COUNTY LINE TO A STREET
GEOTECHNICAL INVESTIGATION
PROJECT NO. 1112049
JUNE 2012

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June 15, 2012

TO: Chris Brummer, P.E., L.G., Engineer III, River and Floodplain Management Section, Water and Land Resources Division

VIA: Alan Corwin, P.E., Materials Engineer, Materials Laboratory, Project Support Services Group

FM: Doug Walters, P.E., Engineer III, Materials Laboratory, Project Support Services Group

RE: **County Line to A Street Geotechnical Investigation: Project 1112049**

As requested, our office has completed a geotechnical investigation for the County Line to A Street Levee Modification Project. The purpose of this investigation is to provide subsurface information that may be used for design and construction of a new setback levee and engineered logjams.

We appreciate the opportunity to have been of service on this project and trust this report addresses your current needs. Please call Alan Corwin at (206) 296-7711 or Doug Walters at (206) 296-7708, should you have any questions, concerns, or if we may be of further assistance.

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COUNTY LINE TO A STREET
GEOTECHNICAL INVESTIGATION

1.0 INTRODUCTION

1.1 GENERAL

As requested, our office has completed a geotechnical investigation for the County Line to A Street Levee Modification Project. The purpose of this investigation is to provide subsurface information that may be used for design and construction of a new setback levee and engineered logjams. Our work included drilling 16 soil borings, excavating six test pits and three scrapes, performing laboratory testing of selected soil samples, and providing conductivity testing at two well locations.

The County Line to A Street Levee Modification Project is located adjacent the White River near the town of Pacific, at the King and Pierce County Borderline. The general location is shown on the Vicinity Map, Figure 1, at the conclusion of the text.

2.0 SUBSURFACE INVESTIGATION

2.1 Background

This geotechnical exploration program was implemented in two phases. The first phase was conducted between September 22 and October 1, 2010 and consisted of drilling 13 borings. The second phase of drilling was performed between September 28 and October 4, 2011 and included drilling of four test borings. The second phase of the subsurface investigation also included excavating six test pits and three scrapes on October 14, 2011. A general discussion of our findings is presented below.

2.2 Test Borings

All 16 borings were drilled using a track mounted drill utilizing mud rotary methodology. Standard Penetration Tests (SPT) were generally taken at 5-foot increments from the surface as each boring was advanced. The SPT provides a measure of compaction or relative density of granular soils, and consistency or stiffness of cohesive fine-grained soils. Representative soil samples were collected and returned to our laboratory for identification and testing. Approximate boring locations are shown in Figure 2 following the text. Copies of the borehole logs (Plates A1 to A16) are provided in Appendix A. Laboratory test results on selected boring soil samples (Figures A1 to A31) are presented following the boring logs.

KCB-1 through KCB-9, and KCB-16 were drilled east of the existing levee in the general area of the proposed setback levee. The borings ranged in depth from 31.5 feet to 76.5 feet below the ground surface. Two-inch diameter PVC monitoring wells were installed in KCB-2 and KCB-4. In general, soils encountered in these borings consisted of alluvial deposits of loose to medium dense alternating layers of fine to medium grained sands, silty sands, and

silts. Peat up to five feet in thickness was noted in KCB-6 and KCB-7 along with minor peat lenses observed in several other borings. Gravels were encountered in KCB-16 to a depth of 15 feet below the ground surface.

KCB-10 through KCB-12 and KCB-14 and KCB-15 were drilled on top of the existing levee. In general, dense to very dense gravel and cobble were encountered to a depth of 20 to 30 feet below the ground surface. Underlying the gravel, alternating layers of sand, silty sand, and silt with some gravel were encountered to the termination depths of up to 76.5 feet below the ground surface.

KCB-13 was drilled on the west side of the wetland east of the existing levee road. In general, 10 feet of loose fine overbank sand overlayed 10 feet of gravel. Below the gravel, alternating layers of sand, silty sand, and silt were encountered to the termination depth of 66.5 feet below the ground surface.

Due to the use of mud rotary, we were unable to determine water levels in the borings. However, we anticipate the water levels in the borings will be similar to the surface water elevations of the adjacent White River or wetland.

2.3 Test Pits

Six test pits (KCTP-1 through KCTP-6) were excavated on October 14, 2011 utilizing a Volvo EC140C Excavator with a three-foot wide digging bucket. The test pits ranged from approximately five to eight feet in depth below the ground surface. The underlying soils were visually classified in the field and representative grab soil samples were collected and returned to our laboratory for testing and storage. Test holes were terminated due to groundwater or when excessive sidewall caving made further excavation not practical. The approximate test pit locations are shown on Figure 2 at the conclusion of the text. Detailed logs (Plates B1 to B6) and laboratory test results (Figures B1 to B3) are provided for review in Appendix B.

The test pits revealed the levee was predominantly constructed with dredge spoils from the adjacent White River. In general, we encountered 1 foot of road surfacing overlaying gravel with an estimated 20 to 40 percent cobble and occasional boulder. Groundwater was encountered in KCTP-1, KCTP-2, and KCTP-3 at four, seven, and eight feet respectively. The groundwater generally coincided with the surface elevation of the adjacent White River.

2.4 Scrapes

Three scrapes were excavated on the outer levee slope on October 14, 2011 with a Volvo EC140C Excavator with a three-foot wide digging bucket. The scrapes were made to determine the general makeup and depth of materials used for the bank armoring of the levee. Drawings of the materials encountered are provided in Figures C1 through C3 in Appendix C.

3.0 HYDRAULIC CONDUCTIVITY

Field hydraulic conductivity testing was performed at two monitoring wells, KCB-2 and KCB-4, constructed during our geotechnical site exploration. Both wells were drilled to a total depth of 31.5 feet below the original ground surface elevation. Logs of monitoring wells KCB-2 and KCB-4 (Plates A2 and A4) can be found in Appendix A.

3.1 Piezometers

The KCB-2 and KCB-4 plastic standpipe piezometers consist of a two-inch inside diameter blank PVC pipe with 20-slot well screen. Slotted PVC screen was installed in KCB-2 between 20 and 30 feet below the ground surface, and in KCB-4 between 10 and 30 feet below the ground surface. The annular spaces around the screens were filled with a clean 10-20 uniform sand filter. The remaining depths to the near surface elevations were backfilled with bentonite chips. Blank PVC casing was installed above the screened well sections to an elevation of approximately 3 feet above the original ground surface. The above ground PVC is within a protective steel casing with locking cover. The monitoring wells were constructed in general accordance with the WSDOE WAC 173-160 "Minimum Standards for Construction and Maintenance of Water Wells."

3.2 Hydraulic Conductivity Testing

Monitoring wells were initially developed using a down-hole pump and preliminary data was collected on drawdown and recovery. The down-hole pump was not capable of dropping water levels sufficiently to obtain reliable recovery data for estimating saturated horizontal hydraulic conductivity (K) of the near surface aquifer underlying the site.

Based on the preliminary pump drawdown data and characteristics of the aquifer and subsurface soils, the *Bouwer and Rice* (1976) falling head slug test was selected for data collection and analysis to estimate horizontal hydraulic conductivity. The falling head slug test involves quickly raising and lowering water levels in a well from equilibrium and measuring the subsequent rate of fall. This test method was originally developed for unconfined aquifers but is also suitable for confined or stratified aquifers provided the top of the screen is below the upper confining layer. Water levels in KCB-2 and KCB-4 were approximately two feet below the ground surface when testing was performed. The soils surrounding the screened portion of the wells consisted of stratified sands and silts/silty sands.

Three slug tests were performed on both monitoring wells by quickly adding water up to the top of the casings. The rate of fall was measured using pressure transducers (Level loggers) set to record at 0.5 second intervals. Graphs showing the water level rise and fall with respect to time are shown in Figures D1 and D2 in Appendix D.

Data was analyzed using *Excel* spreadsheets based on the Bouwer and Rice test method and available from the United States Geological Survey. Tests for horizontal hydraulic conductivity (K) near the well screen ranged from 22 to 24 feet per day at KCB-2 (Figures D3 to D5), and 6 to 7 feet per day at KCB-4, (Figures D6 to D8). These values are within the likely minimum and maximum estimates of hydraulic conductivity for fine to medium sands as defined by the 25 and 75 percentile values of the program.

In developing these estimates, it is assumed water is discharged into the well instantaneously, is of finite diameter and may partially penetrate the aquifer. Typical hydraulic conductivity values for various materials, from the USGS program, are provided in Figure D9.

3.3 Limitations

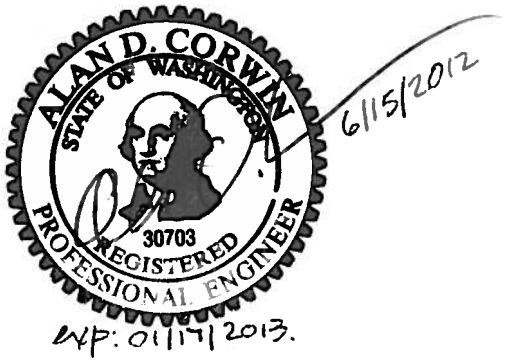
The setback levee will be placed on alluvial deposits of stratified materials that may be highly variable. The hydraulic conductivity values provided are based on test results at two well locations and within materials adjacent the screened interval of the wells. Therefore, the hydraulic conductivity values of the overall site may vary substantially from our test results.

4.0 MATERIAL SUITABILITY TESTING

We do not anticipate the setback levee design will require any further laboratory testing of materials from our subsurface exploration. However, we do store the samples and can provide additional testing of samples if requested. Based on our subsurface investigation, the existing levee is predominately clean gravel and cobble. The material has value and could be screened and crushed to create very good road fill material. However, due to the lack of fines, the existing levee material would not typically be considered appropriate backfill for the new setback levy.

We appreciate the opportunity to have been of service on this project and trust this report addresses your current needs. Please call Alan Corwin at (206) 296-7711 or Doug Walters at (206) 296-7708, should you have any questions, concerns, or if we may be of further assistance.

Respectfully Submitted,
King County Materials Laboratory



Alan D. Corwin, P.E.
King County Materials Engineer

5.0 REFERENCES

Bouwer, H. and R. C. Rice, 1976, A Slug Test for Determining Hydraulic Conductivity of Unconfined Aquifers with Completely or Partially Penetrating Wells, Water Resources Research, Volume 12, Pages 423-428.

United States Geological Survey, pubs.usgs.gov/of/2002/ofr02197/spreadsheets/Slug Bouwer-Rice.xls

Figure 1: Vicinity Map
County Line to A Street
Geotechnical Study

Figure 2 Location
City Boundary
County Boundary

0 2,000 4,000 6,000
Feet

N

King County
Department of Natural Resources and Parks
Water and Land Resources Division

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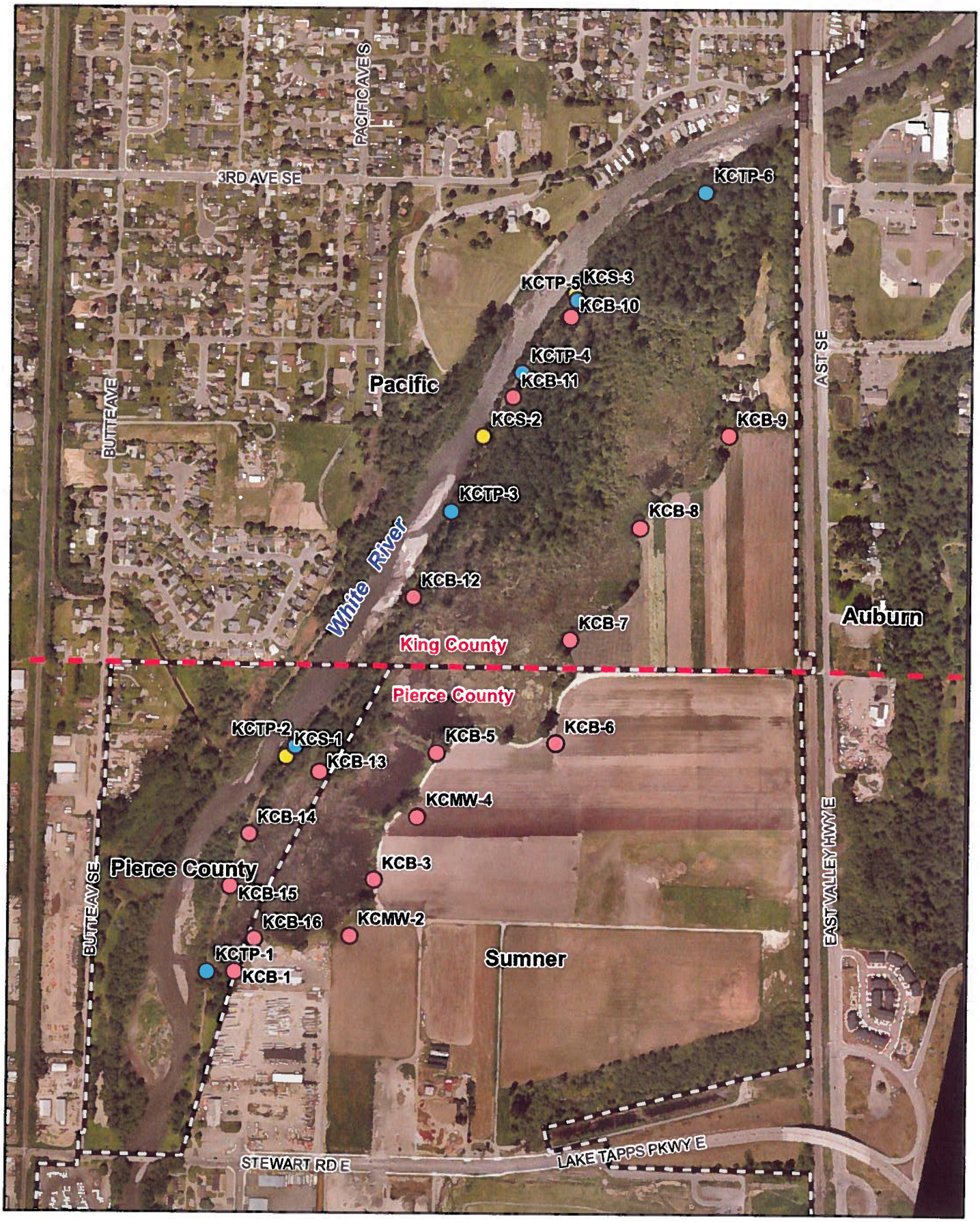

Figure 2: Boring, Test Pit, and Scraping Location Map, County Line to A Street Geotechnical Study

Boring Sites
Test Pits
Scrapes
City Boundary
County Boundary

0 600 1,200
Feet

N

King County
Department of Natural Resources and Parks
Water and Land Resources Division

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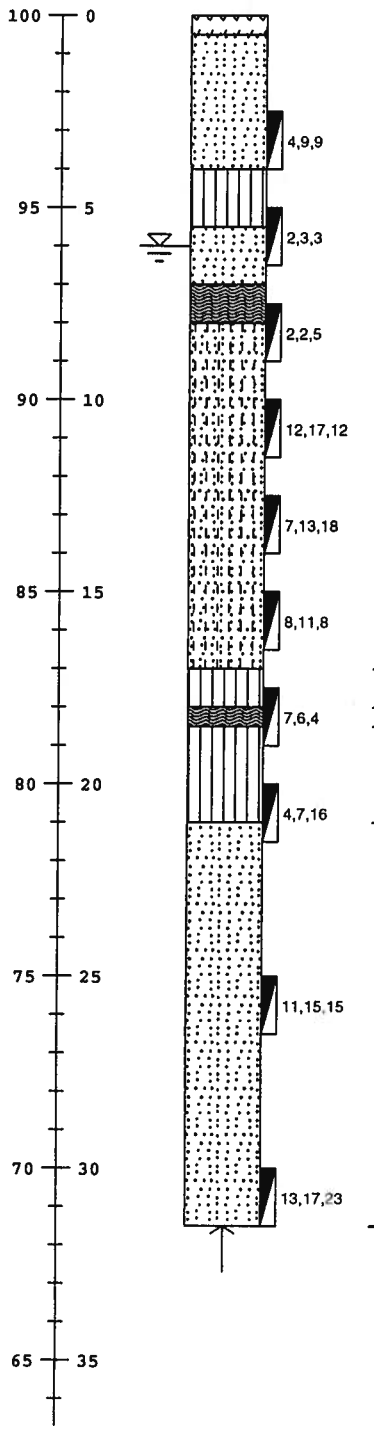
Appendix A

Boring Logs and Laboratory Data

BORING LOG
BORING KCB-1

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Setback Levee Location 1**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **6 ft** Caving: **N. A.**

DATE: **September 28, 2010**
START: **12:00 PM 9/28/2010**
FINISH: **2:00 PM 9/28/2010**
LOGGER: **DA**
DATE CHECKED: **During**



USCS	Description	Moist (%)	-200 (%)	Remarks
SP	Sod and sandy topsoil. Dark brown poorly graded fine to medium grained sand with silt, gravel, and occasional cobbles, moist, medium dense. (Fill)			
ML	Gray silt with sand, moist, loose. The silt contains a few fragments of decaying vegetation.	168.0		
SP				
PT				
SP-SM	Black poorly graded fine to medium sand, wet, loose.			
	Peat.			
	Black poorly graded fine to medium grained sand with silt, wet, loose to dense.	26.4	7.9	The sample contained scattered gravel.
ML	Black silt, wet, medium dense.			
PT	Peat.	168.1		
ML	Dark gray sandy silt, wet, medium dense.	35.4	61.7	The silt was found to be non-plastic.
SP	Black poorly graded fine to medium grained sand, wet, medium dense to dense.			
	The sample contained scattered tephra granules.			

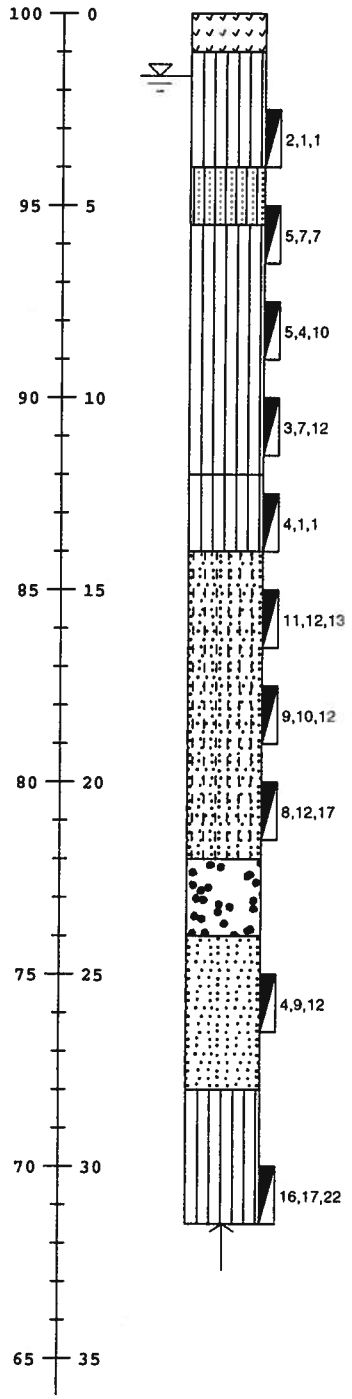
Boring KCB-1 was located in the field by GPS. The approximate boring location is provided in Figure 2.

PLATE NUMBER **A1**

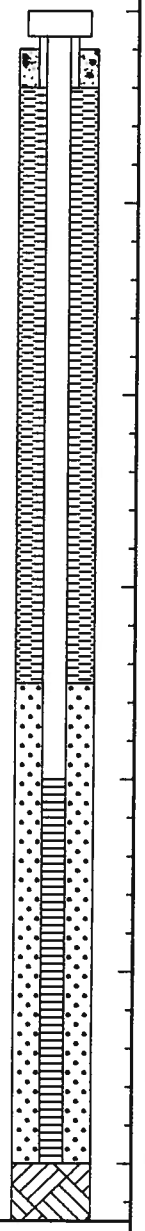
LOG OF MONITOR WELL INSTALLATION
WELL NO. KCB-2

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Setback Levee Location 2**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **1.62 ft**

DATE: **September 22 2010**
START: **12:00 PM 9/22/2010**
FINISH: **2:00 PM 9/22/2010**
LOGGER: **DA**
DATE CHECKED: **7:30 AM 9/30/**



ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
			Cultivated sandy topsoil.			
		ML	Gray mottled silt with sand, moist to wet, very loose. Sample also contained scattered organic material.	53.0	80.6	The silt was found to be non-plastic.
		SM	Black silty sand, wet, medium dense. The sand contains thin lenses of fine sand and silt.			
		ML	Black silt with sand, wet, loose to medium dense.	31.6	72.2	The silt was found to be non-plastic.
		ML	Gray silt, wet, very loose. The sample also contained a 6 inch thick lense of peat.			
		SP-SM	Black poorly graded fine to medium sand with silt, wet, medium dense.	29.5	5.5	
		GP	Poorly graded gravel with sand, wet, medium dense.			The gravel was detected by the action of the drill.
		SP	Black poorly graded fine to medium grained sand, wet, medium dense to dense.			Sample contained scattered decomposed wood debris and root fibers.
		ML	Dark gray sandy silt, wet, dense.	30.0	56.6	The silt was found to be non-plastic.



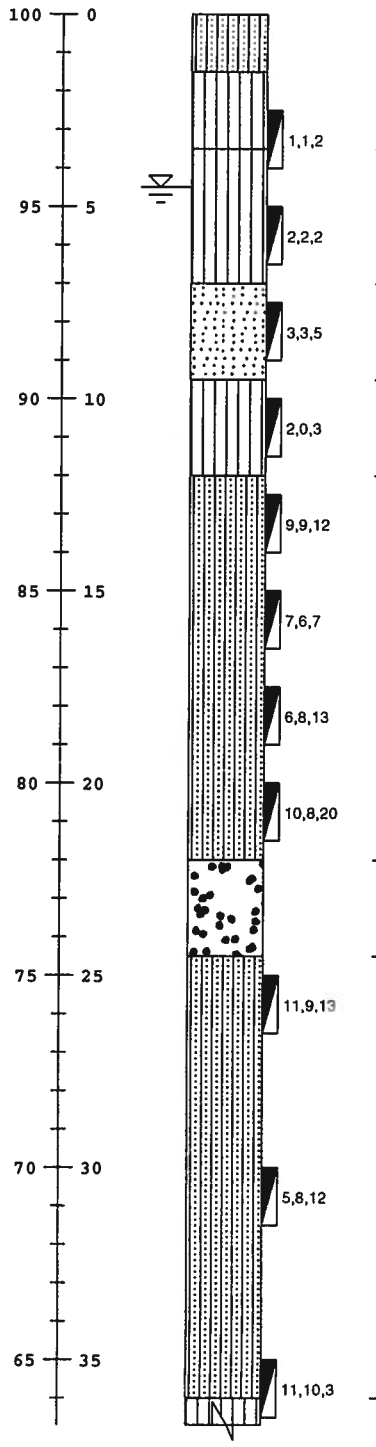
Well KCB-2 was located in the field by GPS. The approximate well location is provided in Figure 2. Well KCB-2 is identified by Washington State Department of Ecology discrete well tag number BCJ 225.

