0.000	1.00	29.2	0.200	0.100	43.33	4.2	24.3
14	0.277	17647	0.000	0.000	1.00	31.8	0.200	0.100	46.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	34.3	0.200	0.100	50.00	4.2	24.3
16	0.277	17647	0.000	0.000	1.00	34.9	0.200	0.100	53.33	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	34.9	0.200	0.100	60.00	4.2	24.3
Toe						74.0	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
54.00	10.81	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
458.9	240.4	8.94	8.93	-0.48	3	30	29.90	4	2	16.8	39.6
386.9	124.2	8.71	8.70	-0.38	3	33	29.16	4	2	16.5	40.1
393.5	130.1	8.74	8.72	-0.41	3	33	29.26	4	2	16.6	40.0
400.0	138.1	8.75	8.75	-0.43	3	32	29.34	4	2	16.5	40.0
406.6	144.9	8.79	8.77	-0.43	4	32	29.44	4	2	16.6	39.9

Hayden Run 16" CIP-0.5" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	69.1	44.4	24.7	8.0	20.683	-2.869	5.79	18.5
25.0	134.1	109.4	24.7	19.6	25.271	-0.810	6.95	16.7
25.0	183.7	109.7	74.0	29.7	26.834	-0.942	7.46	16.5
39.5	308.4	234.4	74.0	67.8	29.519	-0.782	8.42	16.7
54.0	458.9	384.9	74.0	240.4	29.898	-0.481	8.94	16.8

Total Driving Time 78 minutes; Total No. of Blows 3164

G/L at Shaft and Toe: 0.813 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	60.8	36.1	24.7	6.8	19.875	-3.468	5.60	18.8
25.0	113.6	89.0	24.7	15.4	24.204	-1.378	6.68	17.0
25.0	163.2	89.2	74.0	24.5	25.979	-0.891	7.23	16.6
39.5	264.6	190.6	74.0	52.4	28.520	-0.499	8.14	16.2
54.0	386.9	312.9	74.0	124.2	29.159	-0.378	8.71	16.5

Total Driving Time 49 minutes; Total No. of Blows 2019

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	61.6	36.9	24.7	6.9	19.941	-3.417	5.62	18.8
25.0	115.5	90.8	24.7	15.7	24.359	-1.342	6.71	17.0
25.0	165.1	91.1	74.0	25.0	26.041	-0.879	7.25	16.6
39.5	268.6	194.6	74.0	53.5	28.632	-0.568	8.16	16.3
54.0	393.5	319.5	74.0	130.1	29.262	-0.411	8.74	16.6

Total Driving Time 50 minutes; Total No. of Blows 2085

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	62.3	37.6	24.7	7.0	20.026	-3.342	5.64	18.8
25.0	117.4	92.7	24.7	16.1	24.452	-1.305	6.74	17.0
25.0	167.0	92.9	74.0	25.5	26.135	-0.857	7.27	16.6
39.5	272.6	198.5	74.0	54.6	28.769	-0.640	8.19	16.3
54.0	400.0	326.0	74.0	138.1	29.341	-0.425	8.75	16.5

Total Driving Time 52 minutes; Total No. of Blows 2166

Hayden Run 16" CIP-0.5" Wall 43 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	63.1	38.4	24.7	7.2	20.088	-3.308	5.66	18.7
25.0	119.2	94.6	24.7	16.4	24.538	-1.256	6.76	16.9
25.0	168.8	94.8	74.0	25.9	26.226	-0.834	7.29	16.6
39.5	276.6	202.5	74.0	56.1	28.817	-0.689	8.22	16.3
54.0	406.6	332.5	74.0	144.9	29.442	-0.428	8.79	16.6

Total Driving Time 54 minutes; Total No. of Blows 2245

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
12.50	60.00	0.00	10.81	1.00	0.80	1.00	1.00
24.98	60.00	0.00	10.81	1.00	0.80	1.00	1.00
25.02	60.00	0.00	10.81	1.00	0.80	1.00	1.00
39.49	60.00	0.00	10.81	1.00	0.80	1.00	1.00
54.00	60.00	0.00	10.81	1.00	0.80	1.00	1.00

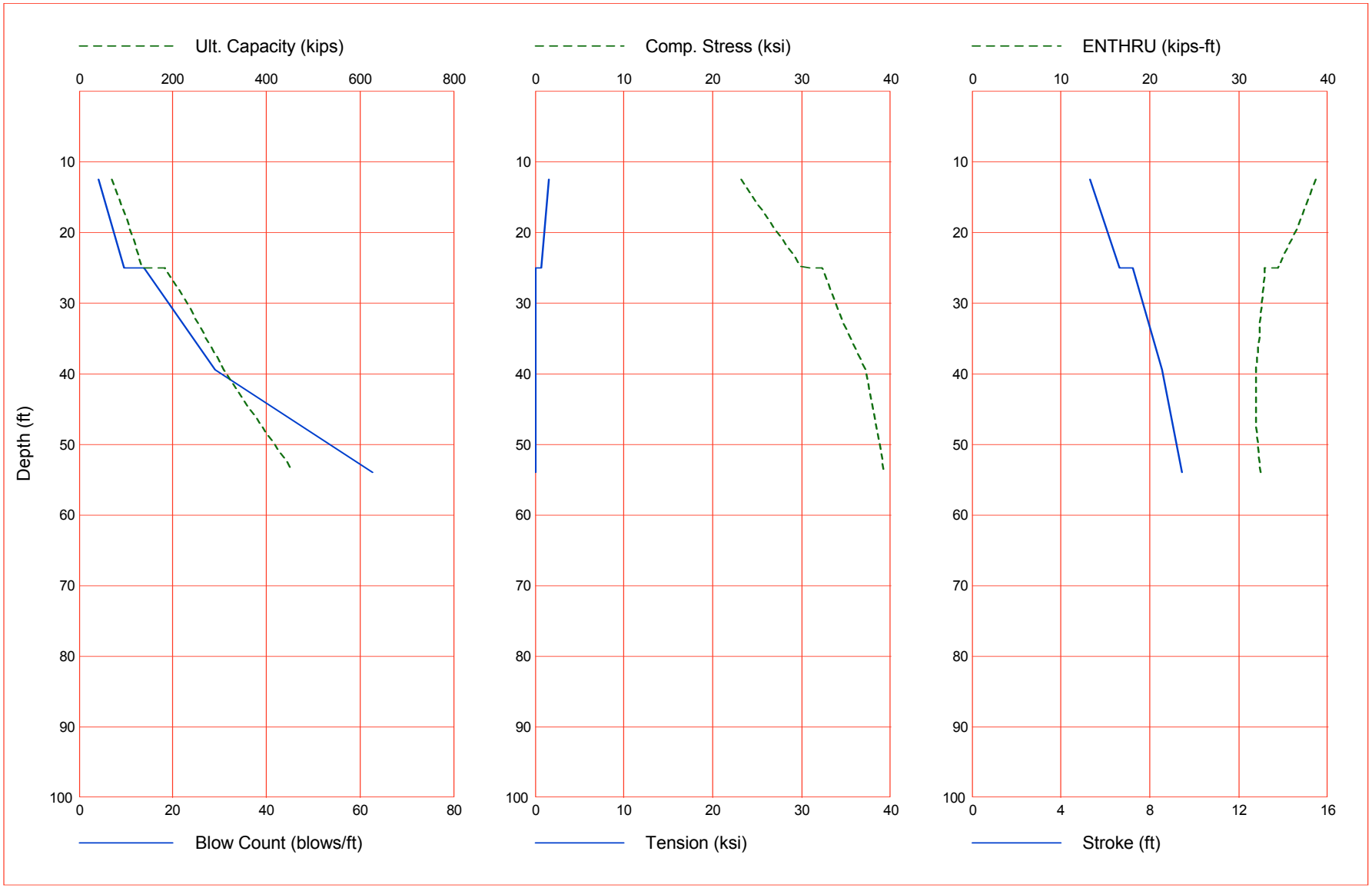
Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
3.00	1.11	24.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
9.01	1.11	24.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
18.01	1.22	24.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
24.99	1.37	24.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
25.01	2.00	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
34.01	2.00	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
43.01	2.50	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
52.01	2.50	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
59.99	2.50	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
60.00	2.50	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000

CTL Engineering Inc
Hayden Run 16" CIP-0.5" Wall 72 Kipft

Jul 11 2013
GRLWEAP Version 2010

Gain/Loss 1 at Shaft and Toe 1.000 / 1.000



Gain/Loss 1 at Shaft and Toe 1.000 / 1.000

Depth ft	Ultimate Capacity kips	Friction kips	End Bearing kips	Blow Count blows/ft	Comp. Stress ksi	Tension Stress ksi	Stroke ft	ENTHRU kips-ft
12.5	69.1	44.4	24.7	4.2	23.182	-1.578	5.32	38.7
25.0	134.1	109.4	24.7	9.7	30.029	-0.640	6.65	34.4
25.0	183.7	109.7	74.0	13.9	32.217	0.000	7.23	32.9
39.5	308.4	234.4	74.0	29.0	37.123	0.000	8.55	31.9
54.0	458.9	384.9	74.0	62.6	39.214	0.000	9.43	32.5

Total Continuous Driving Time 27.00 minutes; Total Number of Blows 1087

GRLWEAP - Version 2010
WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS

written by GRL Engineers, Inc. (formerly Goble Rausche Likins and Associates, Inc.) with cooperation from Pile Dynamics, Inc.