PLATE NUMBER **A2**

BORING LOG
BORING KCB-3

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Setback Levee Log Jam Location 3**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **4.5 ft** Caving: **N.A.**

DATE: **September 22, 2010**
START: **9:00 AM 9/22/2010**
FINISH: **2:00 PM 9/22/2010**
LOGGER: **D. A.**
DATE CHECKED: **During**

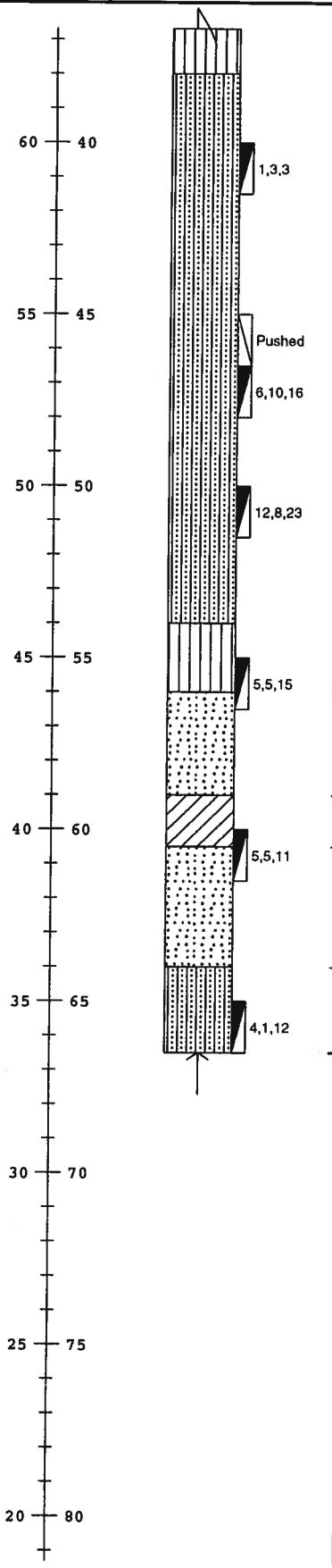


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Brown silty sand with gravel, moist, medium dense. (Road fill)			
		ML	Gray silt with sand, wet, very loose.	42.9	73.8	The silt was found to be non-plastic.
		ML	Gray silt with fine grained sand, wet, very loose. The sample contained roots and traces of decomposed wood debris.	36.5	82.5	The silt was found to be non-plastic.
		SP	Black poorly graded fine to medium grained sand, wet, loose.			
		ML	Gray silt, wet, loose.	45.5	95.3	The silt was found to be non-plastic.
		SM	Black silty fine to medium grained sand, wet, medium dense.	28.4	17.9	
		GP	Black poorly graded gravel with sand, wet, dense.			The gravel was detected by the action of the drill.
		SM	Black silty fine grained sand with scattered gravel, wet, medium dense.	26.2	18.7	A 1-foot thick gravel lense was detected during drilling.
		SM				
		ML				

Boring KCB-3 was located in the field by GPS. The approximate boring location is provided in Figure 2.

PLATE NUMBER **A3**

LOG OF Boring
BORING KCB-3
(continued)

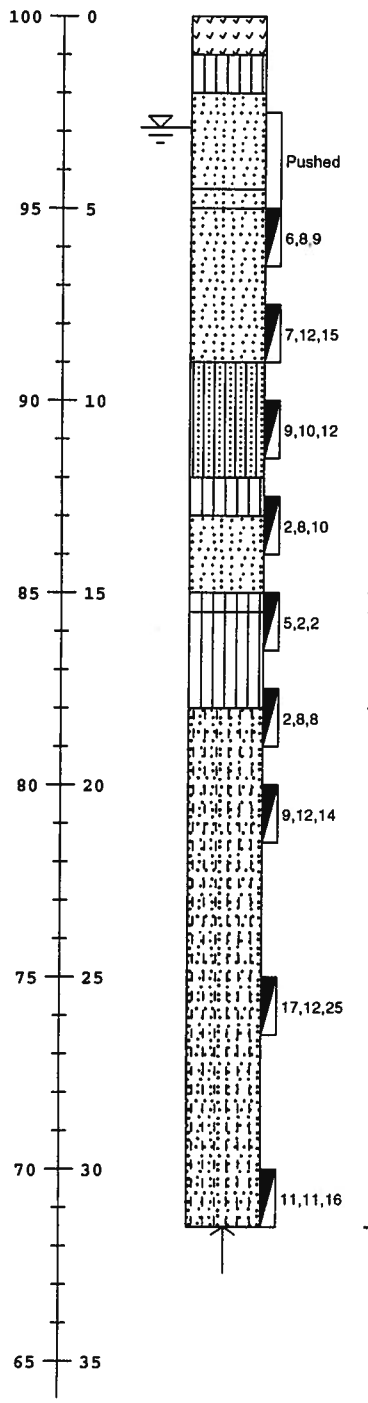


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Brown silt, wet, loose. A 1 inch thick peat lens was found on the surface of the silt.			
			Black silty fine to medium grained sand, wet, loose to medium dense. The soil zone from 38 to 54 feet also contains scattered thin silt and peat lenses with occasional decomposed wood.	45.9	98.5	Liquid Limit 35 Plastic Index 2. The testing at 40 feet was performed on one of the intermittent silt lenses.
				24.2	25.6	A sampler containing rings was pushed at this elevation resulting in no sample recovery.
		ML	Peat and dark brown silt, wet, loose.	51.3	92.7	Liquid Limit 42 Plastic Index 8
		SP	Black poorly graded fine to medium sand, wet, medium dense.			
		CL	Gray silty lean clay, wet, stiff.			
		PT	Peat	112.9		
		SP	Black poorly graded fine to medium sand, wet, medium dense.			
		SM	Dark gray silty fine grained sand, wet, medium dense.			

LOG OF MONITOR WELL INSTALLATION
WELL NO. KCB-4

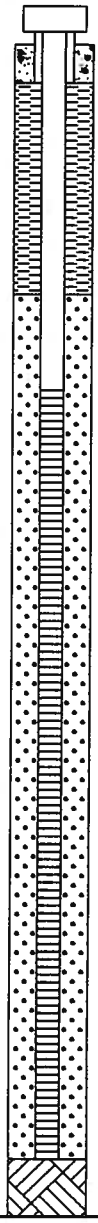
PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Set Back Levee Location 4**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **2.90 ft**

DATE: **September 22, 2010**
START: **2:00 PM 9/22/2010**
FINISH: **9:00 AM 9/23/2010**
LOGGER: **DA**
DATE CHECKED: **7:30 AM 9/30/10**



USCS	Description	Moist (%)	-200 (%)	Remarks
	Cultivated sandy topsoil.			
ML SP	Gray mottled sandy silt, moist to wet, very loose. The sample also contained scattered organic material.	26.7	4.5	Brown fine sand observed in the tip of the shelby.
SP	Black poorly graded fine to medium grained sand, wet, medium dense.			
SM	Brown poorly graded fine grained sand, wet, medium dense.			
ML SP	Black poorly graded fine to medium grained sand with 1 to 2 inch thick lenses of fine sand and silt, wet, medium dense.	28.3	26.1	
ML	Dark gray silty sand, wet, medium dense. Slight bedding visible.	62.5	89.8	
ML	Gray silt, wet, very loose. The sample also contained a 3 inch thick lens of peat at the bottom of the silt.			
SP-SM	Black poorly graded fine to medium grained sand, wet, medium dense.			
	Gray silt, wet, very loose. The sample also contained a 3-inch thick lens of peat at the bottom of the silt.	26.7	11.8	
	Black poorly graded fine to medium grained sand with silt, wet, medium dense to dense.			

Monitor Well Construction Schematic



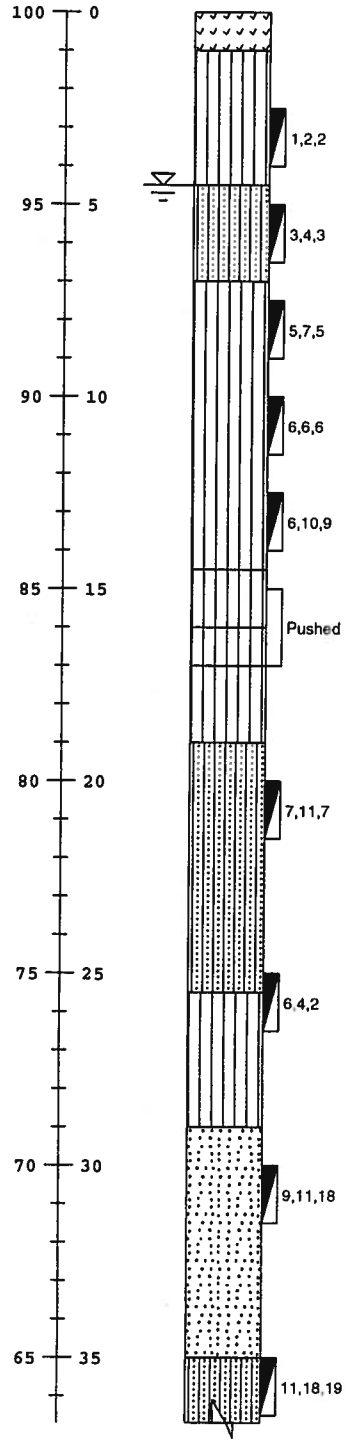
Well KCB-4 was located in the field by GPS. The approximate well location is provided in Figure 2. Well KCB-4 is identified by Washington State Department of Ecology discrete well tag number BCJ 226.

PLATE NUMBER **A4**

BORING LOG
BORING KCB-5

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Setback Levee Log Jam Location 5**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **4.5 ft** Caving: **N.A.**

DATE: **September 23, 2010**
START: **1:45 PM 9/23/2010**
FINISH: **10:AM 9/24/2010**
LOGGER: **D. A.**
DATE CHECKED: **During**

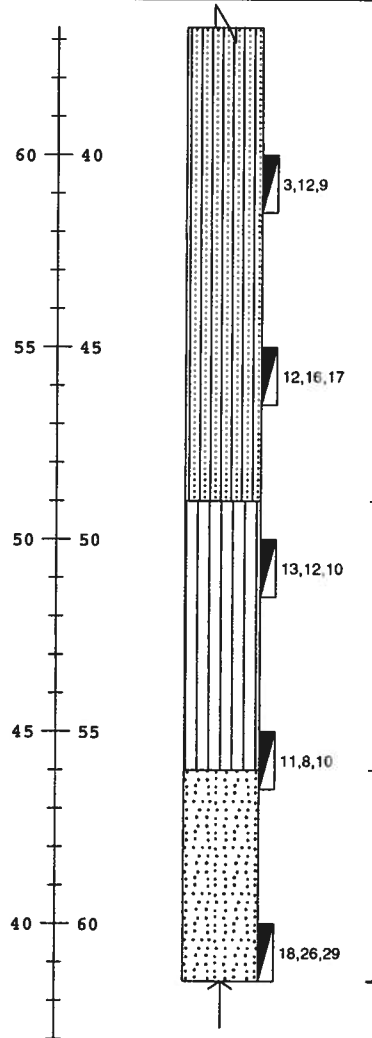


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
			Cultivated sandy topsoil.			
		ML	Gray brown mottled silt, wet, loose. The sample contained scattered root fragments.	49.0	87.9	
		SM	Dark gray silty sand, wet, loose.	29.1		
		ML	Black fine to medium grained sandy silt, wet, medium dense.	48.6	66.2	The silt was found to be non-plastic.
		ML	Brown silt, wet, medium dense.	52.6	98.6	The silt was found to be non-plastic.
		ML	Gray silt, wet, medium stiff to stiff.	49.6	99.6	Liquid Limit 44
		ML	Black sandy silt, wet, medium dense.	36.4	59.0	Plastic Index 10
		SM	Dark gray silty sand, wet, medium dense.	29.1	23.0	The silt was found to be non-plastic. The mud level in the boring at 7:45 AM on 9/24/10 was 4 feet below the surface.
		ML	Dark gray silt with a 4-inch thick peat lens, wet, loose. The silt also contained scattered decomposed wood debris.	40.2	71.3	Scattered decomposed wood debris observed in the drill fluid. The silt was found to be non-plastic.
		SP	Black poorly graded fine to medium grained sand, wet, medium dense to dense.			
		SM	Dark gray silty sand, wet, medium dense			Silt noted in the drill cuttings

Boring KCB-5 was located in the field by GPS. The approximate boring location is provided in Figure 2.

PLATE NUMBER **A5**

LOG OF Boring
BORING KCB-5
(continued)

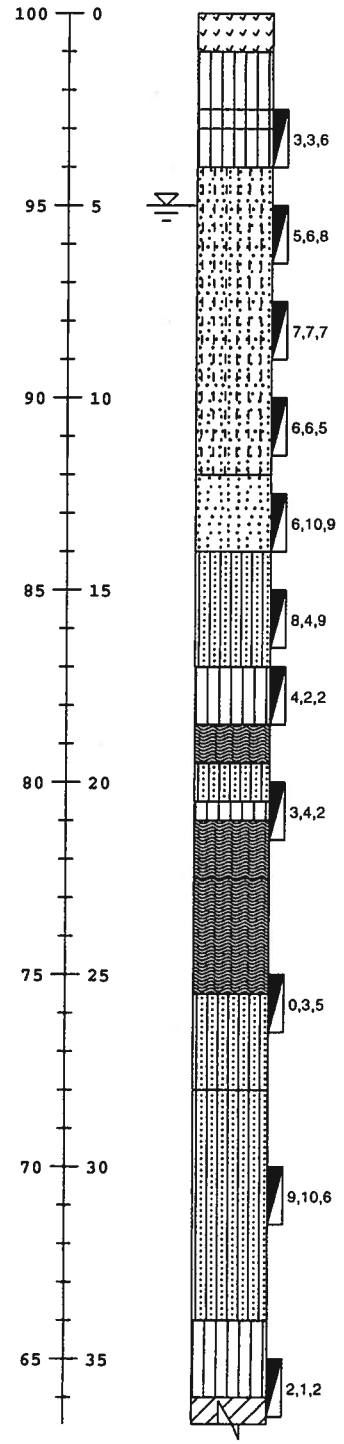


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
60 — 40			to dense.			between 38 and 40 feet below the surface.
	3,12,9			32.3	33.6	
55 — 45						Sloping thin lenses of fine sand in the sample.
	12,16,17					
50 — 50		ML	Dark gray sandy silt, wet, medium dense.	29.1	52.1	A thin volcanic ash lens was found overlying a minor layer of peat in the tip of the sampler. The silt was found to be non-plastic.
	13,12,10					
45 — 55						
	11,8,10	SP	Black poorly graded fine to medium sand, wet, medium dense to very dense.			
40 — 60						Silt was observed in cuttings during drilling.
	18,26,29					
35 — 65						
30 — 70						
25 — 75						
20 — 80						

BORING LOG
BORING KCB-6

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Setback Levee Location 6**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **5 ft** Caving: **N.A.**

DATE: **September 24, 2010**
START: **11:00 AM 9/24/2010**
FINISH: **3:30 PM 9/24/2010**
LOGGER: **D. A.**
DATE CHECKED: **During**

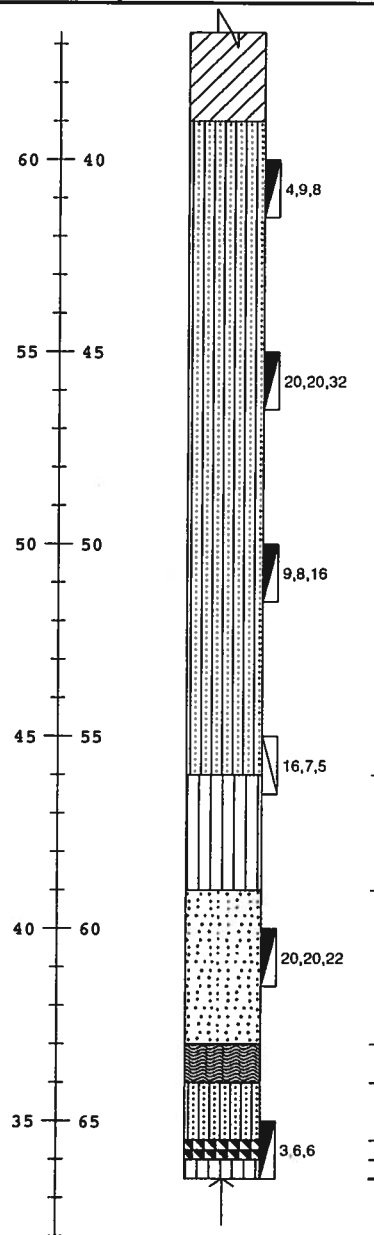


ELEVATION/ DEPTH	USCS	Description	Moist (%)	-200 (%)	Remarks
		Cultivated sandy topsoil.			
	ML	Brown mottled poorly graded fine grained sand with silt, wet, loose.			
	ML		35.3	86.4	The silt was found to be non-plastic.
	ML	Tan mottled silt, wet, loose. The sample also contained a few iron stained joints.			
	SP-SM	Black poorly graded fine to medium grained sand with silt, wet, medium dense. Lenses of fine sand and silt are 1 to 2 inches thick.	26.1	8.5	
	SP	Black poorly graded fine grained sand, wet, loose. This unit contains lenses of fine sand and silt 1 to 2 inches in thickness.			Sample contained scattered decomposed wood fragments.
	SM	Dark gray silty sand, wet, loose.			
	ML	Gray silt with sand, wet, loose.			
	PT	Peat.			
	SM	Dark gray silty sand, wet, loose.			
	ML	Gray silt, wet, loose.	134.7		
	PT	Tan sedimentary peat, wet, soft.			
	PT	Peat with alternating layers of organic silt and sand, wet, loose.			
	SM	Dark gray silty sand, wet, loose.			
	SM	Black silty sand, wet, medium dense. Tephra pebbles noted in the cuttings.	24.0	18.0	
	ML	Dark gray silt with sand and a thin lens of sedimentary peat, wet, loose.	88.9	74.2	The silt was found to be non-plastic.
	CL				

Boring KCB-6 was located in the field by GPS. The approximate boring location is provided in Figure 2.

PLATE NUMBER **A6**

LOG OF Boring
BORING KCB-6
(continued)

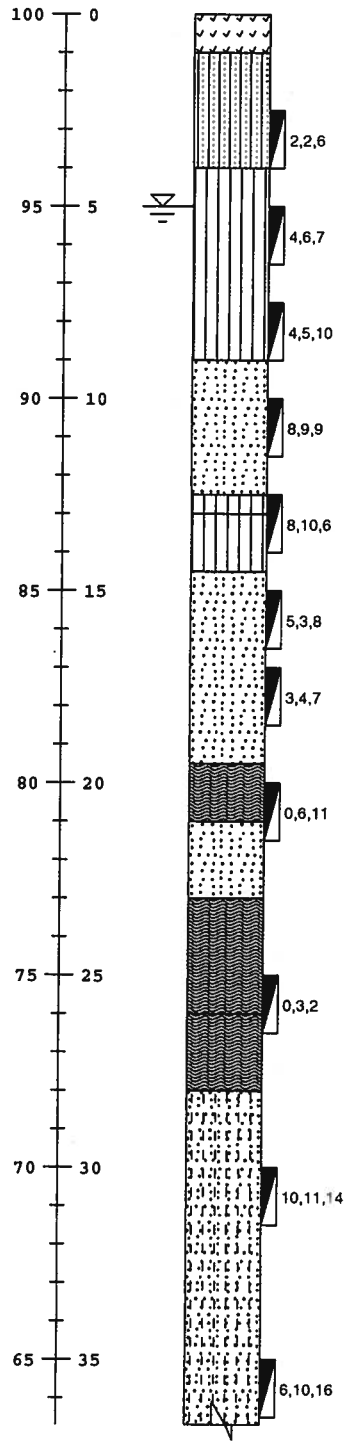


USCS	Description	Moist (%)	-200 (%)	Remarks
	Green lean clay, wet, soft.			
SM	Black silty fine to medium grained sand, wet, medium dense to very dense.			Sloping thin lenses of fine sand in the sample.
		36.7	49.7	Scattered decomposed wood in the sample.
ML	Dark gray silt, wet, medium dense.			Silt observed in the drill cuttings between 56 and 59 feet below the surface.
SP	Black poorly graded fine to medium sand, wet, dense.			
PT	Peat and organic silt, wet, loose.			Material composition based on drill cuttings.
SM	Dark gray silty sand, wet, loose.			
	Decomposed wood.			
ML	Dark gray silt with scattered wood debris, wet, medium dense.			

BORING LOG
BORING KCB-7

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Setback Levee Log Jam Location 7**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **5 ft** Caving: **N.A.**

DATE: **September 27, 2010**
START: **7:30 AM 9/27/2010**
FINISH: **10:30 AM 9/27/2010**
LOGGER: **D. A.**
DATE CHECKED: **During**

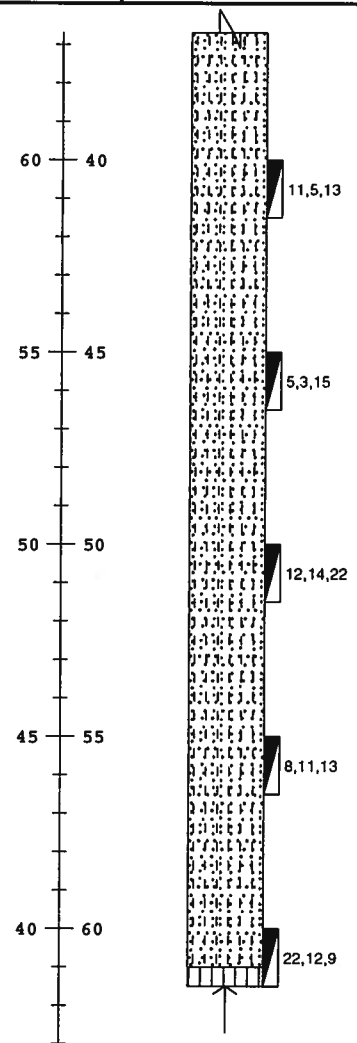


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
			Cultivated sandy topsoil.			
		SM	Brown mottled silty sand, moist, loose.			
		ML	Dark brown sandy silt, wet, medium dense.	29.8	65.3	The silt was found to be non-plastic.
		SP	Black poorly graded fine to medium grained sand, wet, medium dense.			The sample contained scattered decomposed wood fragments.
		ML	Dark gray sandy silt, wet, medium dense.	27.4	50.8	The silt was found to be non-plastic.
		ML				
		SP	Brown silt, wet, medium dense. The silt contains scattered organic material.			
			Black poorly graded fine to medium grained sand with scattered 1 to 2 inch thick lenses of fine sand and silt, wet,			
		PT	medium dense.	166.0		
		SP	Peat and lenses of organic silt.			
			Black poorly graded fine to medium			
		PT	sand, wet, medium dense.			
			Brown peat with lenses of gray organic silt, wet, soft.	201.6		
		PT	Yellow sedimentary peat, wet, soft.			
		SP-SM	Black poorly graded fine to medium grained sand with silt, wet, medium dense. Fine sand in the form of 1 to 2 inch thick lenses throughout this section.			

Boring KCB-7 was located in the field by GPS. The approximate boring location is provided in Figure 2.