ABOUT THE WAVE EQUATION ANALYSIS RESULTS

The GRLWEAP program simulates the behavior of a preformed pile driven by either an impact hammer or a vibratory hammer. The program is based on mathematical models, which describe motion and forces of hammer, driving system, pile and soil under the hammer action. Under certain conditions, the models only crudely approximate, often complex, dynamic situations.

A wave equation analysis generally relies on input data, which represents normal situations. In particular, the hammer data file supplied with the program assumes that the hammer is in good working order. All of the input data selected by the user may be the best available information at the time when the analysis is performed. However, input data and therefore results may significantly differ from actual field conditions.

Therefore, the program authors recommend prudent use of the GRLWEAP results. Soil response and hammer performance should be verified by static and/or dynamic testing and measurements. Estimates of bending or other local non-axial stresses and prestress effects must also be accounted for by the user.

The calculated capacity - blow count relationship, i.e. the bearing graph, should be used in conjunction with observed blow counts for the capacity assessment of a driven pile. Soil setup occurring after pile installation may produce bearing capacity values that differ substantially from those expected from a wave equation analysis due to soil setup or relaxation. This is particularly true for pile driven with vibratory hammers. The GRLWEAP user must estimate such effects and should also use proper care when applying blow counts from restrike because of the variability of hammer energy, soil resistance and blow count during early restriking.

Finally, the GRLWEAP capacities are ultimate values. They MUST be reduced by means of an appropriate factor of safety to yield a design or working load. The selection of a factor of safety should consider the quality of the construction control, the variability of the site conditions, uncertainties in the loads, the importance of building and other factors.

Input File: C:\2013\9529.GWW
Hammer File: C:\ProgramData\PDI\GRLWEAP\2010\Resource\HAMMER2003.GW
Hammer File Version: 2003 (3/21/2012)

Input File Contents

Hayden Run 16" CIP-0.5" Wall 72 Kipft

OUT	OSG	HAM	STR	FUL	PEL	N	SPL	N-U	P-D	%SK	ISM	0	PHI	RSA	ITR	H-D	MXT	DEx
-100	01251		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.000

Pile g	Hammer g	Toe Area	Pile Size		Pile Type		
32.170	32.170	201.060	16.000		Pipe		
W Cp	A Cp	E Cp	T Cp	CoR	ROut	StCp	
1.700	227.000	530.0	2.000	0.800	0.010	0.0	
A Cu	E Cu	T Cu	CoR	ROut	StCu		
0.000	0.0	0.000	0.000	0.000	0.0		
LPle	APle	EPle	WPle	Peri	CI	CoR	ROut
60.000	24.34	29000.0	492.000	4.188	0	0.850	0.010

Manufac	Hmr Name	HmrType	No Seg-s			
ICE	I-30 V2	1	5			
Ram Wt	Ram L	Ram Dia	MaxStrk	RtdStrk	Efficy	
6.61	123.20	16.51	13.70	10.84	0.80	
IB. Wt	IB. L	IB.Dia	IB CoR	IB RO		
1.43	28.10	16.50	0.900	0.010		

CompStrk	A Chamber	V Chamber	C Delay	C Duratn	Exp Coeff	VolCStart	Vol CEnd
17.68	214.60	309.10	0.001	0.002	1.250	0.00	0.00
P atm	P1	P2	P3	P4	P5		
14.70	1436.00	1292.00	1163.00	1045.00	0.00		
Stroke	Effic.	Pressure	R-Weight	T-Delay	Exp-Coeff	Eps-Str	Total-AW
10.8400	0.8000	1436.0000	0.0000	0.0000	0.0000	0.0100	0.0000
Qs	Qt	Js	Jt	Qx	Jx	Rati	Dept
0.100	0.100	0.150	0.150	0.000	0.000	0.000	0.000

Research Soil Model: Atoe, Plug, Gap, Q-fac

0.000	0.000	0.000	0.000

Research Soil Model: RD-skn: m, d, toe: m, d

0.000	0.000	0.000	0.000

Res. Distribution

Dpth	Rskn	Rtoe	Qs	Qt	Js	Jt	SU F	LimD	SU T
0.01	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
2.99	0.00	0.00	0.10	0.10	0.20	0.15	1.21	0.00	0.0
3.00	1.11	24.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
9.01	1.11	24.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
18.01	1.22	24.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
24.99	1.37	24.67	0.10	0.10	0.20	0.15	1.21	0.00	0.0
25.01	2.00	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
34.01	2.00	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
43.01	2.50	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
52.01	2.50	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
59.99	2.50	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0
60.00	2.50	74.02	0.10	0.10	0.20	0.15	1.21	0.00	0.0

Gain/Loss factors: shaft and toe

1.00000	0.81300	0.83000	0.84700	0.86400
1.00000	1.00000	1.00000	1.00000	1.00000

Dpth	L	Wait	Strk	Pmx%	Eff.	Stff	CoR
12.50	0.00	0.00	0.000	0.000	0.000	0.000	0.000
24.98	0.00	0.00	0.000	0.000	0.000	0.000	0.000
25.02	0.00	0.00	0.000	0.000	0.000	0.000	0.000
39.49	0.00	0.00	0.000	0.000	0.000	0.000	0.000
54.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000
0.00	0.00	0.00	0.000	0.000	0.000	0.000	0.000

1	0	10.84000	13.70000	

GRLWEAP: WAVE EQUATION ANALYSIS OF PILE FOUNDATIONS
Version 2010
English Units

Hayden Run 16" CIP-0.5" Wall 72 Kipft

Hammer Model: I-30 V2 Made by: ICE

No.	Weight kips	Stiffn k/inch	CoR	C-Slk ft	Dampg k/ft/s
1	1.323				
2	1.323	251965.7	1.000	0.0100	
3	1.323	251965.7	1.000	0.0100	
4	1.323	251965.7	1.000	0.0100	
5	1.323	251965.7	1.000	0.0100	
Imp Block	1.430	117641.7	0.900	0.0100	
Helmet	1.700	60155.0	0.800	0.0100	9.6
Combined Pile Top		17646.5			

HAMMER OPTIONS:

Hammer File ID No.	1251	Hammer Type	OE Diesel
Stroke Option	FxdP-VarS	Stroke Convergence Crit.	0.010
Fuel Pump Setting	Maximum		

HAMMER DATA:

Ram Weight	(kips)	6.61	Ram Length	(inch)	123.20
Maximum Stroke	(ft)	13.70			
Rated Stroke	(ft)	10.84	Efficiency		0.800
Maximum Pressure	(psi)	1436.00	Actual Pressure	(psi)	1436.00
Compression Exponent		1.350	Expansion Exponent		1.250
Ram Diameter	(inch)	16.51			
Combustion Delay	(s)	0.00050	Ignition Duration	(s)	0.00200

The Hammer Data Includes Estimated (NON-MEASURED) Quantities

HAMMER CUSHION			PILE CUSHION		
Cross Sect. Area	(in2)	227.00	Cross Sect. Area	(in2)	0.00
Elastic-Modulus	(ksi)	530.0	Elastic-Modulus	(ksi)	0.0
Thickness	(inch)	2.00	Thickness	(inch)	0.00
Coeff of Restitution		0.8	Coeff of Restitution		1.0
RoundOut	(ft)	0.0	RoundOut	(ft)	0.0
Stiffness	(kips/in)	60155.0	Stiffness	(kips/in)	0.0

Depth	(ft)	12.5			
Shaft Gain/Loss Factor		1.000	Toe Gain/Loss Factor		1.000

PILE PROFILE:

Toe Area	(in2)	201.060	Pile Type	Pipe
Pile Size	(inch)	16.000		

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model — Total Capacity Rut (kips) 69.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.000	0.100	6.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	0.0	0.200	0.100	50.00	4.2	24.3
16	0.277	17647	0.000	0.000	1.00	13.2	0.200	0.100	53.33	4.2	24.3
17	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	56.67	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	15.8	0.200	0.100	60.00	4.2	24.3
Toe						24.7	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

PILE, SOIL, ANALYSIS OPTIONS:

Uniform pile		Pile Segments: Automatic	
No. of Slacks/Splices	0	Pile Damping (%)	1
		Pile Damping Fact.(k/ft/s)	0.854
Driveability Analysis			
Soil Damping Option	Smith		
Max No Analysis Iterations	0	Time Increment/Critical	160
Output Time Interval	1	Analysis Time-Input (ms)	0
Output Level: Normal			
Gravity Mass, Pile, Hammer:	32.170	32.170	32.170
Output Segment Generation: Automatic			

Depth ft	Stroke ft	Pressure Ratio	Efficy
12.50	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
69.1	4.2	5.32	5.30	-1.58	3	11	23.18	8	3	38.7	51.3
60.8	3.6	5.11	5.08	-1.61	3	11	22.00	5	3	39.6	52.4
61.6	3.7	5.13	5.10	-1.61	3	11	22.11	5	3	39.5	52.3
62.3	3.7	5.15	5.13	-1.60	3	11	22.18	5	3	39.3	52.2
63.1	3.8	5.17	5.14	-1.60	3	11	22.31	5	3	39.3	52.1

1 0 10.84000 13.70000

Hayden Run 16" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 201.060 Pile Type Pipe
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 134.1