PLATE NUMBER **A7**

LOG OF Boring
BORING KCB-7
(continued)

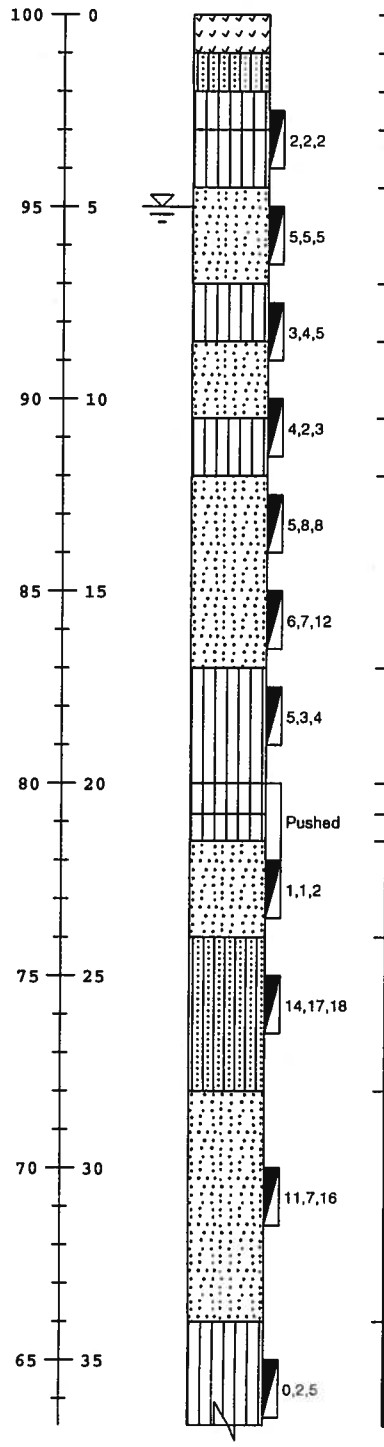


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
60 — 40						
55 — 45				39.3	8.2	
50 — 50						
45 — 55						Scattered decomposed wood in the sample.
40 — 60		ML	Dark gray silt with scattered wood debris, wet, medium dense.			
35 — 65						
30 — 70						
25 — 75						
20 — 80						

BORING LOG
BORING KCB-8

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Set Back Levee Log Jam Location 8**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **5 ft** Caving: **N.A.**

DATE: **September 27, 2010**
START: **11:30 AM 9/27/2010**
FINISH: **3:30 PM 9/27/2010**
LOGGER: **D. A.**
DATE CHECKED: **During**

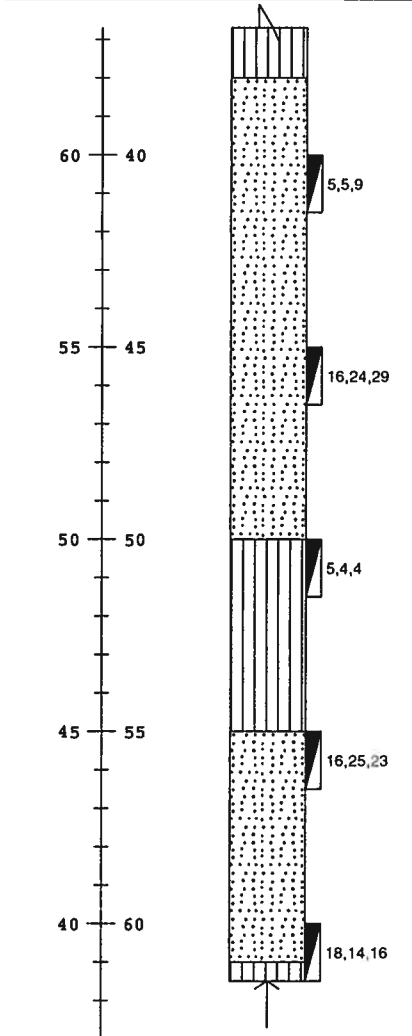


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
			Cultivated sandy topsoil.			
		SM	Brown mottled silty sand, moist, loose.			
		ML	Tan mottled silt, moist, loose.	35.7	80.4	The silt was found to be non-plastic.
		ML	Dark gray silt with scattered organic material, wet, loose.			
		SP	Brown mottled poorly graded fine grained sand, wet, loose to medium dense.			
		ML	Gray mottled sandy silt, wet, loose.	38.6	58.8	The silt was found to be non-plastic.
		SP	Black poorly graded fine to medium grained sand, wet, loose.			
		ML	Gray mottled silt with scattered organic material, wet, loose.			
		SP	Black poorly graded fine to medium grained sand with 1 to 2 inch thick silt and fine grained sand lenses, wet, medium dense.			
		ML	Dark gray silt with scattered organic material, wet, loose.	42.7	86.2	The silt was found to be non-plastic.
		ML		32.8	90.1	
		ML	Dark gray sandy silt, wet, loose.	33.3	62.1	The silt was found to be non-plastic.
		SP	Black poorly graded fine to medium sand, wet, medium dense.	30.7	1.9	
		SM	Dark gray silty sand, wet, dense.	29.0	40.5	
		SP	Black poorly graded fine to medium grained sand, wet, medium dense. Fine sand in the form of 1 to 2 inch thick lenses throughout this section.			
		ML	Green silt, wet, loose.	54.3	99.4	Liquid Limit 45 Plastic Index 8

Boring KCB-8 was located in the field by GPS. The approximate boring location is provided in Figure 2.

PLATE NUMBER **A8**

LOG OF Boring
BORING KCB-8
(continued)

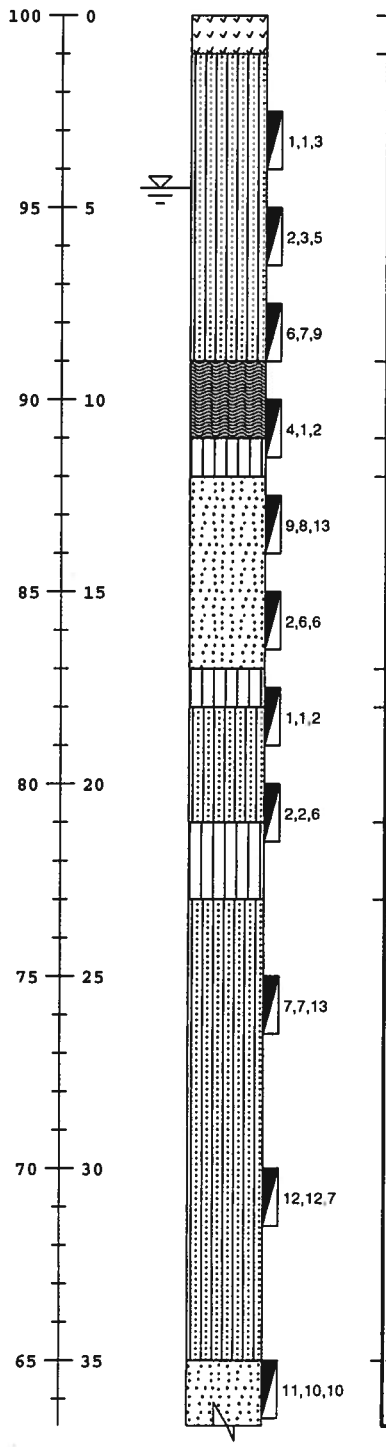


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
60 — 40		SP	Black poorly graded fine to medium grained sand, wet, loose to very dense. The fine sand and silt is in the form of 1 to 2 inch to thick lenses throughout out this section.			
55 — 45						
50 — 50		ML	Gray sandy silt, wet, dense to very dense.	33.2	66.7	The silt was found to be non-plastic.
45 — 55		SP	Black poorly graded fine to medium grained sand, wet, loose to very dense. The fine sand and silt is in the form of 1 to 2 inch to thick lenses throughout out this section.			
40 — 60		ML	Dark gray silt with scattered wood debris, wet, dense.			
35 — 65						
30 — 70						
25 — 75						
20 — 80						

BORING LOG
BORING KCB-9

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Setback Levee Log Jam Location 9**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **4.5 ft** Caving: **N.A.**

DATE: **September 28, 2010**
START: **8:00 AM 9/28/2010**
FINISH: **10:30 AM 9/28/2010**
LOGGER: **D. A.**
DATE CHECKED: **During**

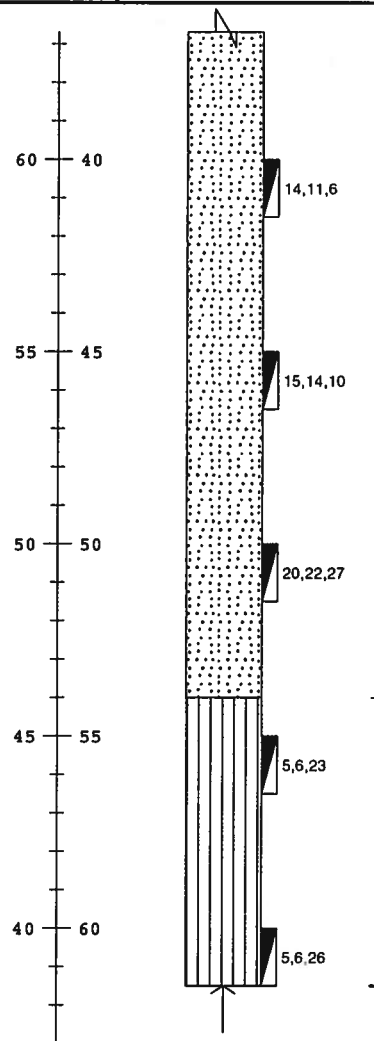


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
			Cultivated sandy topsoil.			
		SM	Brown mottled poorly graded fine to medium grained sand, moist, loose.	32.6	47.1	
		PT	Brown peat.	47.1		
		ML	Gray mottled silt with scattered organic material, wet, loose.			
		SP	Black poorly graded fine to medium grained sand with 1 to 2 inch thick silt and fine grained sand lenses, wet, medium dense.			
		ML	Dark gray silt with scattered organic material, wet, loose.			A thin peat lens was found at the base of the silt in the sampler.
		SM	Dark gray silty fine grained sand, wet, loose.	39.2	48.2	
		ML	Dark gray silt with thin fine sand lenses, wet, loose. A thin peat lens 1/4 inch thick was found on the surface of the silt.			
		SM	Black silty fine to medium grained sand, wet, medium dense to dense. Silt and fine sand are in the form of 1 to 2 inch thick lenses throughout this section.	26.6	24.6	
		SP	Black poorly graded fine to medium			

Boring KCB-9 was locate in the field by GPS. The approximate boring location is provided in Figure 2.

PLATE NUMBER **A9**

LOG OF Boring
BORING KCB-9
(continued)

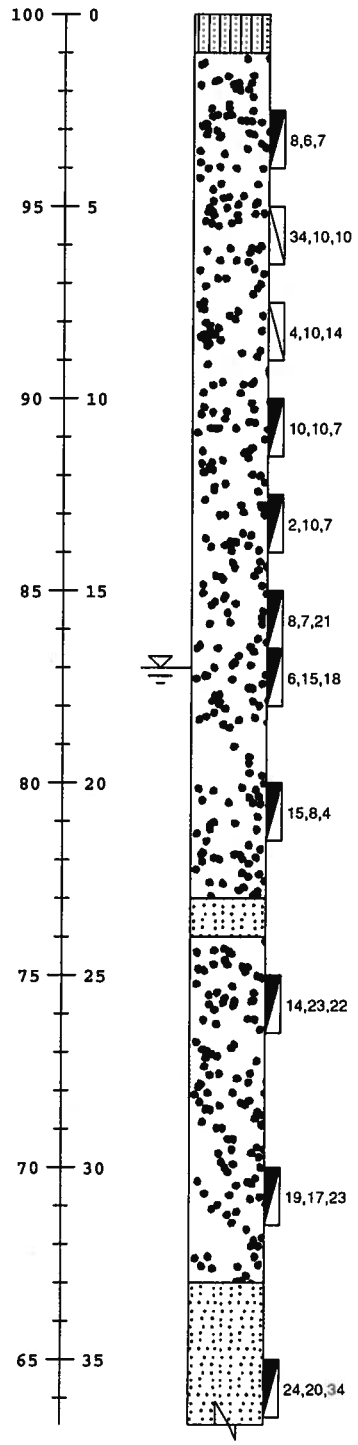


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
60 — 40			grained sand, wet, medium dense to dense. Silt and fine sand are in the form of 1 to 2 inch thick lenses throughout this section.			
55 — 45						
50 — 50						
45 — 55		ML	Dark gray silt with sand, wet, medium dense to dense.	30.3	75.3	The silt was found to be non-plastic.
40 — 60						
35 — 65						
30 — 70						
25 — 75						
20 — 80						

BORING LOG
BORING KCB-10

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Levee Log Jam Location 10**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **17 ft** Caving: **N.A.**

DATE: **October 1, 2010**
START: **2:00 PM 10/1/2010**
FINISH: **12:45 PM 10/4/2010**
LOGGER: **D. A.**
DATE CHECKED: **During**

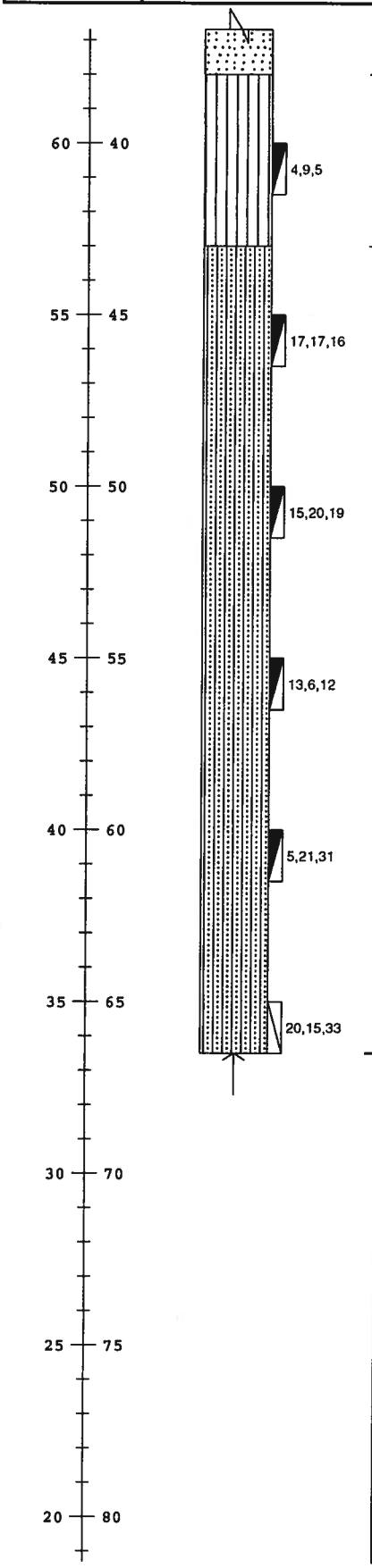


ELEVATION/ DEPTH	USCS	Description	Moist (%)	-200 (%)	Remarks
	SM	Dark brown silty sand with gravel and occasional cobbles, moist, dense. (Road surface fill at the top of the levee)			
	GP	Black poorly graded gravel with occasional cobbles and scattered boulders, moist to wet, medium dense to dense. (Levee fill)			A 3 inch diameter sampler was used to obtain soil samples from 15 to 18 feet. The blow count may be overstated. Casing was installed to 19 feet.
	SP	Black poorly graded fine to medium grained sand, wet, medium dense.			Material classification based on the action of the drill during drilling.
	GP	Black poorly graded fine grained gravel with sand, wet, dense. Native river bed.			
	SP	Black fine to medium sand, wet, dense.			

Boring KCB-10 was located in the field by GPS. The approximate boring location is provided in Figure 2. The water level on 10/4/2010 was measured at 17 feet below the ground surface.

PLATE NUMBER **A10**

LOG OF Boring
BORING KCB-10
(continued)

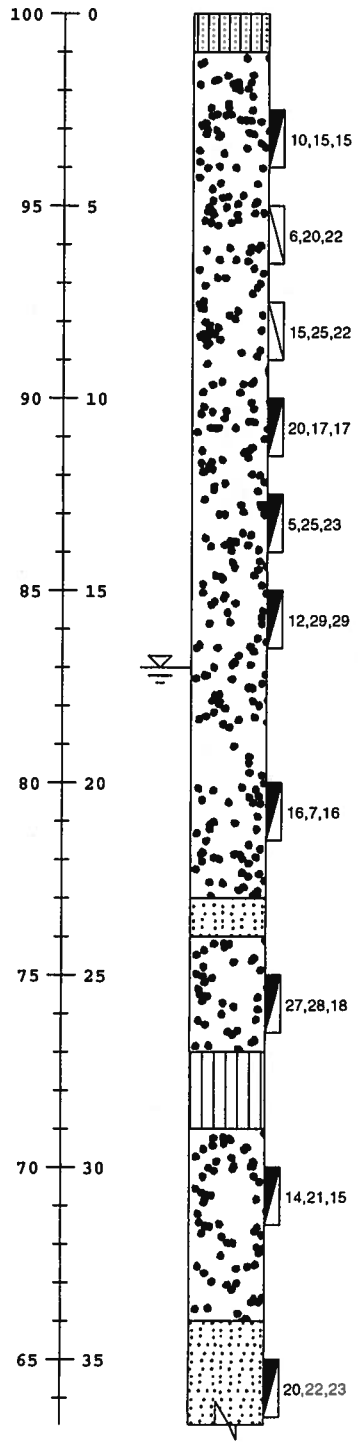


USCS	Description	Moist (%)	-200 (%)	Remarks
ML	Green silt with sand, wet, medium dense to dense. Silt lenses are 10 to 12 inches thick.	46.6	70.8	The silt was found to be non-plastic.
SM	Black silty fine to medium grained sand, wet, medium dense to very dense. The soil also contains lenses of gray silt up to 12 inches thick.	36.1	36.3	

BORING LOG
BORING KCB-11

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Levee Log Jam Location 11**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **17 ft** Caving: **N.A.**

DATE: **September 30, 2010**
START: **2:00 PM 9/30/2010**
FINISH: **12:45 PM 10/1/2010**
LOGGER: **D. A.**
DATE CHECKED: **During**

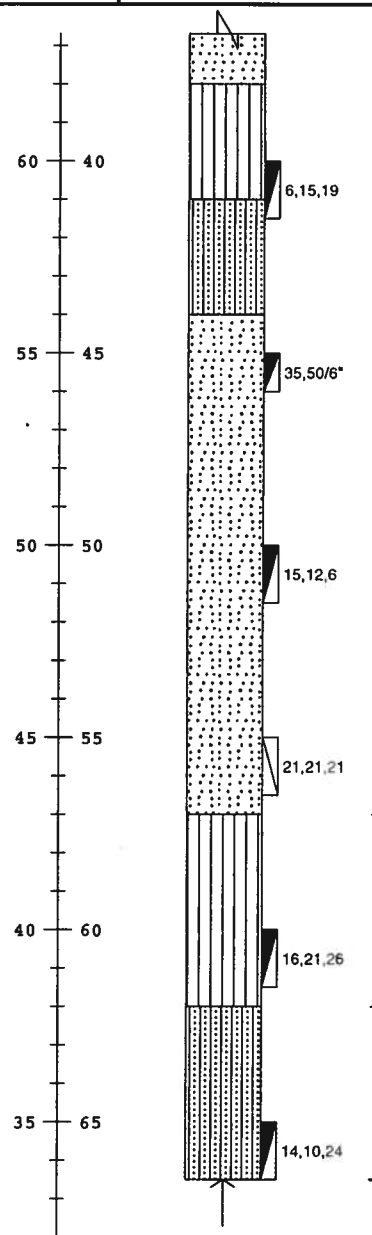


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Dark brown silty sand with gravel and occasional cobbles, moist, dense. (Road surface fill at the top of the levee)			
		GP	Black poorly graded gravel with occasional cobbles and scattered boulders, moist to wet, dense to very dense. (Levee fill)			
			Tephra pebbles observed in the drill cuttings.			Casing installed to 19 feet.
		SP	Black poorly graded fine to medium grained sand, wet, medium dense.			
		GP	Black poorly graded fine grained gravel with sand, wet, dense. Native river bed.			
		ML	Dark gray silt with thin peat lenses, wet, dense.			Soil classification based on drill cuttings.
		GP	Black poorly graded fine grained gravel with sand, wet, dense.			
		SP	Black fine to medium sand, wet, dense.			

Boring KCB-11 was located in the field by GPS. The approximate boring location is provided in Figure 2.

PLATE NUMBER **A11**

LOG OF Boring
BORING KCB-11
(continued)

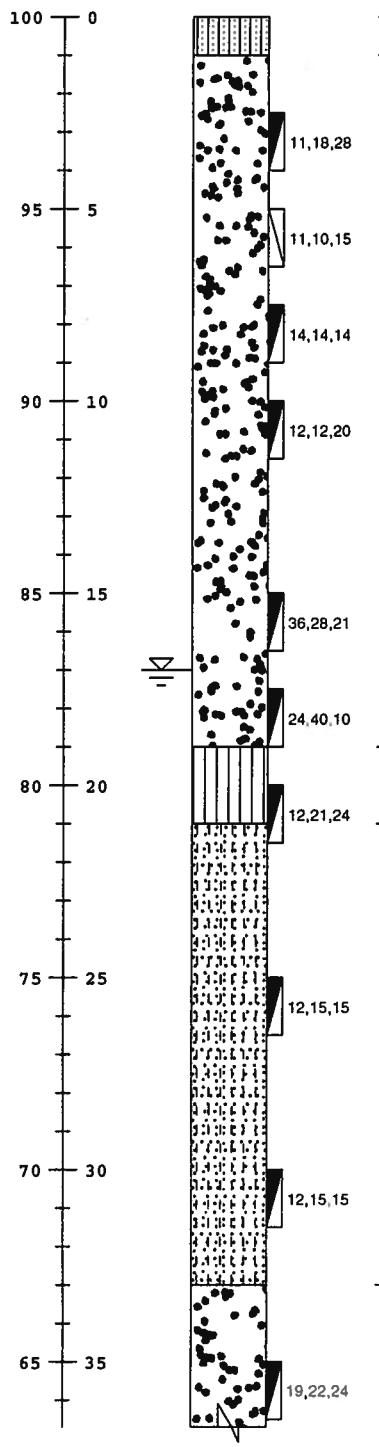


ELEVATION/ DEPTH	USCS	Description	Moist (%)	-200 (%)	Remarks
60 — 40	ML	Green silt with sand, wet, medium dense. Lenses of sand are 10 to 12 inches thick.	33.9	72.8	The silt was found to be non-plastic.
	SM	Dark gray silty sand, wet, dense.			
55 — 45	SP	Black poorly graded fine to medium grained sand, wet, medium dense to very dense. The soil also contains lenses of gray silt up to 12 inches thick.			A rock was lodged in the tip of the sampler. Blows may be overstated.
50 — 50					
45 — 55					
40 — 60	ML	Gray green silt with thin peat lenses 1 to 2 inches thick, wet, hard.	43.6	90.2	Liquid Limit 40 Plastic Index 9
35 — 65	SM	Dark gray silty sand, wet, dense.	31.5	49.9	
30 — 70					
25 — 75					
20 — 80					

BORING LOG
BORING KCB-12

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Levee Log Jam Location 12**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **17 ft** Caving: **N.A.**

DATE: **September 29, 2010**
START: **2:30 PM 9/29/2010**
FINISH: **2:45 PM 9/30/2010**
LOGGER: **D. A.**
DATE CHECKED: **During**

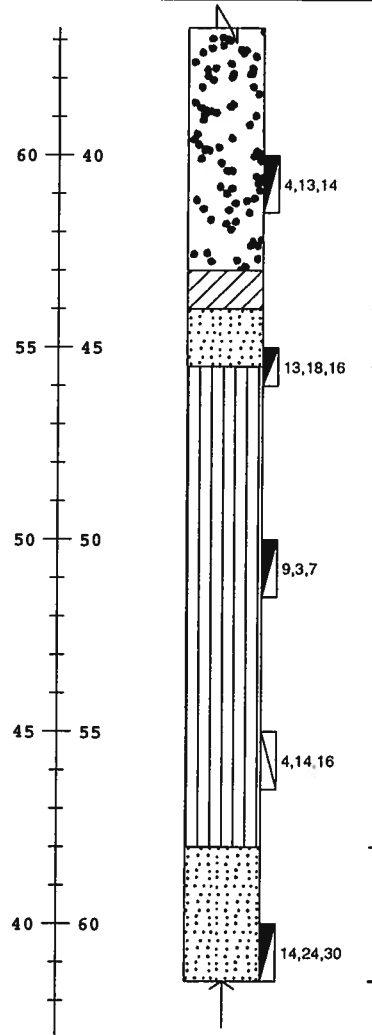


USCS	Description	Moist (%)	-200 (%)	Remarks
SM GP	Dark brown silty sand with gravel and occasional cobbles, moist, dense. (Road surface fill at the top of the levee)	35.3		Decomposed fragments found in the sample.
	Black poorly graded gravel with occasional cobbles and scattered boulders, moist to wet, medium dense to dense. (Levee fill)			High mud loss below this sample.
				Casing driven to 13 feet below the surface. Sample skipped at 12.5 feet.
ML	Gray and brown silt with scattered organic material, wet, dense. Native soil.			Casing installed to 19 feet.
SP-SM	Black poorly graded sand with silt, wet, medium dense. Scattered fine sand and silt lenses 1 to 2 inches thick are found in this soil.	24.4	5.0	
GP	Black poorly graded gravel, wet, dense.			The gravel was noted by the action of the drill

Boring KCB-12 was located in the field by GPS. The approximate boring location is provided in Figure 2.