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.000	0.100	6.67	4.2	24.3
11	0.277	17647	0.000	0.000	1.00	0.0	0.200	0.100	36.67	4.2	24.3
12	0.277	17647	0.000	0.000	1.00	9.2	0.200	0.100	40.00	4.2	24.3
13	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	43.33	4.2	24.3
14	0.277	17647	0.000	0.000	1.00	15.7	0.200	0.100	46.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	16.2	0.200	0.100	50.00	4.2	24.3
16	0.277	17647	0.000	0.000	1.00	16.8	0.200	0.100	53.33	4.2	24.3
17	0.277	17647	0.000	0.000	1.00	17.6	0.200	0.100	56.67	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	18.6	0.200	0.100	60.00	4.2	24.3
Toe						24.7	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
24.98	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
134.1	9.7	6.65	6.60	-0.64	12	44	30.03	12	4	34.4	45.7
113.6	7.8	6.23	6.24	-0.51	3	10	28.20	12	4	35.1	47.2
115.5	8.0	6.26	6.28	-0.36	3	10	28.36	12	4	34.9	47.0
117.4	8.2	6.30	6.31	-0.30	12	50	28.56	12	4	34.9	46.9
119.2	8.3	6.33	6.35	-0.28	12	46	28.67	12	4	34.8	46.8
1		0	10.84000		13.70000						

Hayden Run 16" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 25.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 201.060 Pile Type Pipe
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 183.7

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.000	0.100	6.67	4.2	24.3
11	0.277	17647	0.000	0.000	1.00	0.0	0.200	0.100	36.67	4.2	24.3
12	0.277	17647	0.000	0.000	1.00	9.4	0.200	0.100	40.00	4.2	24.3
13	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	43.33	4.2	24.3
14	0.277	17647	0.000	0.000	1.00	15.7	0.200	0.100	46.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	16.2	0.200	0.100	50.00	4.2	24.3
16	0.277	17647	0.000	0.000	1.00	16.8	0.200	0.100	53.33	4.2	24.3
17	0.277	17647	0.000	0.000	1.00	17.6	0.200	0.100	56.67	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	18.6	0.200	0.100	60.00	4.2	24.3
Toe						74.0	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
25.02	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
183.7	13.9	7.23	7.22	0.00	1	0	32.22	12	4	32.9	43.8
163.2	11.8	6.96	6.92	-0.13	12	39	31.09	12	4	33.6	44.7
165.1	12.0	6.98	6.95	-0.13	12	39	31.08	12	4	33.4	44.6
167.0	12.2	7.00	6.98	-0.13	12	39	31.26	12	4	33.4	44.6
168.8	12.4	7.03	7.01	-0.12	12	39	31.33	12	4	33.3	44.5
1		0	10.84000		13.70000						

Hayden Run 16" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 39.5
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 201.060 Pile Type Pipe
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 308.4

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.000	0.100	6.67	4.2	24.3
7	0.277	17646	0.000	0.000	1.00	0.0	0.200	0.100	23.33	4.2	24.3
8	0.277	17646	0.000	0.000	1.00	14.7	0.200	0.100	26.67	4.2	24.3
9	0.277	17646	0.000	0.000	1.00	15.5	0.200	0.100	30.00	4.2	24.3
10	0.277	17646	0.000	0.000	1.00	15.8	0.200	0.100	33.33	4.2	24.3
11	0.277	17647	0.000	0.000	1.00	16.4	0.200	0.100	36.67	4.2	24.3
12	0.277	17647	0.000	0.000	1.00	17.0	0.200	0.100	40.00	4.2	24.3
13	0.277	17647	0.000	0.000	1.00	17.9	0.200	0.100	43.33	4.2	24.3
14	0.277	17647	0.000	0.000	1.00	21.9	0.200	0.100	46.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	27.9	0.200	0.100	50.00	4.2	24.3
17	0.277	17647	0.000	0.000	1.00	28.5	0.200	0.100	56.67	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	30.9	0.200	0.100	60.00	4.2	24.3
Toe						74.0	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
39.49	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
308.4	29.0	8.55	8.54	0.00	1	0	37.12	8	3	31.9	40.4
264.6	24.0	8.30	8.22	0.00	1	0	35.98	8	3	31.8	41.0
268.6	24.4	8.34	8.26	0.00	1	0	36.13	8	3	31.8	40.9
272.6	24.8	8.37	8.30	0.00	1	0	36.25	8	3	31.8	40.9
276.6	25.4	8.32	8.33	0.00	1	0	36.16	8	3	31.5	40.9
	1		0	10.84000			13.70000				

Hayden Run 16" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

Depth (ft) 54.0
Shaft Gain/Loss Factor 1.000 Toe Gain/Loss Factor 1.000

PILE PROFILE:
Toe Area (in2) 201.060 Pile Type Pipe
Pile Size (inch) 16.000

L b Top ft	Area in2	E-Mod ksi	Spec Wt lb/ft3	Perim ft	C Index	Wave Sp ft/s	EA/c k/ft/s
0.0	24.34	29000.	492.0	4.2	0	16524.	42.7
60.0	24.34	29000.	492.0	4.2	0	16524.	42.7

Wave Travel Time 2L/c (ms) 7.262

Pile and Soil Model Total Capacity Rut (kips) 458.9

No.	Weight kips	Stiffn k/in	C-Slk ft	T-Slk ft	CoR	Soil-S kips	Soil-D s/ft	Quake inch	LbTop ft	Perim ft	Area in2
1	0.277	17647	0.010	0.000	0.85	0.0	0.000	0.100	3.33	4.2	24.3
2	0.277	17647	0.000	0.000	1.00	0.0	0.200	0.100	6.67	4.2	24.3
3	0.277	17646	0.000	0.000	1.00	4.7	0.200	0.100	10.00	4.2	24.3
4	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	13.33	4.2	24.3
5	0.277	17647	0.000	0.000	1.00	15.5	0.200	0.100	16.67	4.2	24.3
6	0.277	17646	0.000	0.000	1.00	16.0	0.200	0.100	20.00	4.2	24.3
7	0.277	17646	0.000	0.000	1.00	16.6	0.200	0.100	23.33	4.2	24.3
8	0.277	17646	0.000	0.000	1.00	17.3	0.200	0.100	26.67	4.2	24.3
9	0.277	17646	0.000	0.000	1.00	18.3	0.200	0.100	30.00	4.2	24.3
10	0.277	17646	0.000	0.000	1.00	25.2	0.200	0.100	33.33	4.2	24.3
11	0.277	17647	0.000	0.000	1.00	27.9	0.200	0.100	36.67	4.2	24.3
13	0.277	17647	0.000	0.000	1.00	29.2	0.200	0.100	43.33	4.2	24.3
14	0.277	17647	0.000	0.000	1.00	31.8	0.200	0.100	46.67	4.2	24.3
15	0.277	17647	0.000	0.000	1.00	34.3	0.200	0.100	50.00	4.2	24.3
16	0.277	17647	0.000	0.000	1.00	34.9	0.200	0.100	53.33	4.2	24.3
18	0.277	17647	0.000	0.000	1.00	34.9	0.200	0.100	60.00	4.2	24.3
Toe						74.0	0.150	0.100			

4.990 kips total unreduced pile weight (g= 32.17 ft/s2)
4.990 kips total reduced pile weight (g= 32.17 ft/s2)

Depth ft	Stroke ft	Pressure Ratio	Efficy
54.00	10.84	1.00	0.800

Rut kips	Bl Ct b/ft	Stroke (ft) down	up	Ten Str ksi	i	t	Comp Str ksi	i	t	ENTHRU kip-ft	Bl Rt b/min
458.9	62.6	9.43	9.41	0.00	1	0	39.21	4	2	32.5	38.5
386.9	44.0	9.07	9.06	0.00	1	0	38.02	4	2	31.7	39.2
393.5	45.4	9.10	9.09	0.00	1	0	38.17	4	2	31.8	39.2
400.0	46.8	9.14	9.13	0.00	1	0	38.25	4	2	31.8	39.1
406.6	48.3	9.17	9.16	0.00	1	0	38.41	4	2	31.9	39.0

Hayden Run 16" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 1.000 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	69.1	44.4	24.7	4.2	23.182	-1.578	5.32	38.7
25.0	134.1	109.4	24.7	9.7	30.029	-0.640	6.65	34.4
25.0	183.7	109.7	74.0	13.9	32.217	0.000	7.23	32.9
39.5	308.4	234.4	74.0	29.0	37.123	0.000	8.55	31.9
54.0	458.9	384.9	74.0	62.6	39.214	0.000	9.43	32.5

Total Driving Time 27 minutes; Total No. of Blows 1087

G/L at Shaft and Toe: 0.813 1.000

Depth ft	Rut kips	Frictn kips	End Bg kips	Bl Ct bl/ft	Com Str ksi	Ten Str ksi	Stroke ft	ENTHRU kip-ft
12.5	60.8	36.1	24.7	3.6	22.001	-1.608	5.11	39.6
25.0	113.6	89.0	24.7	7.8	28.200	-0.511	6.23	35.1
25.0	163.2	89.2	74.0	11.8	31.085	-0.134	6.96	33.6
39.5	264.6	190.6	74.0	24.0	35.983	0.000	8.30	31.8
54.0	386.9	312.9	74.0	44.0	38.020	0.000	9.07	31.7

Total Driving Time 20 minutes; Total No. of Blows 845

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.830 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	61.6	36.9	24.7	3.7	22.105	-1.607	5.13	39.5
25.0	115.5	90.8	24.7	8.0	28.357	-0.363	6.26	34.9
25.0	165.1	91.1	74.0	12.0	31.085	-0.134	6.98	33.4
39.5	268.6	194.6	74.0	24.4	36.128	0.000	8.34	31.8
54.0	393.5	319.5	74.0	45.4	38.172	0.000	9.10	31.8