PLATE NUMBER **A12**

LOG OF Boring
BORING KCB-12
(continued)

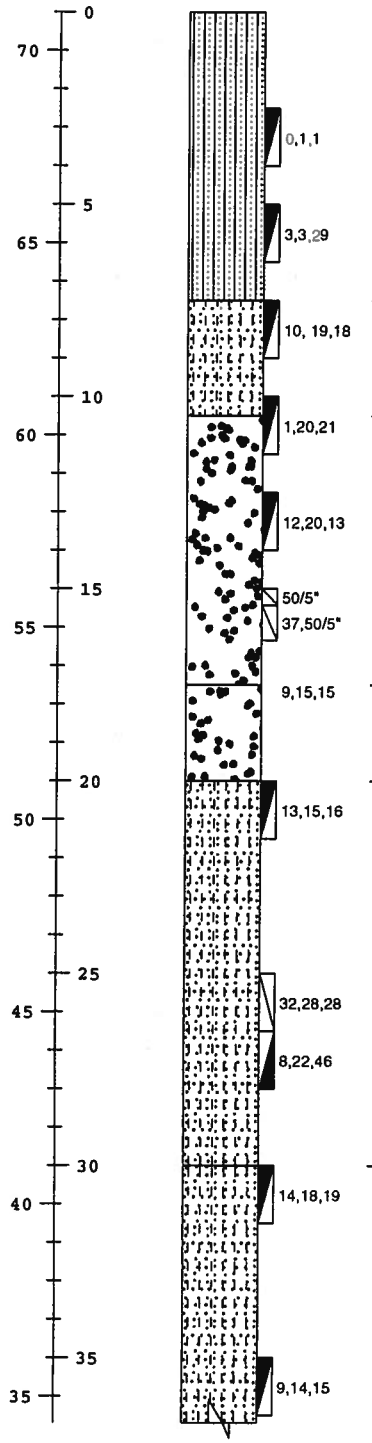


ELEVATION/ DEPTH	USCS	Description	Moist (%)	-200 (%)	Remarks
60 — 40	CL	Green lean clay with lenses of silt 1 to 2 inches thick, wet, stiff.			The clay was found in the drill cuttings.
55 — 45	SP				
	ML	Black poorly graded fine to medium grained sand, wet, dense.			
50 — 50		Dark gray sandy silt, wet, dense.	45.5	65.0	The silt was found to be non-plastic.
45 — 55					
40 — 60	SP	Black fine to medium sand, wet, very dense.			
35 — 65					
30 — 70					
25 — 75					
20 — 80					

BORING LOG
BORING KCB-13

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Forested Wetland**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **N/A** Caving: **N/A**

DATE: **September 28, 2011**
START: **11:30 AM 9/28/2011**
FINISH: **10:00 AM 9/29/2011**
LOGGER: **DW**
DATE CHECKED: **N/A**

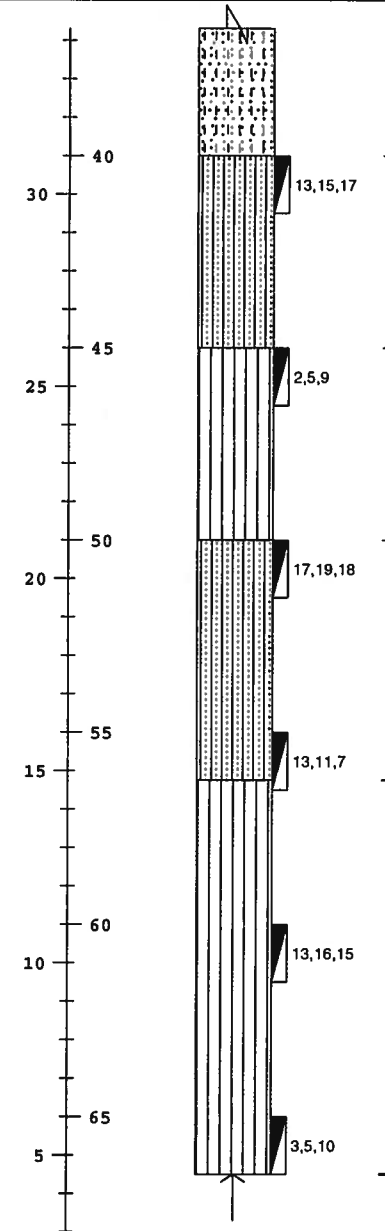


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Black silty sand, trace organics and roots, moist to wet, very loose to loose.	27.0	13.0	Wood debris in cuttings from 5 to 7.5 feet. Sample pounded on rock or log? Blow count may be overstated.
		SP-SM	Black poorly graded fine grained sand with silt and gravel, wet, dense.			
		GP	Black poorly graded gravel with sand, numerous cobble, occasional boulder, wet, dense.			Casing driven to 15 feet due to caving gravels. No recovery of sample at 15. Dames and Moore sample, no recovery. Casing installed to 17.5 feet.
		GP	Black poorly graded gravel with sand, scattered cobble, wet, medium dense to dense.			
		SP-SM	Black poorly graded fine to medium grained sand with silt and gravel, wet, dense. Single silt lense 1 inch thick at 20.9 feet.	17.6	8.1	Casing installed to 20 feet. No recovery. Pounded on rock? Dames and Moore sample. Recovered single 2.4 inch diameter rock.
		SP-SM	Black poorly graded sand with silt to silty sand, wet, dense.	16.2	11.4	

Boring KCB-13 was located east of the levee prism in a forested wetland area. The boring location is provided in Figure 2. No water level was determined for the boring due to use of mud rotary methodology. However, the water level is anticipated to be at the approximate depth of the adjacent wetland.

PLATE NUMBER **A13**

LOG OF Boring
BORING KCB-13
(continued)

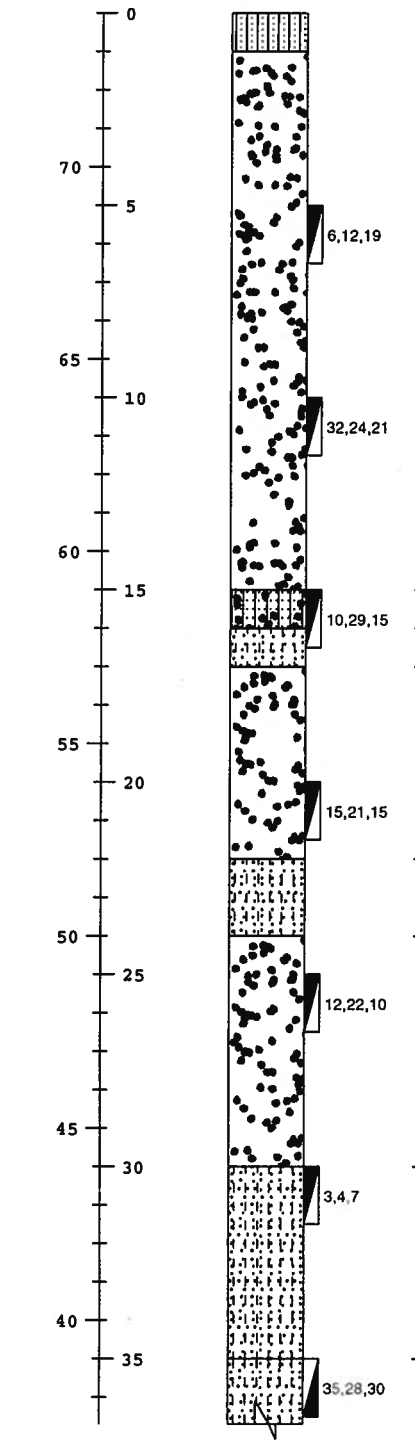


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Black silty sand, trace gravel, wet, medium dense to dense.	27.3	32.8	
		ML	Dark gray sandy silt, trace organics and wood debris, wet, medium dense.			
		SM	Black silty sand, wet, medium denes to dense.	24.9	37.2	
		ML	Gray sandy silt, scattered wood debris, trace organics, wet, medium dense to dense. (Non-plastic) Same-5 inch layer of black silty sand at 60.5 feet. Same-layer of wood from 60.5 to 60.8 feet.			KCB-13 terminated at 66.5 feet.

BORING LOG
BORING KCB-14

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Levee Road**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **N/A** Caving: **N/A**

DATE: **September 29, 2011**
START: **11:45 AM 9/29/2011**
FINISH: **4:15 PM 9/30/2011**
LOGGER: **DW**
DATE CHECKED: **N/A**



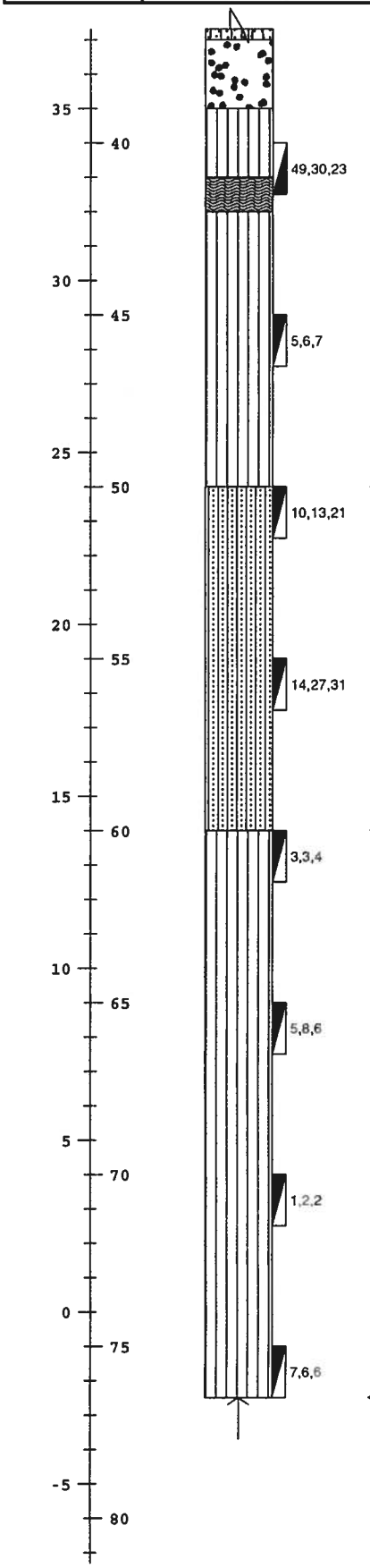
ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Dark brown silty sand with gravel, occasional cobble, moist, medium dense.			
		GP	Black poorly graded gravel with sand, numerous cobble, occasional boulder, moist to wet, dense. (Levee fill)			Casing installed to 5 feet.
						Casing installed to 10 feet.
						Casing installed to 15'
		GP-GM	Black poorly graded gravel with silt and sand, numerous cobble, wet, dense.	12.1	5.1	
		SP-SM				
		GP	Black poorly graded fine grained sand with silt with gravel, wet, dense. (Native contact?)			Casing installed to 20 feet.
			Black poorly graded gravel with sand, scattered cobble, occasional boulder, moist to wet, dense.			Heavy mud loss from 20 to 25 feet. Casing installed to 25 feet.
		SP-SM				
		GP	Black poorly graded sand with silt and gravel, wet, dense. (Based on smooth action of drill)			Gravels decreasing in size based on action of drill rig.
			Black poorly graded gravel with sand, occasional cobble, wet, dense.			Casing installed to 30 feet. Wood in cuttings at approximately 29 feet.
		SP-SM	Black poorly graded fine grained sand with silt and gravel, wet, medium dense.			Minimal sample recovery. Casing installed to 35 feet due to caving gravel
		SP-SM	Black poorly graded fine to medium	16.3	10.3	Dames and Moore Sample.

Boring KCB-14 was located east of the levee road in the levee fill prism. The boring location is provided in Figure 2. No water level was determined for the boring due to use of mud rotary methodology. However, the water level is anticipated to be at the approximate depth of the adjacent wetland.

PLATE NUMBER **A14**

KING COUNTY MATERIALS LABORATORY

LOG OF Boring
BORING KCB-14
(continued)

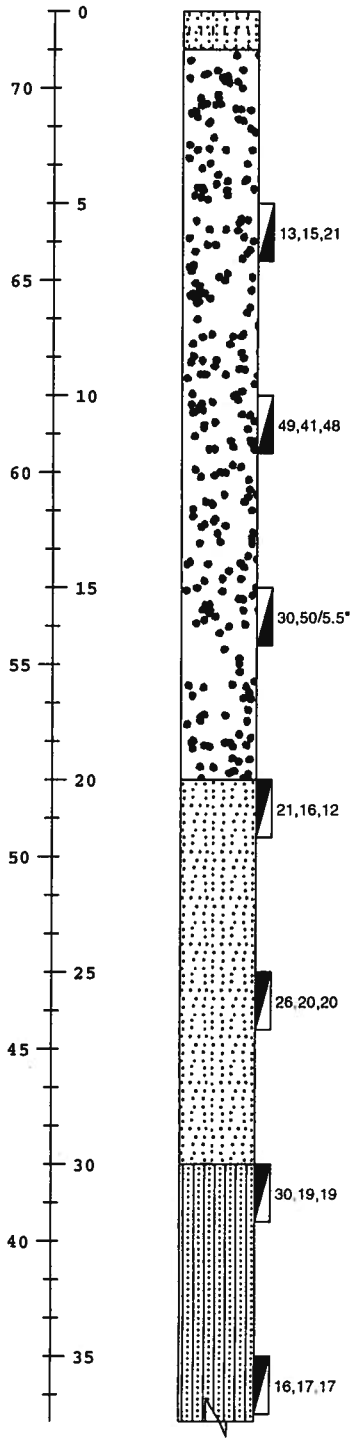


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		GP	grained sand with silt, wet, dense to very dense.			2' gravel zone according to driller.
		ML	Black poorly graded gravel with sand, wet, dense.			Dames and Moore Sample.
			Gray sandy silt, wet, dense.			
		ML	Dark brown peat, wet, medium dense.			
			Gray sandy silt, trace gravel, wet, medium dense.			
		SM	Black silty sand, wet, dense to very dense.	28.2	21.8	
		ML	Gray sandy silt to fine silty sand, trace gravel, scattered organics and wood debris, wet, loose to medium dense. (non-plastic)			Slightly harder drilling from 62 to 64 feet according to driller.
						Some peat coming up in cuttings from 68 to 70 feet.
				36.5	49.9	
						KCB-14 terminated at 76.5 feet.

BORING LOG
BORING KCB-15

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Levee Road**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **N/A** Caving: **N/A**

DATE: **October 3, 2011**
START: **7:30 AM 10/3/2011**
FINISH: **3:30 PM 10/3/2011**
LOGGER: **DW**
DATE CHECKED: **N/A**

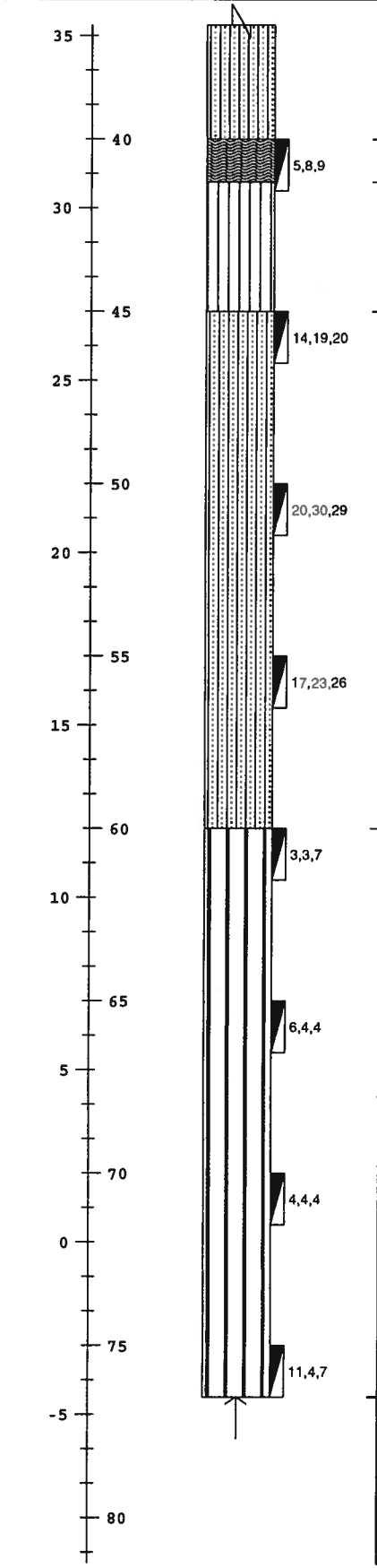


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SP-SM	Black poorly graded fine grained sand with silt, loose.			Casing installed to 5 feet.
		GP	Black poorly graded gravel with sand, numerous cobble, occasional boulder, moist to wet, dense. (Levee fill)			Dames and Moore sample. Casing installed to 10 feet.
				8.9	2.0	Dames and Moore sample. Casing installed to 15'.
						Dames and Moore sample. Casing installed to 20'.
		SP	Black poorly graded fine grained sand with gravel, wet, medium dense to dense.	17.4	3.7	Dames and Moore sample.
		SM	Black silty sand, wet, dense.	26.7	30.7	

Boring KCB-15 was located east of the levee road in the levee fill prism. The boring location is provided in Figure 2. No water level was determined for the boring due to use of mud rotary methodology. However, the water level is anticipated to be at the approximate depth of the adjacent wetland.

PLATE NUMBER **A15**

LOG OF Boring
BORING KCB-15
(continued)

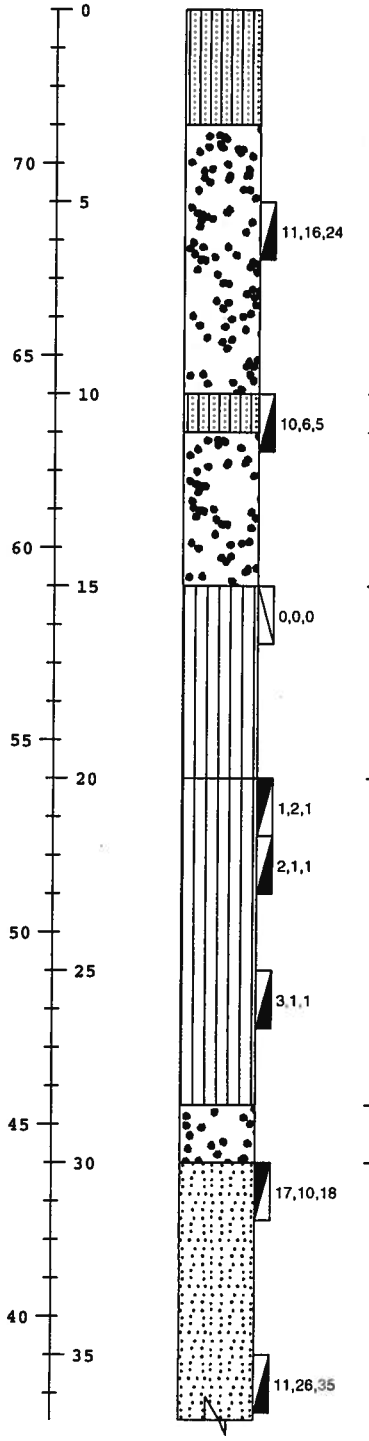


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
			Dark brown peat, wet, medium dense.			
		ML	Gray sandy silt, wet, medium dense.			
		SM	Black silty sand, wet, dense to very dense.	26.6	33.7	
		MH	Gray elastic silt with sand to sandy silt, trace gravel, scattered to numerous wood debris and organics, stiff.	76.8	81.8	LL=59, PL=42, PI=17
			Same-4 inch thick piece of wood at 65 feet.			
						KCB-15 terminated at 76.5 feet.

BORING LOG
BORING KCB-16

PROJECT: **Countyline to A-Street Geotechnical Study**
BORING LOCATION: **Fairweather Property**
DRILL METHOD: **Mud Rotary**
DRILLER: **Holocene Drilling Inc.**
DEPTH TO - Water: **N/A** Caving: **N/A**

DATE: **October 4, 2011**
START: **7:45 AM 10/4/2011**
FINISH: **2:15 PM 10/4/2011**
LOGGER: **DW**
DATE CHECKED: **N/A**

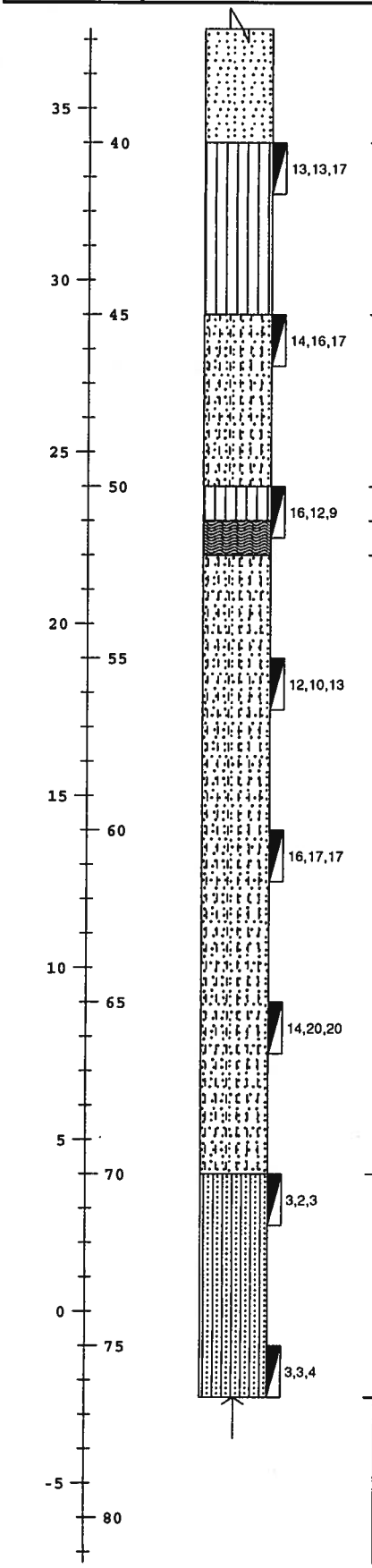


ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Brown silty sand with gravel, occasional cobble, scattered concrete debris, moist to wet, medium dense. (Fill)			
		GP	Black poorly graded gravel with sand and cobble, scattered concrete debris, trace paper, moist to wet, medium dense to dense. (Fill)			Dames and Moore sample.
		SM	Brown silty sand with gravel, trace concrete debris, moist to wet, medium dense. (Fill)	26.2	29.6	Dames and Moore sample.
		GP	Black poorly graded gravel with sand, wet, medium dense. (Native contact?)			
		ML	Gray sandy silt, wet, very loose?			Weight of hammer dropped sampler 18 inches. No sample recovery.
		ML	Wood debris with gray sandy silt, wet, very loose?			No sample recovery at 20 or 21.5 feet. Description based on minor sample recovery at 25 feet. Heavy mud loss between 20 and 30 feet. Dames and Moore sample.
		GP	Black poorly graded gravel with sand, occasional cobble, wet, dense.			Dames and Moore sample.
		SP	Black poorly graded sand with gravel, wet, dense.	39.0	3.8	Minor recovery of wood debris (twigs) and gray sandy silt. Installed casing to 35 feet. Black sand at tip of sampler.

Boring KCB-16 was drilled in the Fairweather Propery south of the wetland. The boring location is provided in Figure 2. No water level was determined for the boring due to use of mud rotary methodology. However, the water level is anticipated to be at the approximate depth of the adjacent wetland.