Total Driving Time 21 minutes; Total No. of Blows 865

G/L at Shaft and Toe: 0.847 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	62.3	37.6	24.7	3.7	22.176	-1.601	5.15	39.3
25.0	117.4	92.7	24.7	8.2	28.559	-0.296	6.30	34.9
25.0	167.0	92.9	74.0	12.2	31.260	-0.128	7.00	33.4
39.5	272.6	198.5	74.0	24.8	36.246	0.000	8.37	31.8
54.0	400.0	326.0	74.0	46.8	38.250	0.000	9.14	31.8

Total Driving Time 21 minutes; Total No. of Blows 885

Hayden Run 16" CIP-0.5" Wall 72 Kipft 07/11/2013
CTL Engineering Inc GRLWEAP Version 2010

SUMMARY OVER DEPTHS

G/L at Shaft and Toe: 0.864 1.000

Depth	Rut	Frictn	End Bg	Bl Ct	Com Str	Ten Str	Stroke	ENTHRU
ft	kips	kips	kips	bl/ft	ksi	ksi	ft	kip-ft
12.5	63.1	38.4	24.7	3.8	22.305	-1.603	5.17	39.3
25.0	119.2	94.6	24.7	8.3	28.674	-0.284	6.33	34.8
25.0	168.8	94.8	74.0	12.4	31.334	-0.120	7.03	33.3
39.5	276.6	202.5	74.0	25.4	36.159	0.000	8.32	31.5
54.0	406.6	332.5	74.0	48.3	38.406	0.000	9.17	31.9

Total Driving Time 22 minutes; Total No. of Blows 908

Table of Depths Analyzed with Driving System Modifiers

Depth ft	Temp. Length ft	Wait Time hr	Equivalent Stroke ft	Pressure Ratio	Efficy.	Stiffn. Factor	Cushion CoR
12.50	60.00	0.00	10.84	1.00	0.80	1.00	1.00
24.98	60.00	0.00	10.84	1.00	0.80	1.00	1.00
25.02	60.00	0.00	10.84	1.00	0.80	1.00	1.00
39.49	60.00	0.00	10.84	1.00	0.80	1.00	1.00
54.00	60.00	0.00	10.84	1.00	0.80	1.00	1.00

Soil Layer Resistance Values

Depth ft	Shaft Res. k/ft2	End Bearing kips	Shaft Quake inch	Toe Quake inch	Shaft Damping s/ft	Toe Damping s/ft	Soil Setup Normlzd	Limit Distance ft	Setup Time hrs
0.01	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
2.99	0.00	0.00	0.100	0.100	0.200	0.150	1.000	0.000	0.000
3.00	1.11	24.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
9.01	1.11	24.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
18.01	1.22	24.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
24.99	1.37	24.67	0.100	0.100	0.200	0.150	1.000	0.000	0.000
25.01	2.00	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
34.01	2.00	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
43.01	2.50	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
52.01	2.50	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
59.99	2.50	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000
60.00	2.50	74.02	0.100	0.100	0.200	0.150	1.000	0.000	0.000

APPENDIX I
GB1 ANALYSES

Subgrade Analysis

V. 12.00 12/30/11

Design CBR 6

Global Options		
320	R&R	No
206	CS	No
	LS	Option
	LKD	No
206	Depth	14

Classification Counts by Sample																	
R	1a	1b	3	3a	2-4	2-5	2-6	2-7	4a	4b	5	6a	6b	7-5	7-6	8a	8b
0	0	0	0	0	3	0	0	0	2	0	0	0	0	1	6	0	0
					25%				17%					8%	50%		
0%	25%								75%								

Surface Class		
2-5	0	
4b	0	
5	0	
7-5	1	20%
7-6	3	60%
8a	0	
8b	0	
R	0	

% Borings	
N_{60L} <= 5	0%
<=10	80%
>=20	0%
M+	100%
R	0%

% Surface	
80%	
20%	80%

Rig	ER
A	85
B	87
C	
D	
E	
F	
G	
H	

		N_{60}	N_{60L}			PI		Clay		M	M_{OPT}		GI
Total Borings	5	Average	10.2	7.2		24.9		37.3		20.8	15.3		10.00
PID		Maximum	18	11	55	28	53	49	93	32	21		17
Location	Hayden Run Blvd.	Minimum	6	6	44	23	13	3	16	9	10		0