PLATE NUMBER **A16**

LOG OF Boring
BORING KCB-16
(continued)



ELEVATION/ DEPTH	USCS	Description	Moist (%)	-200 (%)	Remarks
35 – 40	ML	Dark gray sandy silt, wet, medium dense to dense.			
30 – 45	SP-SM	Black poorly graded fine to medium sand with silt, wet, dense.	19.2	11.0	
25 – 50	ML	Gray sandy silt, wet, medium dense.			
		Dark brown fibrous peat, wet, medium dense.			
20 – 55	SP-SM	Black poorly graded fine grained sand with silt, trace gravel, wet, medium dense to dense.			
15 – 60			28.9	10.8	
10 – 65					
5 – 70	SM	Gray silty sand to sandy silt, scatterd organics and wood debris, wet, loose.			
0 – 75			69.3	49.2	LL=29, PL=29, PI=0, KCB-16 terminated at 76.5 feet.
-5 – 80					

KEY TO SYMBOLS

Symbol	Description
Strata symbols	
	Silty sand
	Silt
	Poorly graded sand
	Poorly graded gravel
	Low plasticity clay
	Topsoil
	Peat
	Poorly graded sand with silt
	Decomposed wood
	Poorly graded gravel with silt
	Elastic silt
Misc. Symbols	
	Water table during drilling
	End of boring

Symbol	Description
	Boring continues
Soil Samplers	
	Standard penetration test
	No recovery
	Undisturbed thin wall Shelby tube
	Dutch cone test
Monitor Well Details	
	riser with cover and protective casing
	protective casing set in concrete
	bentonite pellets
	silica sand, blank PVC
	slotted pipe w/ sand
	no pipe, filler material

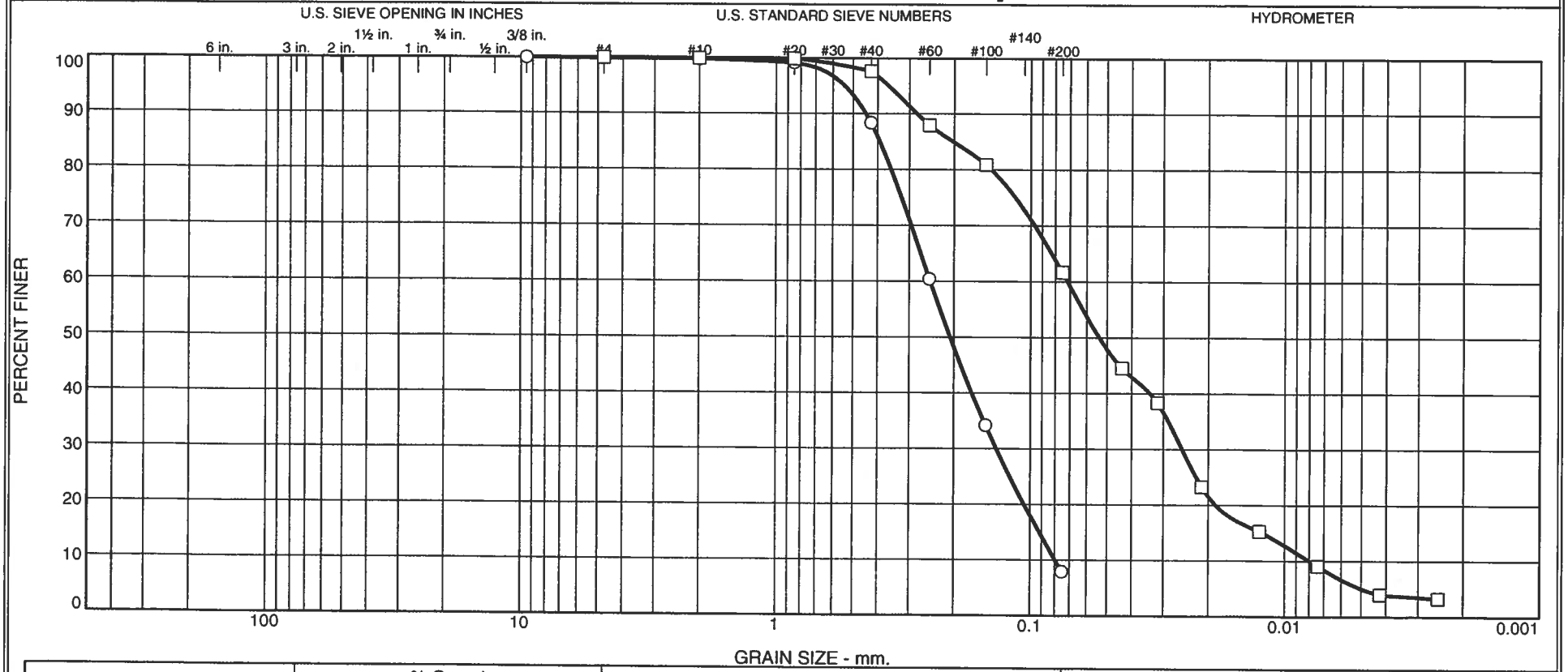
Notes:

1. KCB-1 through KCB-12 were drilled between September 22, 2010 and October 1, 2010. KCB-13 through KCB-16 were drilled between September 28, 2011 and October 4, 2011. All borings were drilled using a CME-850 track mounted drill utilizing mud rotary methodology.

2. Results of tests conducted on samples recovered are reported on the logs.

3. These logs are subject to the limitations, conclusions, and recommendations in this report.

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.1	0.1	11.4	80.5	7.9	
□	0.0	0.0	0.0	0.0	2.4	35.9	56.7	5.0

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-1	KC-10-971	12.5	10/8/10	SP-SM	Poorly graded sand with silt	26.4	NV	NP
□	KCB-1	KC-10-973	20	10/8/10	ML	Sandy silt	35.4	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

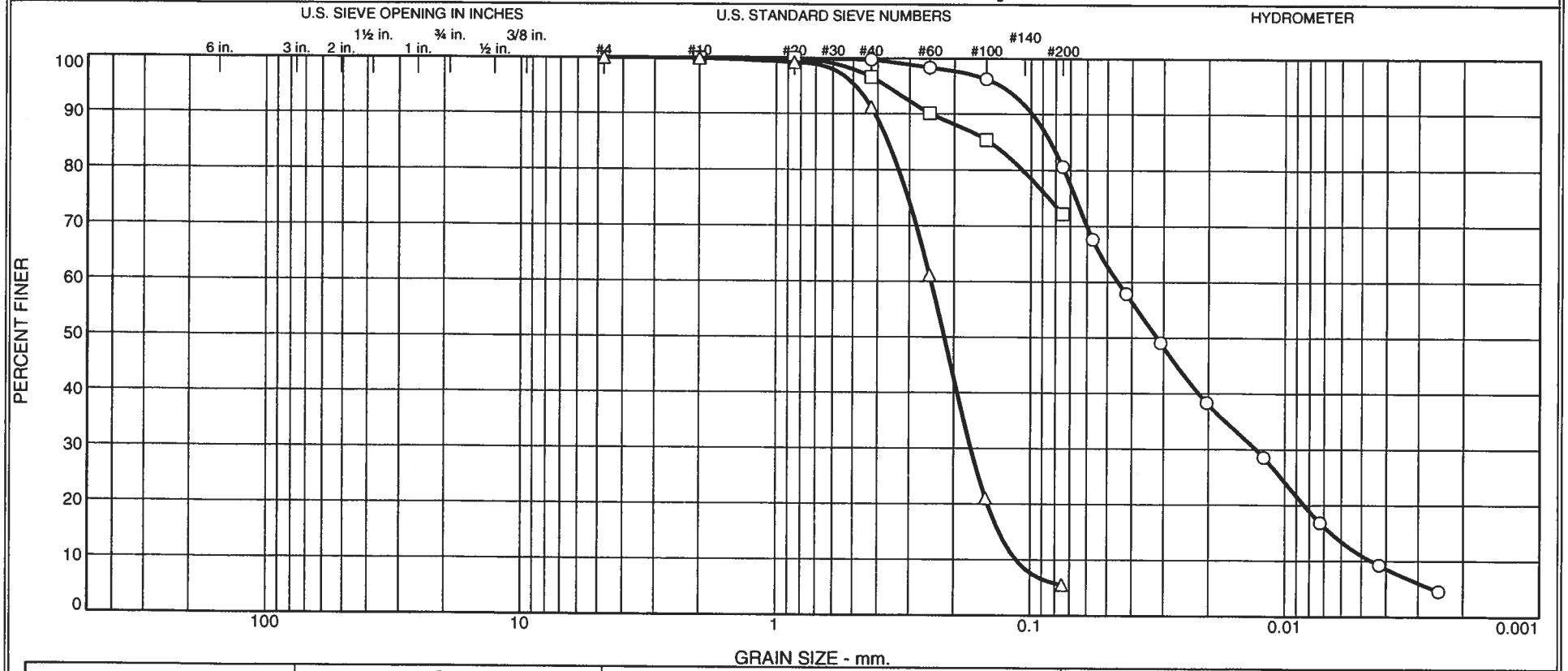
Project No. FL9001 Figure A1

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.3	19.1	69.6	11.0
□	0.0	0.0	0.0	0.0	3.4	24.4	72.2	
△	0.0	0.0	0.0	0.1	8.7	85.7	5.5	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-2	KC-10-974	2.5	10/8/10	ML	Silt with sand	53.0	NV	NP
□	KCB-2	KC-10-975	7.5	10/8/10	ML	Silt with sand	31.6	NV	NP
△	KCB-2	KC-10-976	17.5	10/8/10	SP-SM	Poorly graded sand with silt	29.5	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

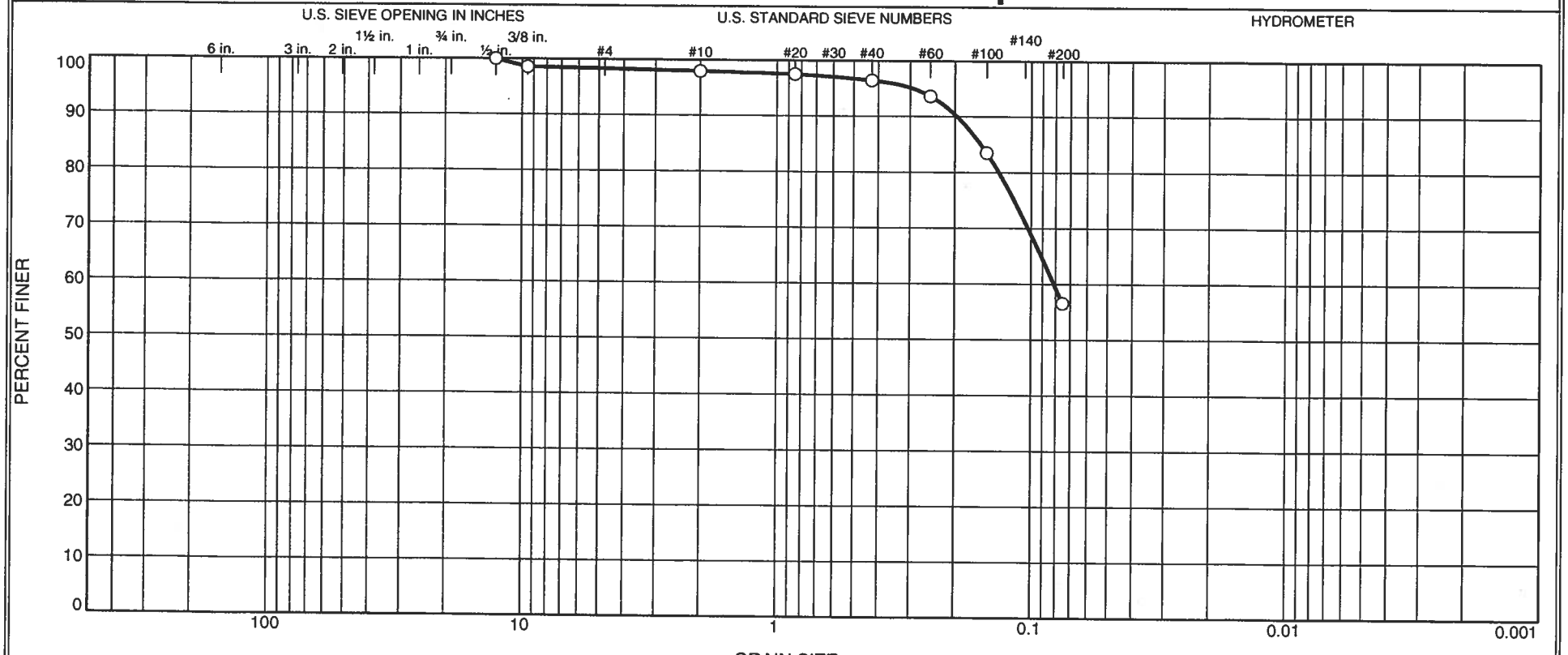
Project No. FL9001 Figure A2

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	1.7	0.4	1.4	39.9	56.6	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	KCB-2	KC-10-977	30	10/8/10	ML	Sandy silt	30.0	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

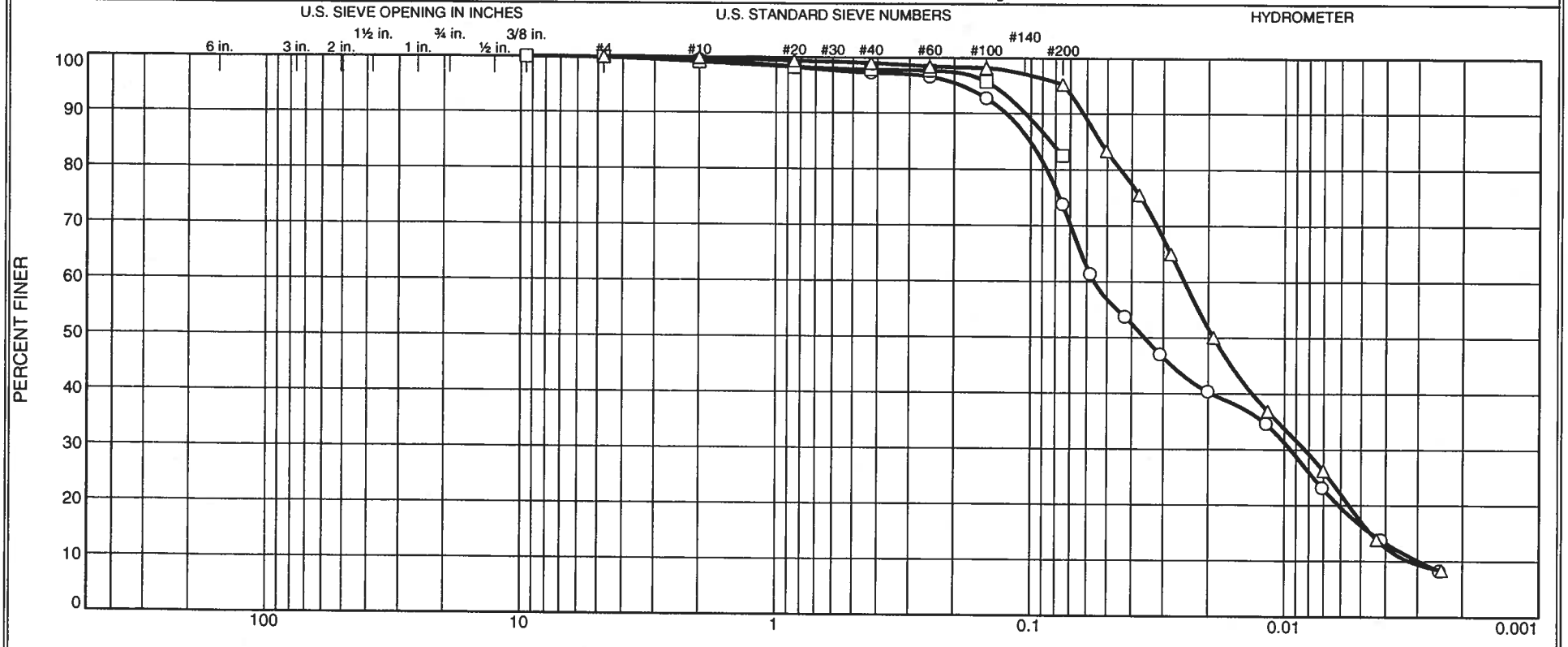
Project No. FL9001 Figure A3

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.5	2.2	23.5	57.4	16.4
□	0.0	0.0	0.1	0.7	1.4	15.3	82.5	
△	0.0	0.0	0.0	0.1	0.9	3.7	78.2	17.1

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-3	KC-10-978	2.5	10/8/10	ML	Silt with sand	42.9	NV	NP
□	KCB-3	KC-10-979	5	10/8/10	ML	Silt with sand	36.5	NV	NP
△	KCB-3	KC-10-980	10	10/8/10	ML	Silt	45.5	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

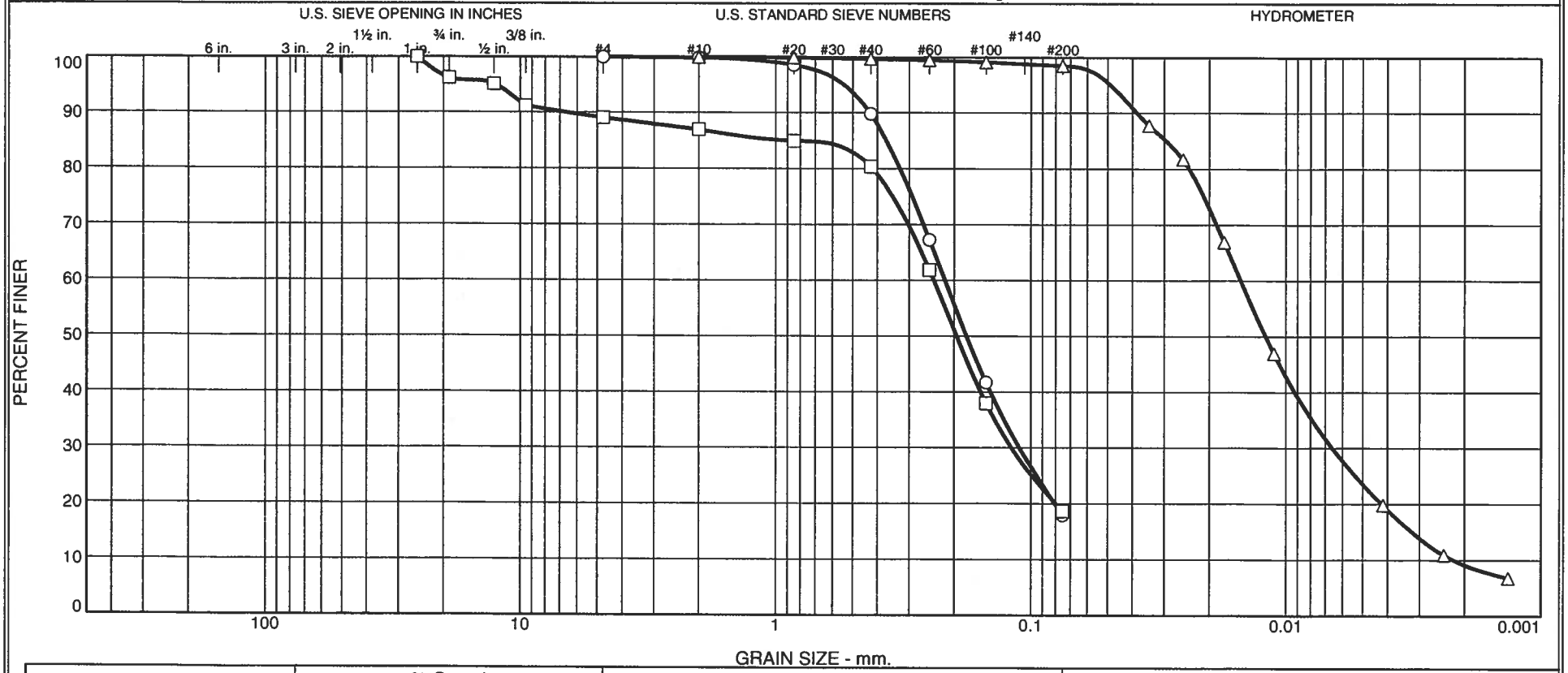
Project No. FL9001 Figure A4

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.1	10.1	71.9	17.9	
□	0.0	3.8	7.1	2.1	6.6	61.7	18.7	
△	0.0	0.0	0.0	0.0	0.3	1.2	74.9	23.6

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-3	KC-10-981	15	10/8/10	SM	Silty sand	28.4	NV	NP
□	KCB-3	KC-10-982	30	10/8/10	SM	Silty sand	26.2	NV	NP
△	KCB-3	KC-10-983	40	10/8/10	ML	Silt	45.9	35	33

Client WLRD

Project Countyline to A-Street Geotechnical Study

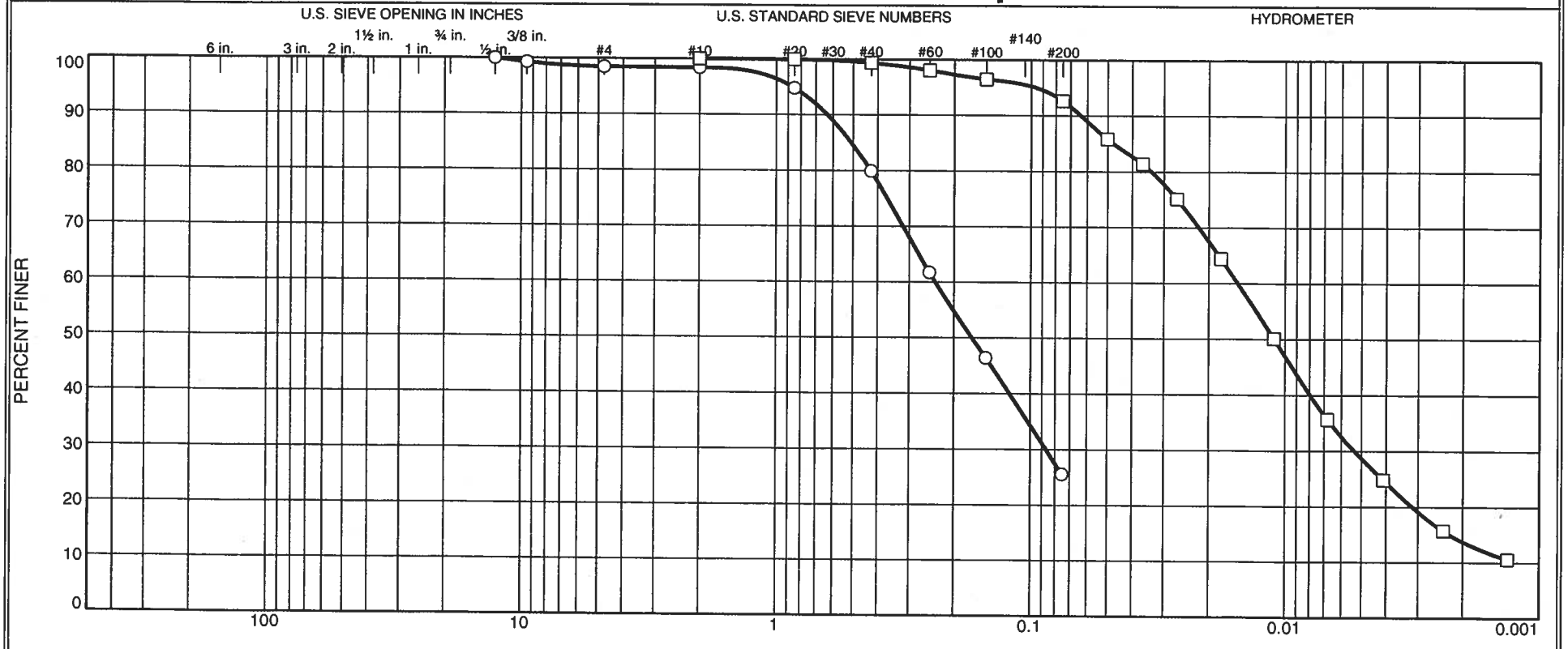
Project No. FL9001 Figure A5

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.5	0.1	18.5	54.3	25.6	
□	0.0	0.0	0.0	0.0	0.6	6.7	64.0	28.7

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-3	KC-10-984	46.5	10/8/10	SM	Silty sand	24.2	NV	NP
□	KCB-3	KC-10-985	55	10/8/10	ML	Silt	51.3	42	34

Client WLRD

Project Countyline to A-Street Geotechnical Study

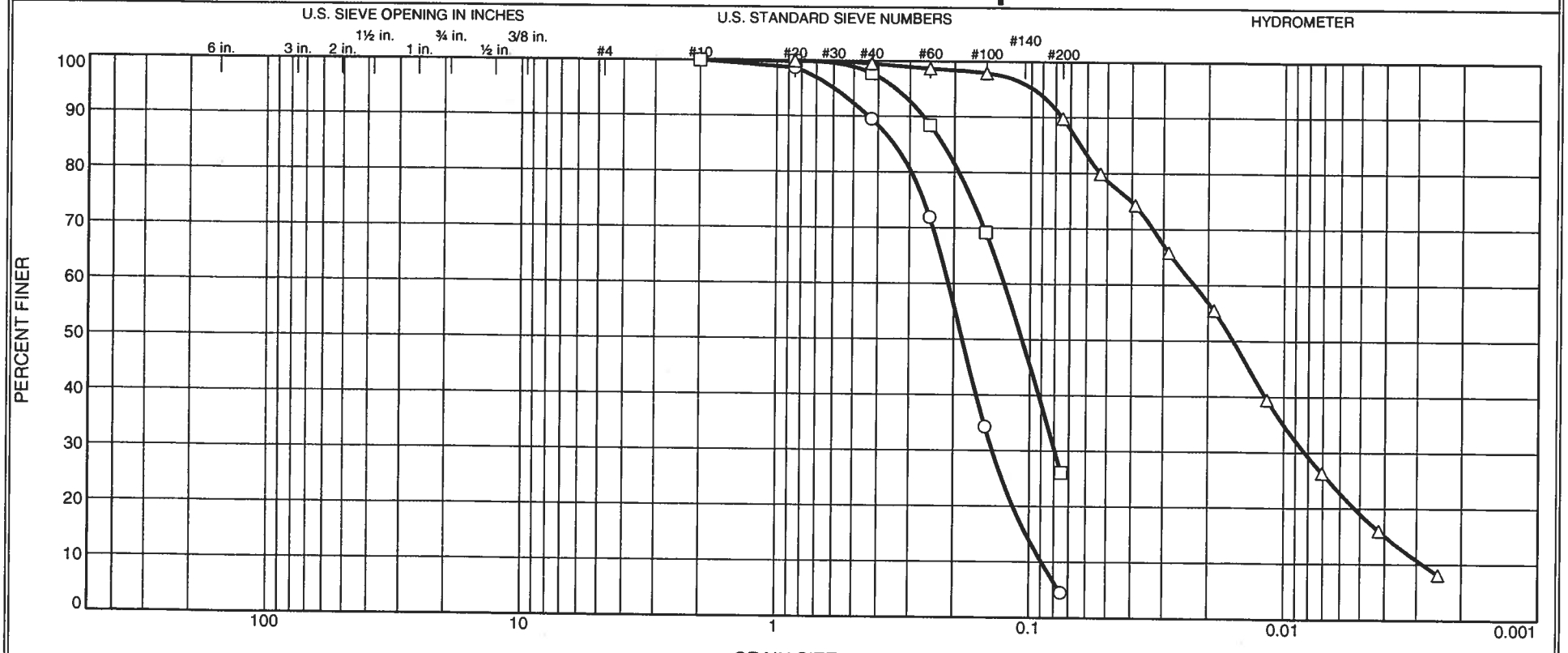
Project No. FL9001 Figure A6

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	10.5	85.0	4.5	
□	0.0	0.0	0.0	0.0	2.2	71.7	26.1	
△	0.0	0.0	0.0	0.0	0.5	9.7	70.7	19.1

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-4	KC-10-1025	2.5	10/8/10	SP	Poorly graded sand	26.7	NV	NP
□	KCB-4	KC-10-987	10	10/8/10	SM	Silty sand	28.3	NV	NP
△	KCB-4	KC-10-988	15	10/8/10	ML	Silt	62.5	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

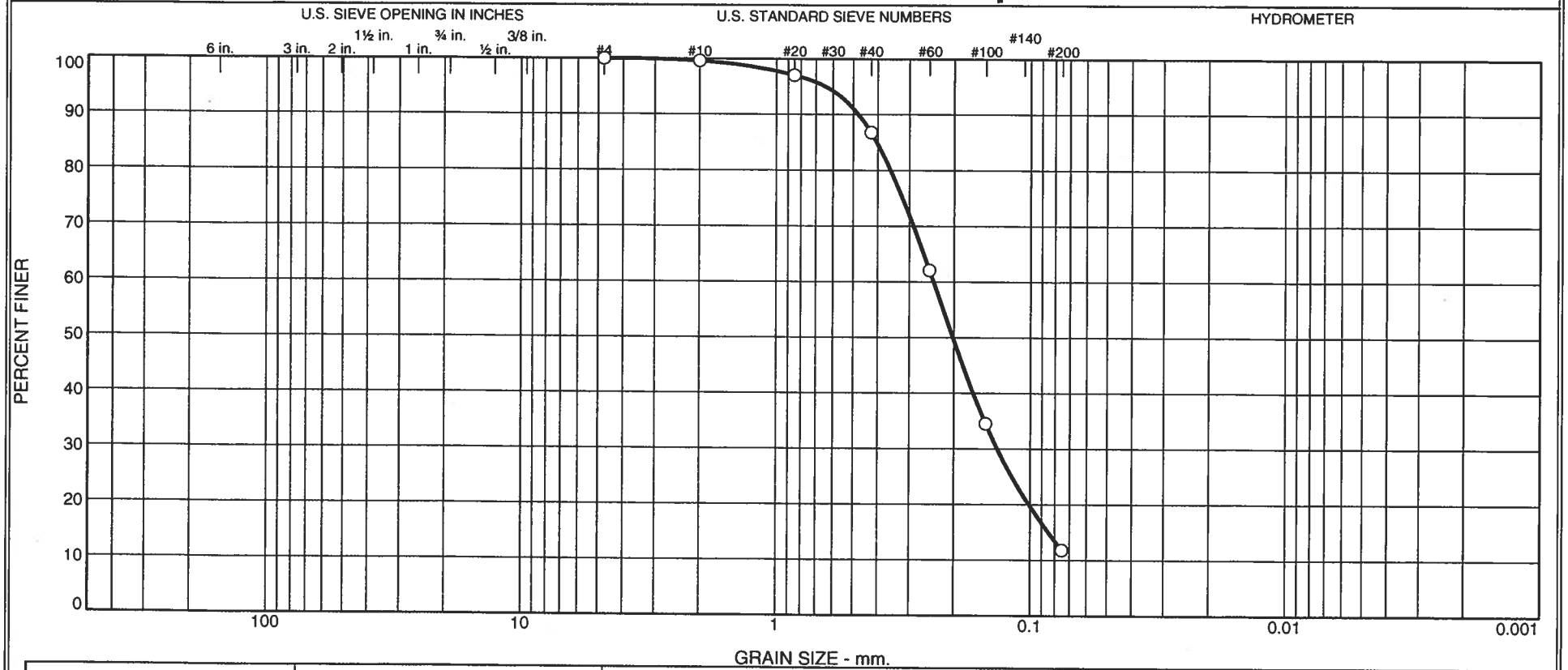
Project No. FL9001 Figure A7

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	0.0	0.4	12.8	75.0	11.8	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	KCB-4	KC-10-989	25	10/8/10	SP-SM	Poorly graded sand with silt	26.7	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

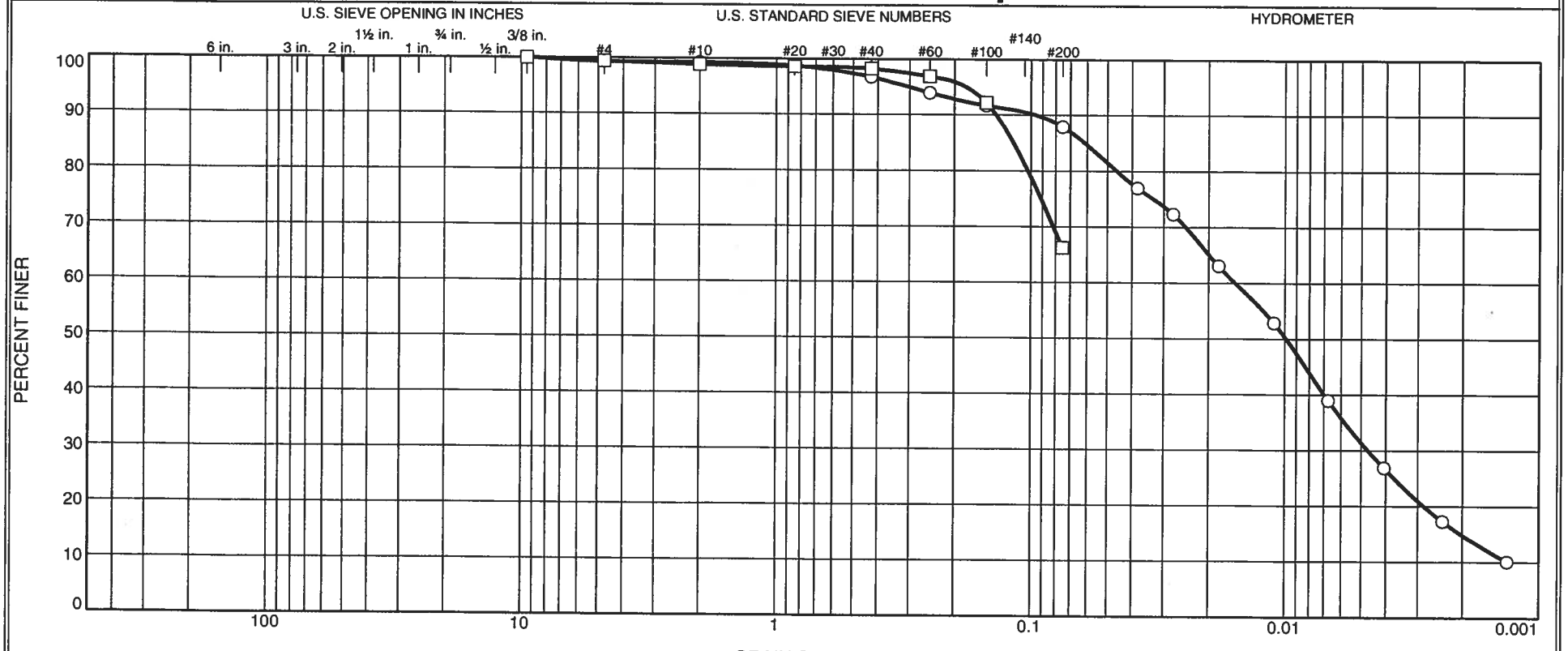
Project No. FL9001 Figure A8

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.7	0.1	2.5	8.8	56.5	31.4
□	0.0	0.0	0.6	0.5	0.6	32.1	66.2	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-5	KC-10-990	2.5	10/8/10	ML	Silt	49	35	30
□	KCB-5	KC-10-991	10	10/8/10	ML	Sandy silt	48.6	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

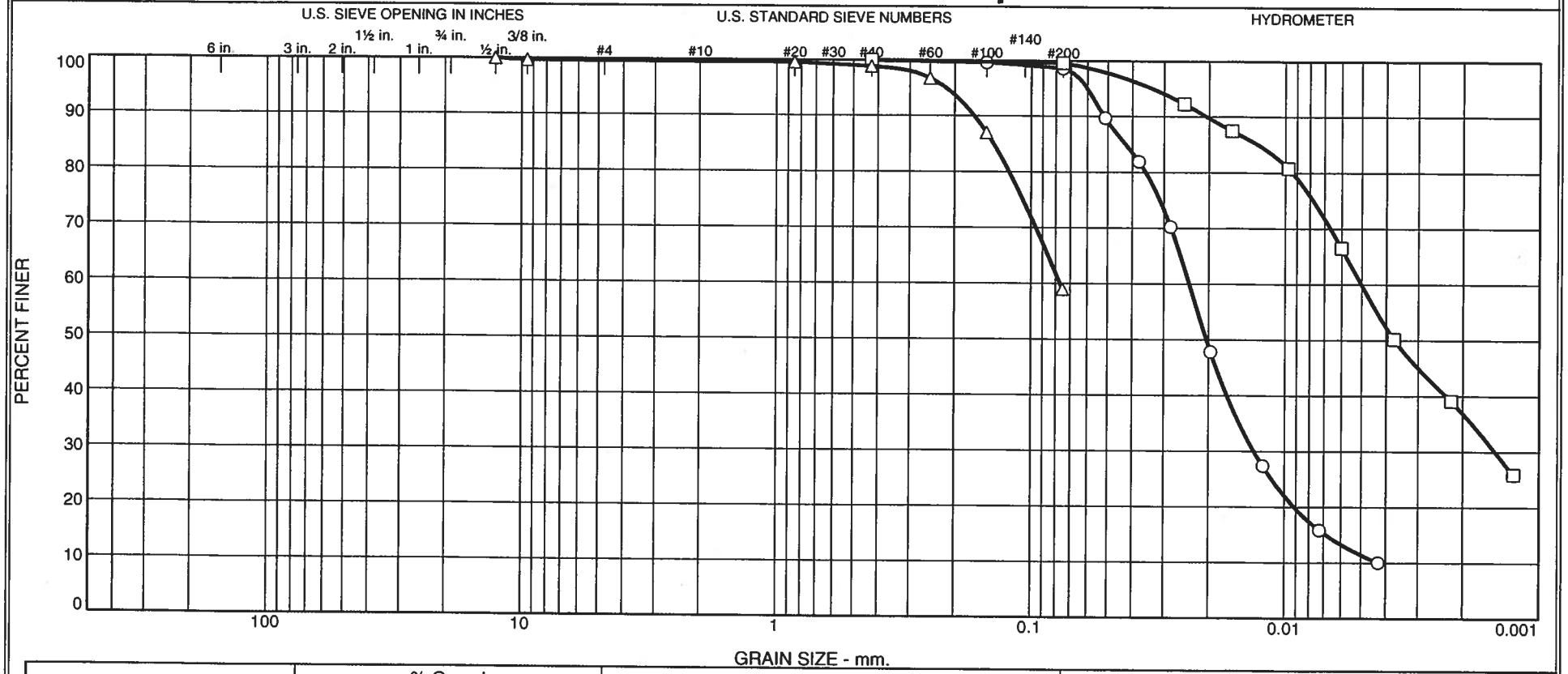
Project No. FL9001 Figure A9

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.0	1.4	87.1	11.5
□	0.0	0.0	0.0	0.0	0.0	0.4	39.7	59.9
△	0.0	0.0	0.4	0.0	0.7	39.9	59.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-5	KC-10-1026	15	10/8/10	ML	Brown silt	52.6	NV	NP
□	KCB-5	KC-10-1026	16	10/8/10	ML	Gray silt	49.6	44	34
△	KCB-5	KC-10-1026	17	10/8/10	ML	Sandy silt	36.4	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

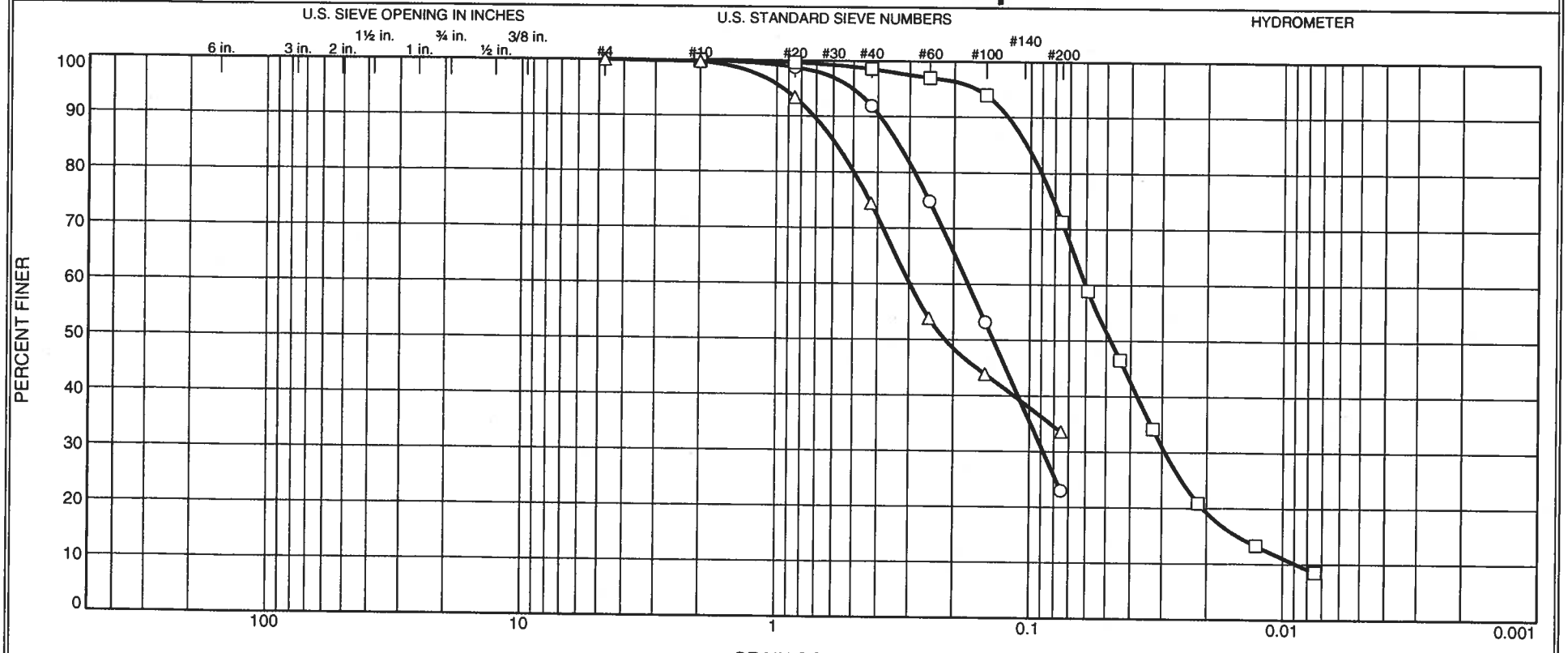
Project No. FL9001 Figure A10

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	8.1	68.9	23.0	
□	0.0	0.0	0.0	0.0	1.4	27.3	71.3	
△	0.0	0.0	0.0	0.2	25.3	40.9	33.6	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-5	KC-10-992	20	10/8/10	SM	Silty sand	29.1	NV	NP
□	KCB-5	KC-10-993	25	10/8/10	ML	Silt with sand	40.2	NV	NP
△	KCB-5	KC-10-994	40	10/8/10	SM	Silty sand	32.3	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

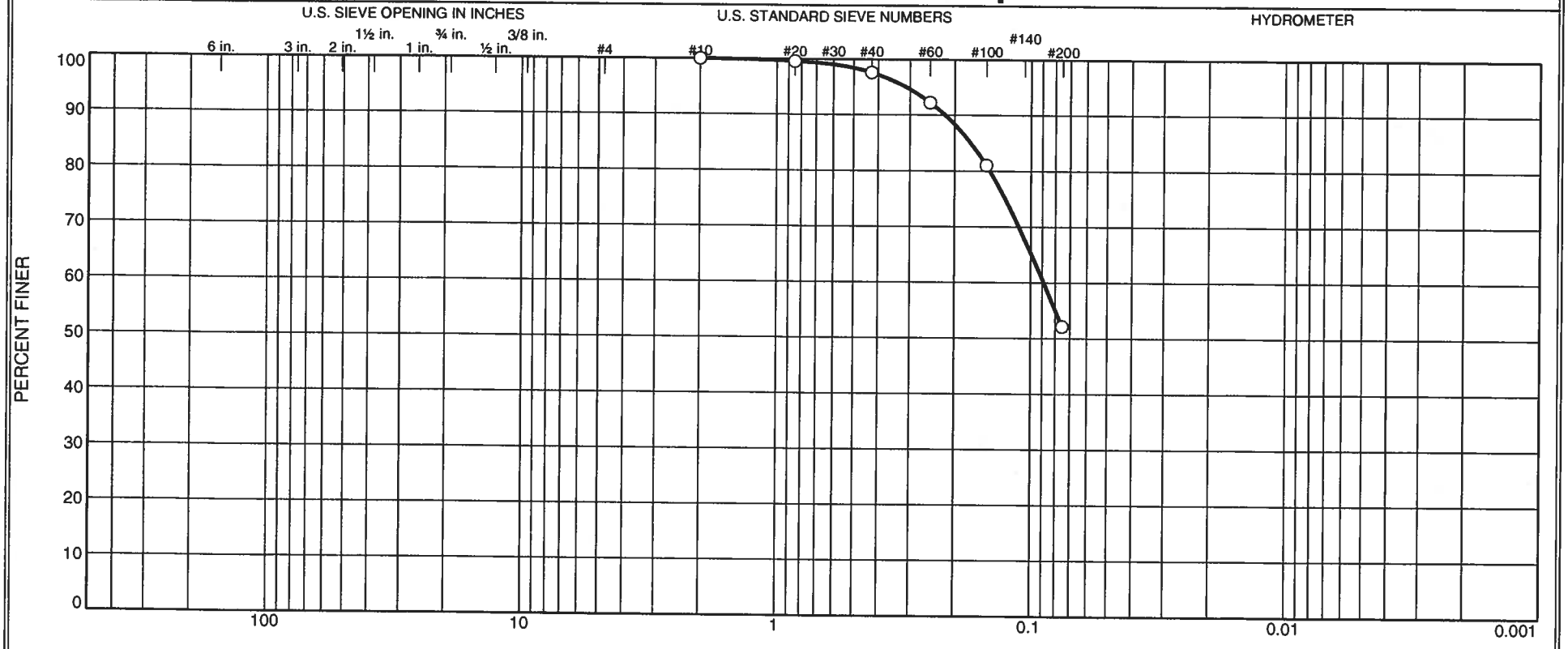
Project No. FL9001 Figure A11

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	0.0	0.0	2.4	45.5	52.1	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	KCB-5	KC-10-995	50	10/8/10	ML	Sandy silt	29.1	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

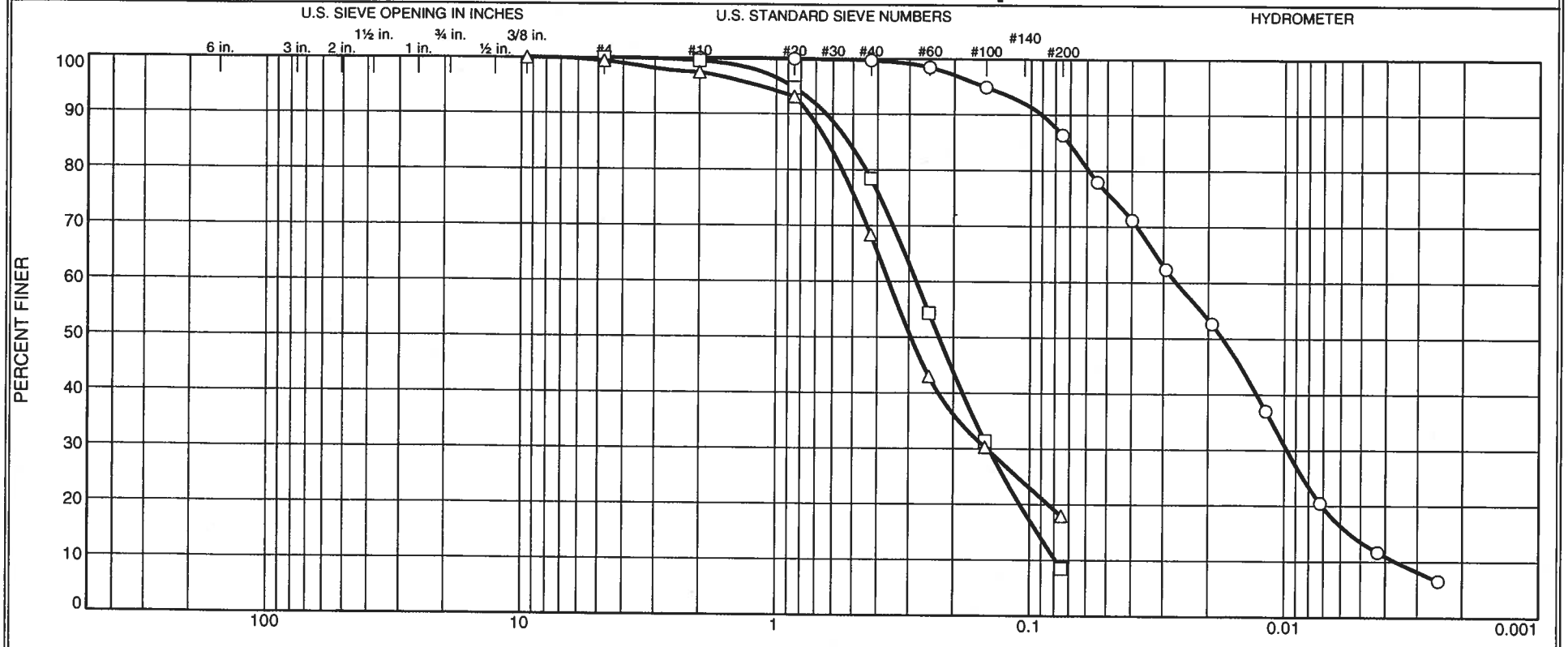
Project No. FL9001 Figure A12

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.3	13.3	72.8	13.6
□	0.0	0.0	0.0	0.5	21.1	69.9	8.5	
△	0.0	0.0	0.6	1.9	29.1	50.4	18.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-6	KC-10-996	2.5	10/8/10	ML		35.3	NV	NP
□	KCB-6	KC-10-997	7.5	10/8/10	SP-SM	Poorly graded sand with silt	26.1	NV	NP
△	KCB-6	KC-10-999	30	10/8/10	SM	Silty sand	24	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