UC @ Surface
23.8
36
14

	Boring					Subgrade		Standard Penetration						Physical Characteristics						Moisture		Class		Comments	Problem		Undercuts		Analysis
#	B #	Boring Location	Depth	To	Cut Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI		w/ Class	w/ MN	UC Class	UC MN	
1	SB-1	89+91.7 Hayden Run Blvd.	0.0	1.5	3.5	3.5	5.0	3	5	8	A	11	11	51	23	28	43	49	92	26	20	7-6	17			N		14	
2	SB6	111+81.22 Hayden Run Blvd.	1.0	2.5	-0.4	0.6	2.1	2	3	5	B	7		49	22	27	50	42	92	27	19	7-6	17			N		21	
			2.5	4.0		2.1	3.6	2	4	6		9		49	24	25	45	48	93	19	21	7-6	16			N		16	
			4.0	5.5		3.6	5.1	5	6	11		16	7							16	10	4a	5			M			
3	SB9	46+63.72 Avery Road	0.0	1.5	0.5	0.5	2.0	6	7	13	A	18		NP	NP	NP	13	3	16	9	10	2-4	0						
			1.5	3.0		2.0	3.5	2	2	4		6								11	10	2-4	0			N		24	
			3.0	4.5		3.5	5.0	2	2	4		6	6							15	10	2-4	0			N		24	
4	SB7	50+91.38 Avery Road	1.0	2.5	0.4	1.4	2.9	2	2	4	A	6		55	32	23	47	34	81	32		7-5	16		Un	N	36/All	24	
			2.5	4.0		2.9	4.4	3	4	7		10	6	46	23	23	43	43	86	25	20	7-6	14			N		15	
5	SB8	55+85.97 Avery Road	1.0	2.5	-0.5	0.5	2.0	2	2	4	A	6		44	21	23	53	36	89	27	18	7-6	14			N		24	
			2.5	4.0		2.0	3.5	3	4	7		10		48	23	25	43	43	86	24	20	7-6	16			N		15	
			4.0	5.5		3.5	5.0	5	7	12		17	6							19	10	4a	5			M			

Subgrade Analysis

V. 12.00 12/30/11

Design CBR 6

Global Options		
320	R&R	No
206	CS	No
	LS	Option
	LKD	No
206	Depth	14

Classification Counts by Sample																	
R	1a	1b	3	3a	2-4	2-5	2-6	2-7	4a	4b	5	6a	6b	7-5	7-6	8a	8b
0	0	0	0	0	3	0	0	0	2	0	0	0	0	1	6	0	0
					25%				17%					8%	50%		
0%	25%								75%								

Surface Class		
2-5	0	
4b	0	
5	0	
7-5	1	20%
7-6	3	60%
8a	0	
8b	0	
R	0	

% Borings	
N_{60L} <= 5	0%
<=10	80%
>=20	0%
M+	100%
R	0%

% Surface	
80%	
20%	80%

Rig	ER
A	85
B	87
C	
D	
E	
F	
G	
H	

Total Borings	5
PID	
Location	Hayden Run Blvd.

	N_{60}	N_{60L}			PI		Clay		M	M_{OPT}	GI
Average	10.2	7.2			24.9		37.3		20.8	15.3	10.00
Maximum	18	11	55	32	28	53	49	93	32	21	17
Minimum	6	6	44	21	23	13	3	16	9	10	0

UC @ Surface
23.8
36
14

	Boring					Subgrade		Standard Penetration						Physical Characteristics								Moisture		Class		Comments	Problem		Undercuts		Analysis
#	B #	Boring Location	Depth	To	Cut Fill	Depth	To	n_2	n_3	N	Rig	N_{60}	N_{60L}	LL	PL	PI	% Silt	% Clay	P 200	M	M_{OPT}	Ohio DOT	GI		w/ Class	w/ MN	UC Class	UC MN	
1	SB-1	89+91.7 Hayden Run Blvd.	0.0	1.5	3.5	3.5	5.0	3	5	8	A	11	11	51	23	28	43	49	92	26	20	7-6	17			N		14	
2	SB6	111+81.22 Hayden Run Blvd.	1.0	2.5	-0.4	0.6	2.1	2	3	5	B	7		49	22	27	50	42	92	27	19	7-6	17			N		21	
			2.5	4.0		2.1	3.6	2	4	6		9		49	24	25	45	48	93	19	21	7-6	16			N		16	
			4.0	5.5		3.6	5.1	5	6	11		16	7							16	10	4a	5			M			
3	SB9	46+63.72 Avery Road	0.0	1.5	0.5	0.5	2.0	6	7	13	A	18		NP	NP	NP	13	3	16	9	10	2-4	0						
			1.5	3.0		2.0	3.5	2	2	4		6								11	10	2-4	0			N		24	
			3.0	4.5		3.5	5.0	2	2	4		6	6							15	10	2-4	0			N		24	
4	SB7	50+91.38 Avery Road	1.0	2.5	0.4	1.4	2.9	2	2	4	A	6		55	32	23	47	34	81	32		7-5	16		Un	N	36/All	24	
			2.5	4.0		2.9	4.4	3	4	7		10		46	23	23	43	43	86	25	20	7-6	14			N		15	
													6																
5	SB8	55+85.97 Avery Road	1.0	2.5	-0.5	0.5	2.0	2	2	4	A	6		44	21	23	53	36	89	27	18	7-6	14			N		24	
			2.5	4.0		2.0	3.5	3	4	7		10		48	23	25	43	43	86	24	20	7-6	16			N		15	
			4.0	5.5		3.5	5.0	5	7	12		17								19	10	4a	5			M			
													6																