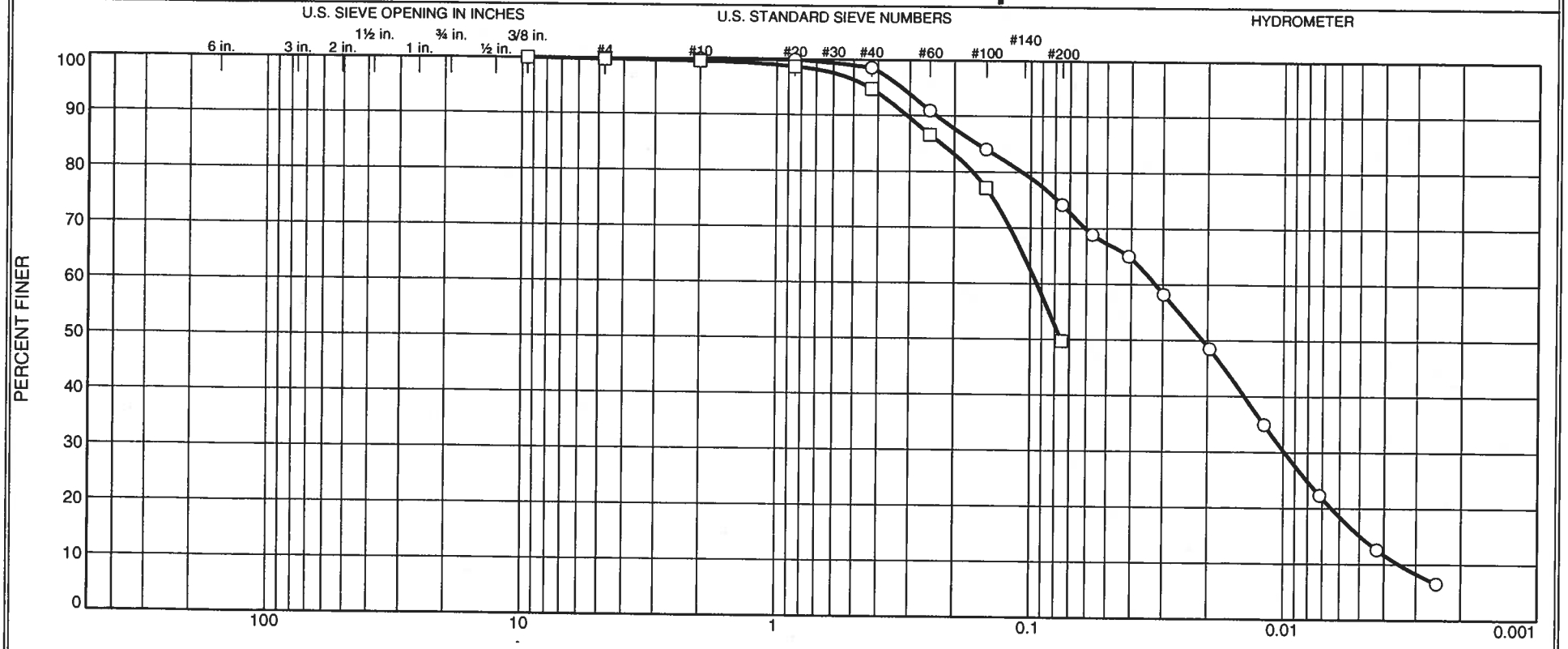
Project No. FL9001 Figure A13

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	1.4	24.4	59.1	15.1
□	0.0	0.0	0.2	0.2	4.8	45.1	49.7	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-6	KC-10-1000	35	10/8/10	ML	Silt with sand	88.9	NV	NP
□	KCB-6	KC-10-1001	50	10/8/28	SM	Silty sand	36.7	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

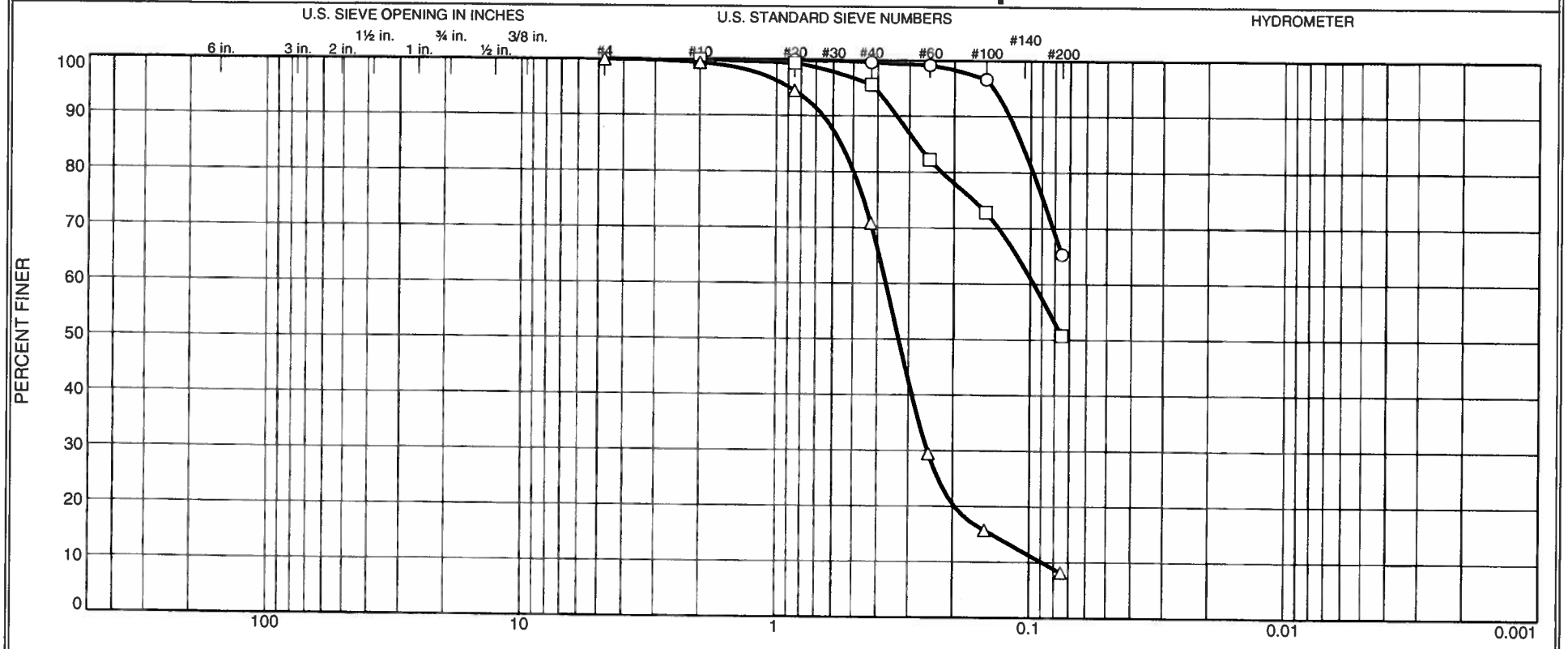
Project No. FL9001 Figure A14

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.4	34.3	65.3	
□	0.0	0.0	0.0	0.0	4.3	44.9	50.8	
△	0.0	0.0	0.0	0.5	28.6	62.7	8.2	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-7	KC-10-1002	5	10/8/10	ML	Sandy silt	29.8	NV	NP
□	KCB-7	KC-10-1003	12.5	10/8/10	ML	Sandy silt	27.4	NV	NP
△	KCB-7	KC-10-1006	45	10/8/10	SP-SM	Poorly graded sand with silt	39.3	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

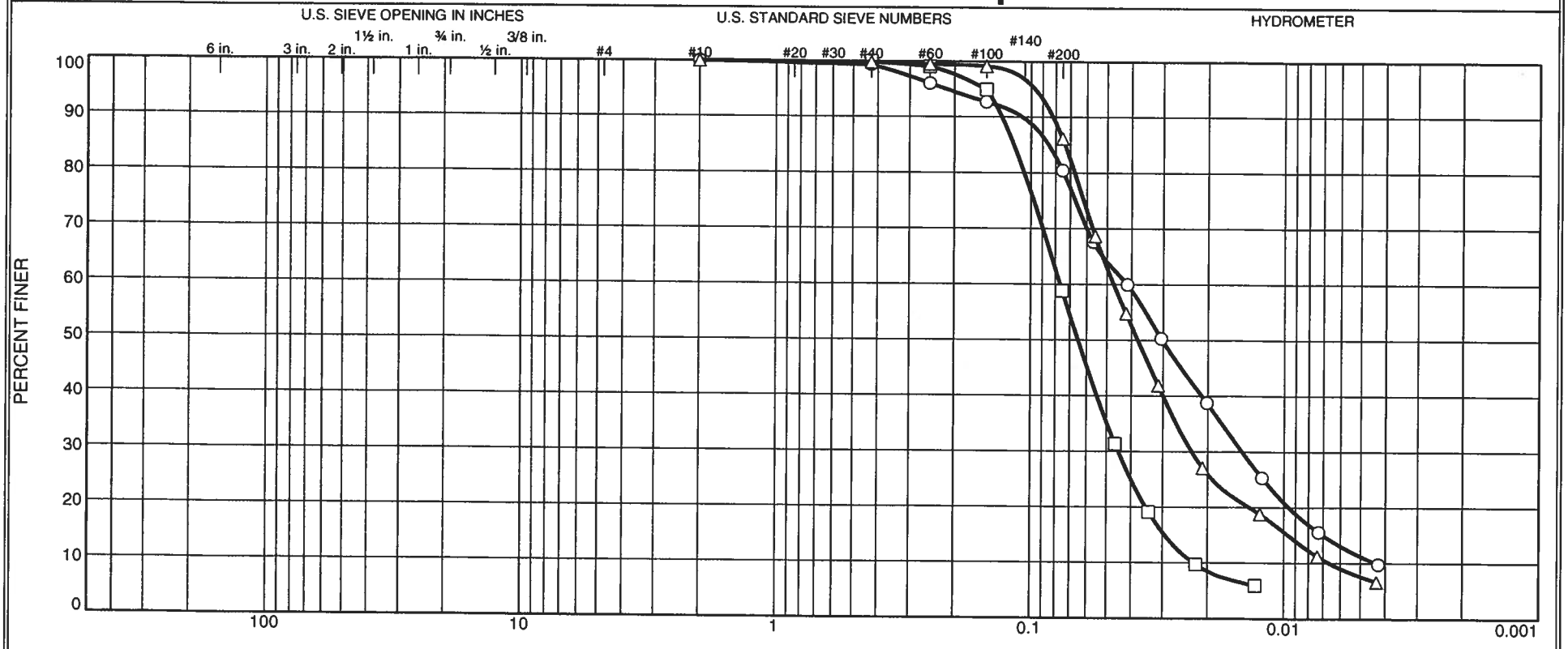
Project No. FL9001 Figure A15

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.6	19.0	69.2	11.2
□	0.0	0.0	0.0	0.0	0.0	41.2	58.8	
△	0.0	0.0	0.0	0.0	0.2	13.6	78.6	7.6

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-8	KC-10-1007	2.5	10/8/10	ML	Silt with sand	35.7	NV	NP
□	KCB-8	KC-10-1008	7.5	10/8/10	ML	Sandy silt	38.6	NV	NP
△	KCB-8	KC-10-1009	17.5	10/8/10	ML	Silt	42.7	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

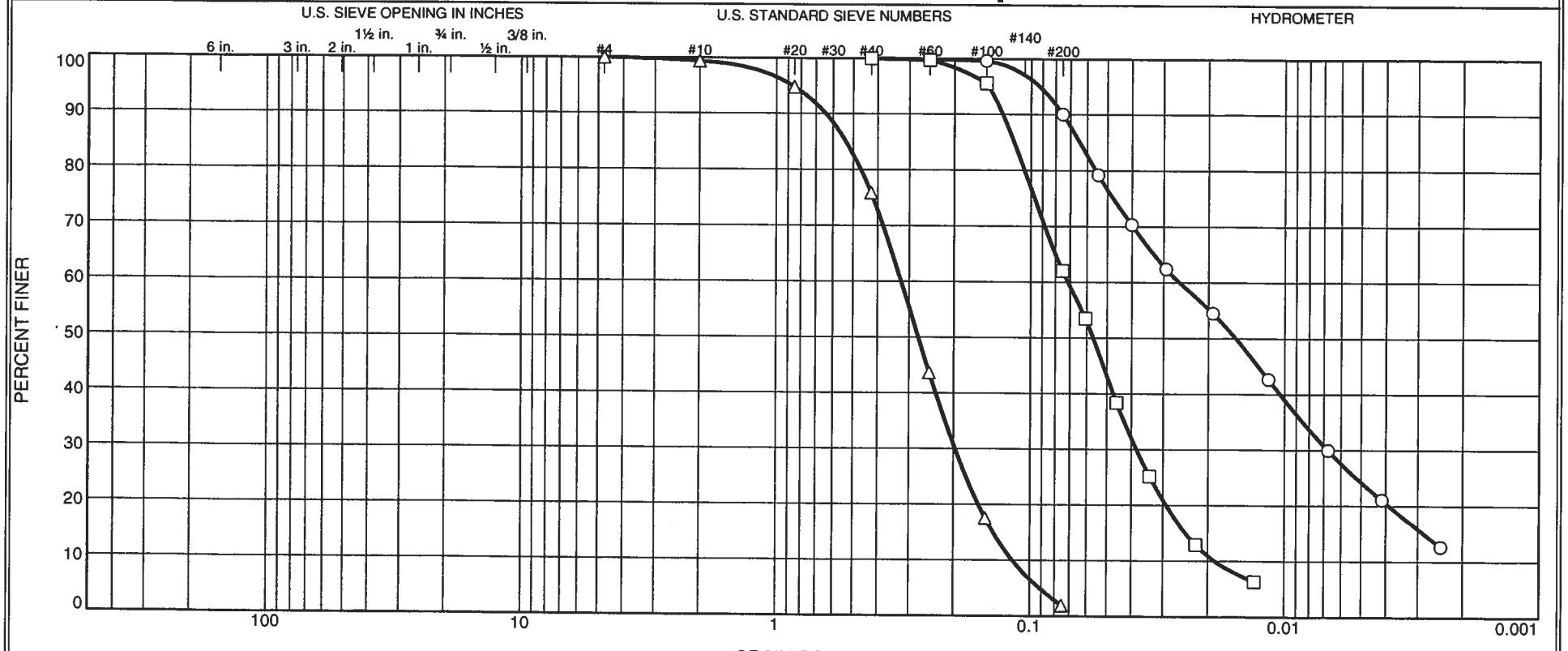
Project No. FL9001 Figure A16

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.0	9.9	65.8	24.3
□	0.0	0.0	0.0	0.0	0.0	37.9	62.1	
△	0.0	0.0	0.0	0.6	23.5	74.0	1.9	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-8	KC-10-1027	20	10/8/10	ML	Silt	32.8	NV	NP
□	KCB-8	KC-10-1027	20.8	10/8/10	ML	Sandy silt	33.3	NV	NP
△	KCB-8	KC-10-1027	21.5	10/8/10	SP	Poorly graded sand	30.7	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

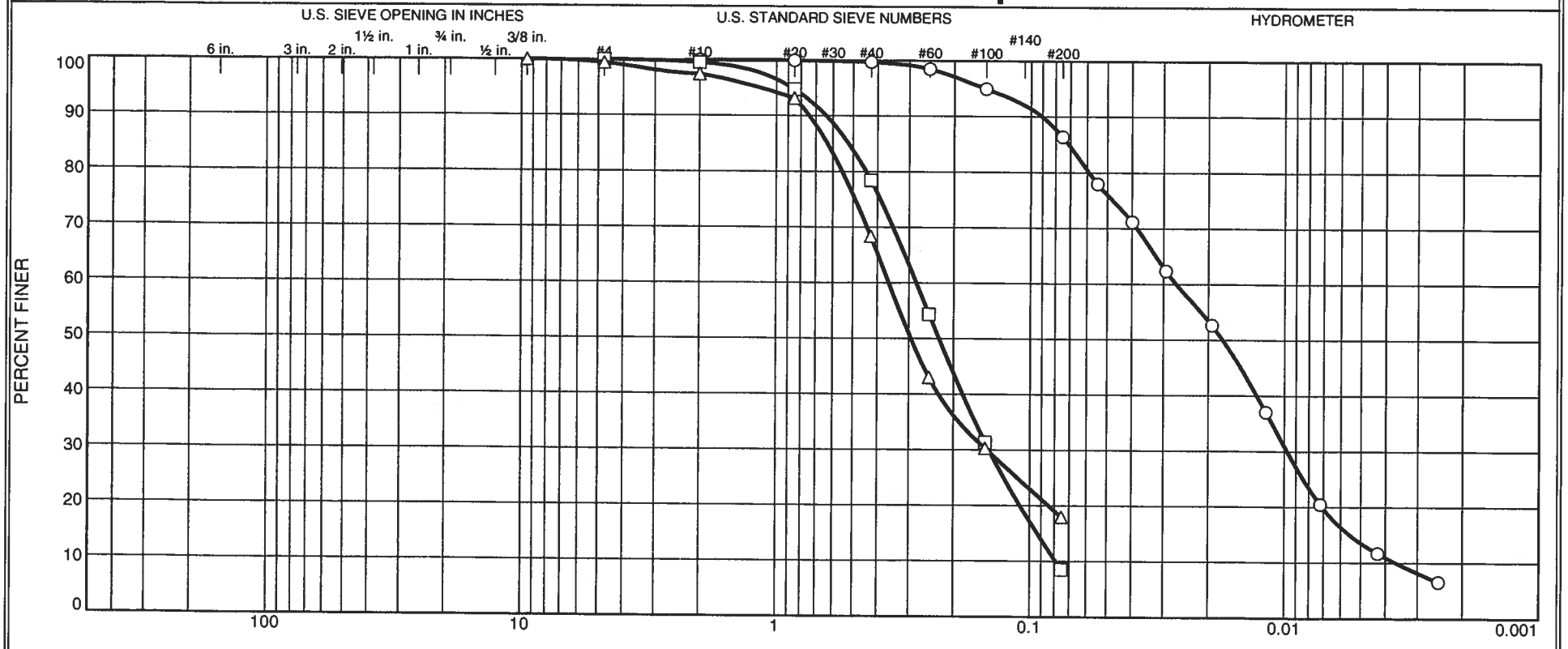
Project No. FL9001 Figure A17

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.3	13.3	72.8	13.6
□	0.0	0.0	0.0	0.5	21.1	69.9	8.5	
△	0.0	0.0	0.6	1.9	29.1	50.4	18.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-6	KC-10-996	2.5	10/8/10	ML		35.3	NV	NP
□	KCB-6	KC-10-997	7.5	10/8/10	SP-SM	Poorly graded sand with silt	26.1	NV	NP
△	KCB-6	KC-10-999	30	10/8/10	SM	Silty sand	24	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

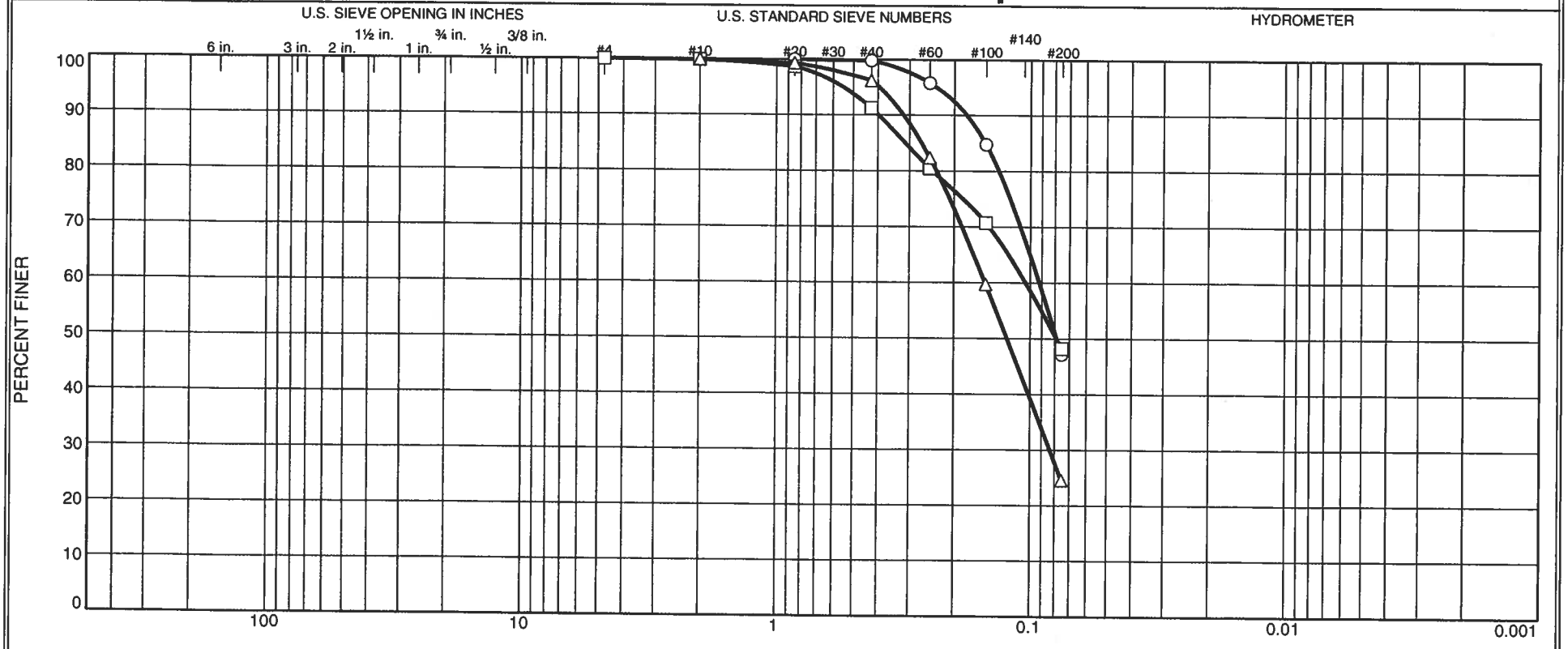
Project No. FL9001 Figure A18

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	0.2	52.7	47.1	
□	0.0	0.0	0.0	0.1	8.6	43.1	48.2	
△	0.0	0.0	0.0	0.0	3.8	71.6	24.6	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-9	KC-10-1013	5	10/8/10	SM	Silty sand	32.6	NV	NP
□	KCB-9	KC-10-1015	20	10/8/10	SM	Silty sand	39.2	NV	NP
△	KCB-9	KC-10-1016	30	10/8/10	SM	Silty sand	26.6	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

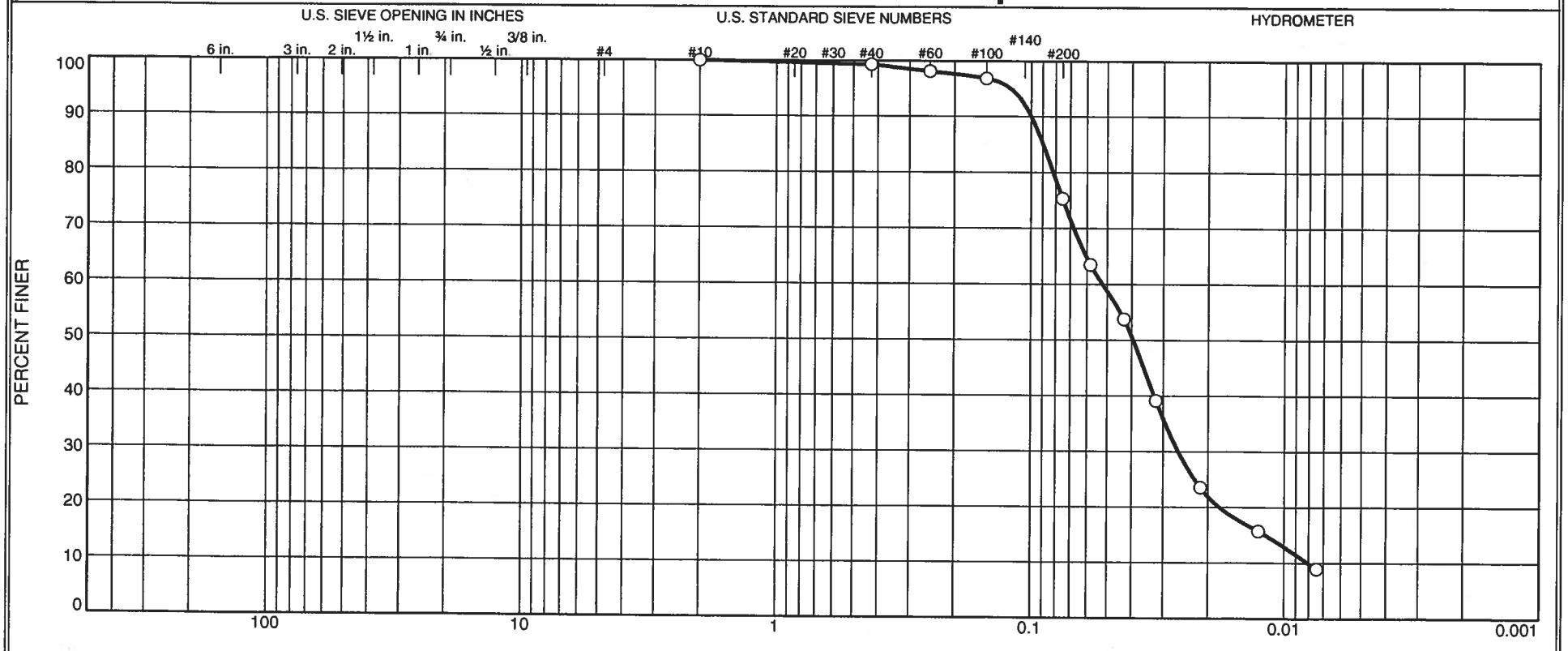
Project No. FL9001 Figure A19

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	0.0	0.0	0.7	24.0	75.3	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	KCB-9	KC-10-1017	55	10/8/10	ML	Silt with sand	30.3	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

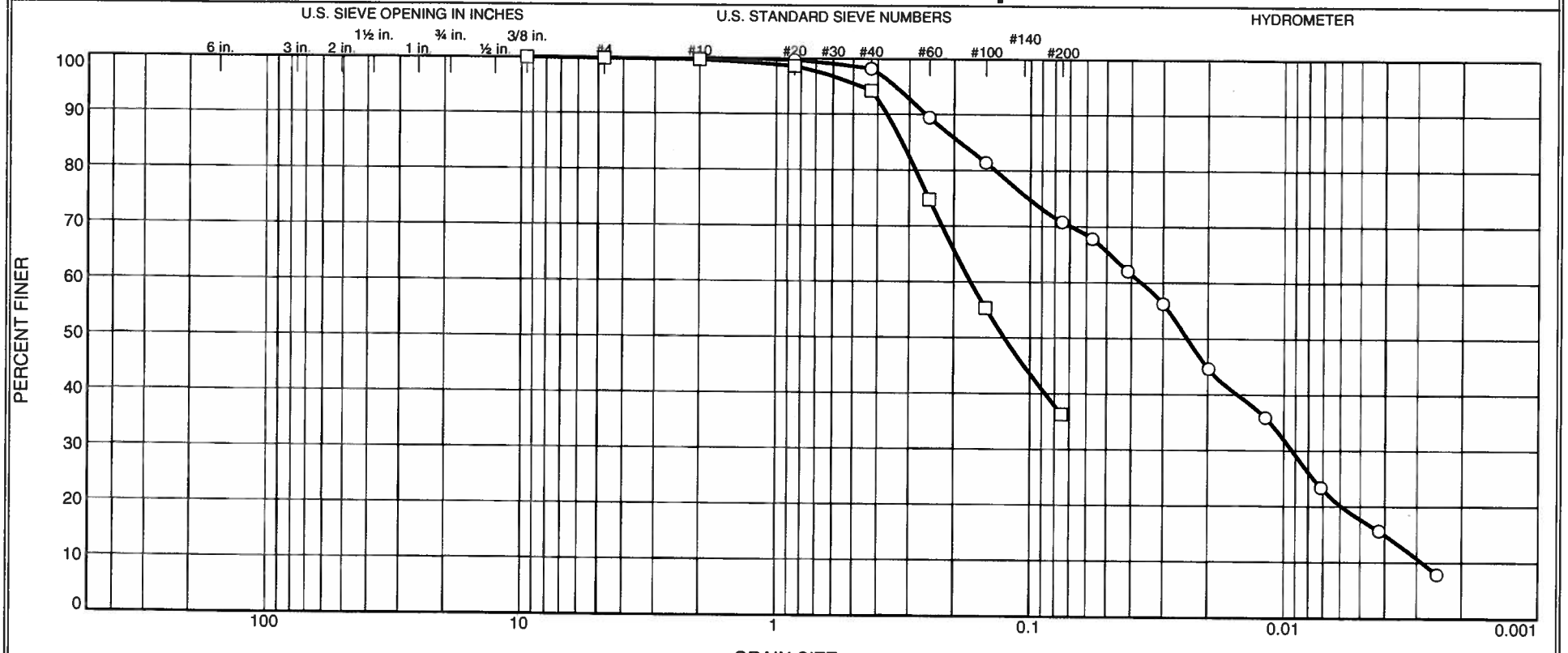
Project No. FL9001 Figure A20

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	1.8	27.4	53.1	17.7
□	0.0	0.0	0.1	0.2	5.5	57.9	36.3	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-10	KC-10-1018	40	10/8/10	ML	Silt with sand	46.6	NV	NP
□	KCB-10	KC-10-1019	55	10/8/10	SM	Silty sand	36.1	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

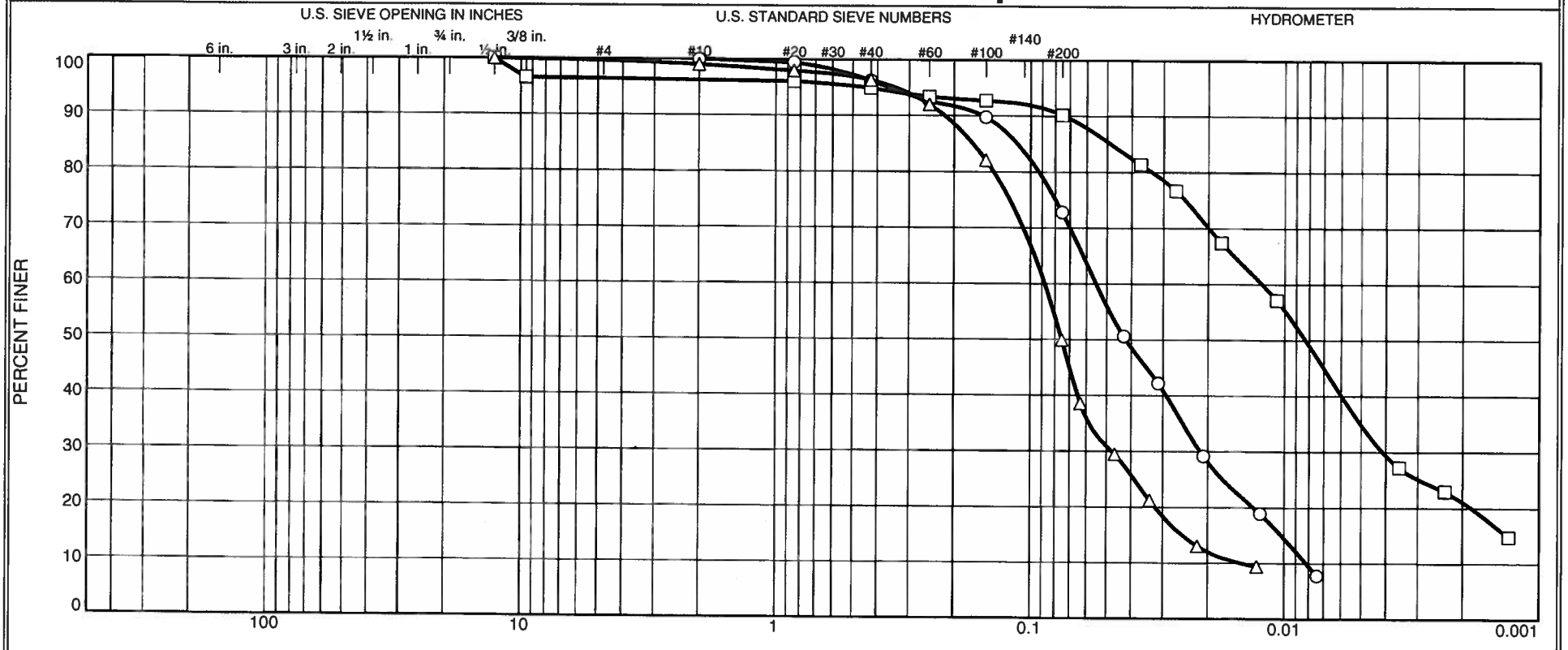
Project No. FL9001 Figure A21

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.0	3.7	23.5	72.8	
□	0.0	0.0	3.6	0.1	1.4	4.7	55.4	34.8
△	0.0	0.0	0.3	0.7	2.6	46.5	49.9	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-11	KC-10-1020	40	10/8/10	ML	Silt with sand	33.9	NV	NP
□	KCB-11	KC-10-1021	60	10/8/10	ML	Silt	43.6	40	31
△	KCB-11	KC-10-1022	65	10/8/10	SM	Silty sand	31.5	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

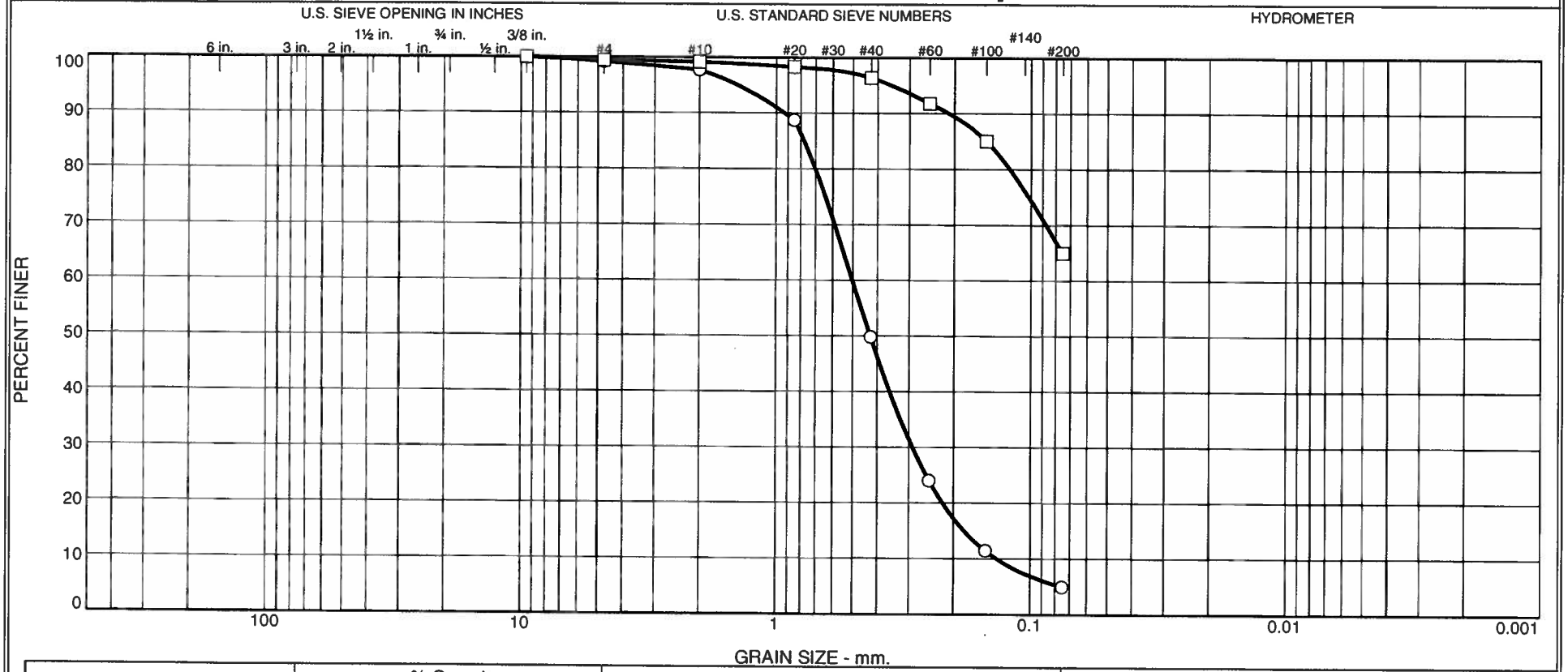
Project No. FL9001 Figure A22

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.8	1.4	48.0	44.8	5.0	
□	0.0	0.0	0.5	0.3	2.8	31.4	65.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-12	KC-10-1023	25	10/8/10	SP-SM	Poorly graded sand with silt	24.4	NV	NP
□	KCB-12	KC-10-1024	50	10/8/10	ML	Sandy silt	45.5	NV	NP

Client WLRD

Project Countyline to A-Street Geotechnical Study

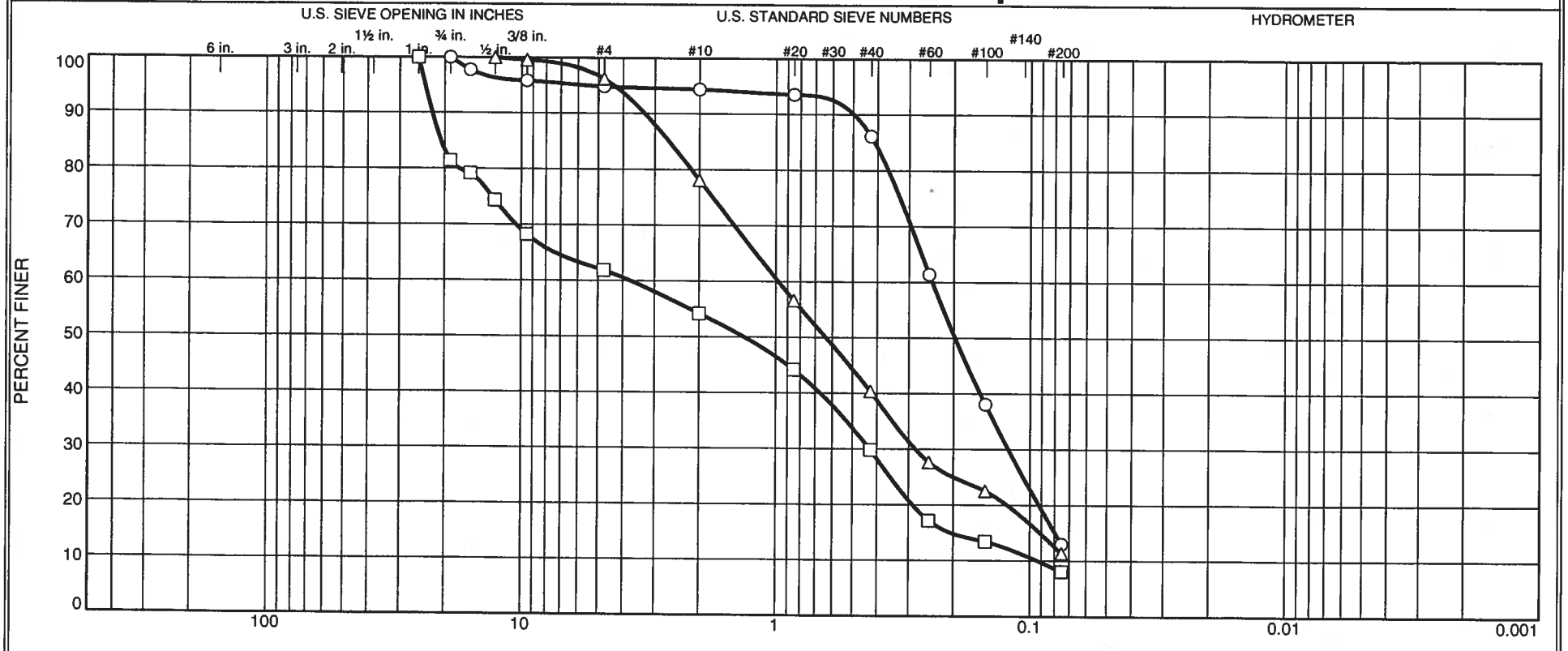
Project No. FL9001 Figure A23

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	5.2	0.4	8.2	73.2	13.0	
□	0.0	18.6	19.5	7.7	24.4	21.7	8.1	
△	0.0	0.0	3.8	18.1	37.8	28.9	11.4	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-13	KC-11-1361	5.0-6.5	10/6/11	SM	Silty sand	27.0		
□	KCB-13	KC-11-1362	20.0-21.5	10/6/11	SP-SM	Poorly graded sand with silt and gravel	17.6		
△	KCB-13	KC-11-1363	30.0-31.5	10/6/11	SP-SM	Poorly graded sand with silt	16.2		

Client King County

Project County Line Levee Relocation

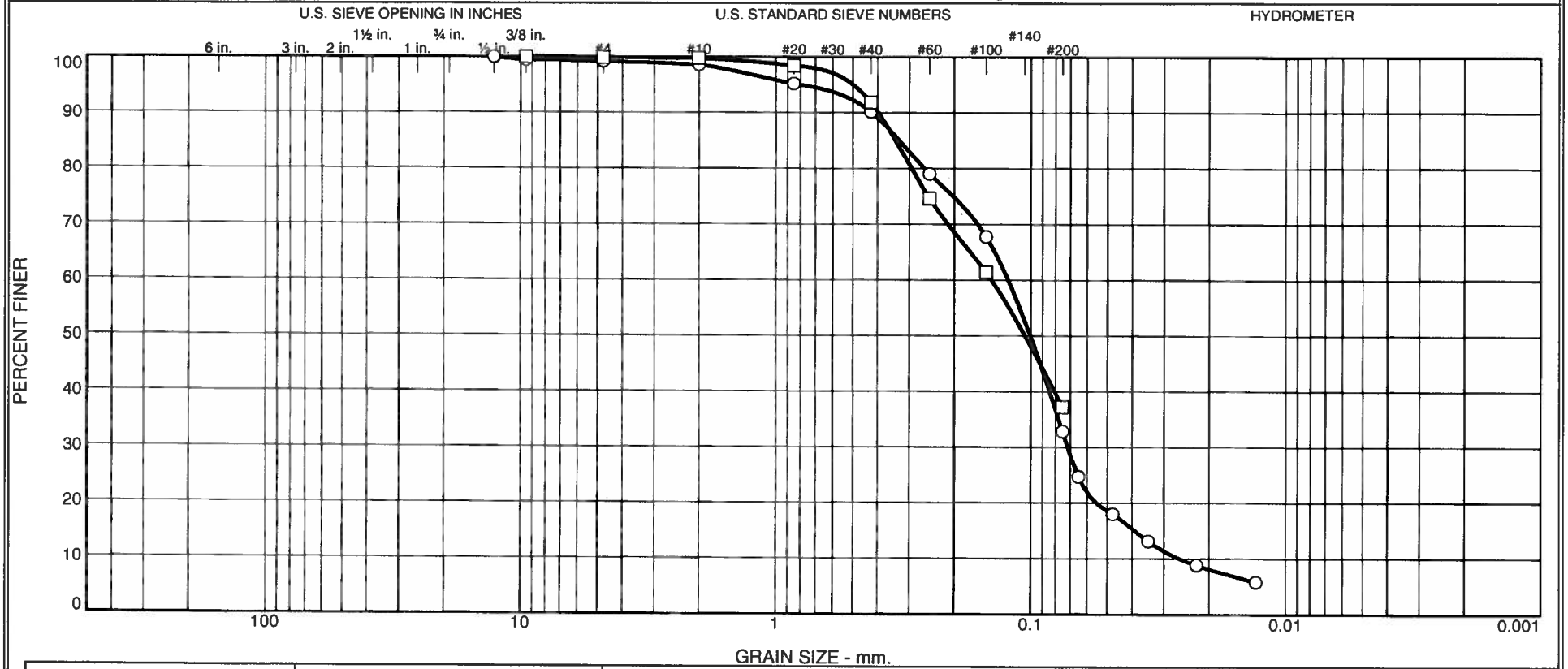
Project No. FL9001 Figure A24

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.8	0.6	8.4	57.4	32.8	
□	0.0	0.0	0.1	0.1	7.9	54.7	37.2	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-13	KC-11-1364	40.0-41.5	10/6/11	SM	Silty sand	27.3		
□	KCB-13	KC-11-1365	50.0-51.5	10/6/11	SM	Silty sand	24.9		

Client King County

Project County Line Levee Relocation

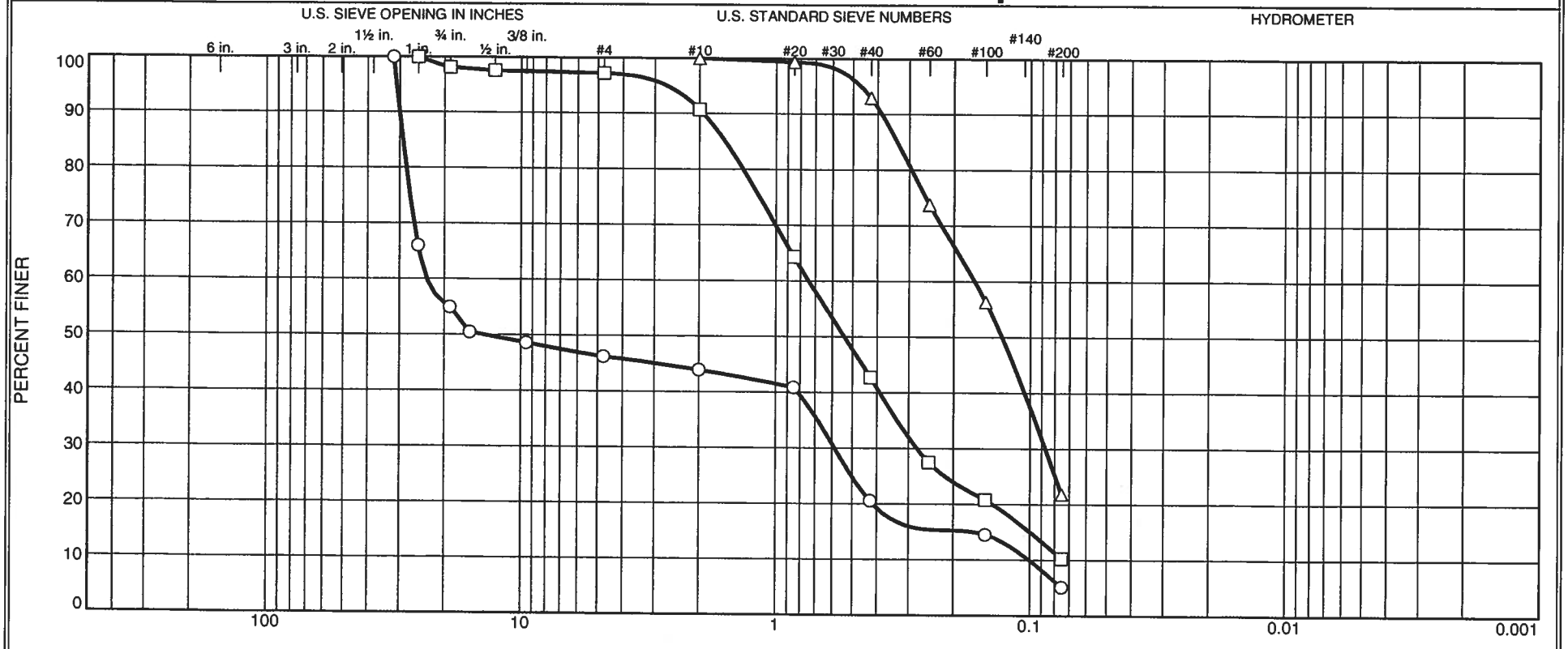
Project No. FL9001 Figure A25

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	45.1	8.7	2.3	23.3	15.5	5.1	
□	0.0	1.9	0.9	6.5	48.0	32.4	10.3	
△	0.0	0.0	0.0	0.0	7.1	71.1	21.8	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-14	KC-11-1366	15.0-16.5	10/6/11	GP-GM	Poorly graded gravel with silt and sand	12.1		
□	KCB-14	KC-11-1367	35.0-36.5	10/6/11	SP-SM	Poorly graded sand with silt	16.3		
△	KCB-14	KC-11-1368	50.0-51.5	10/6/11	SM	Silty sand	28.2		

Client King County

Project County Line Levee Relocation

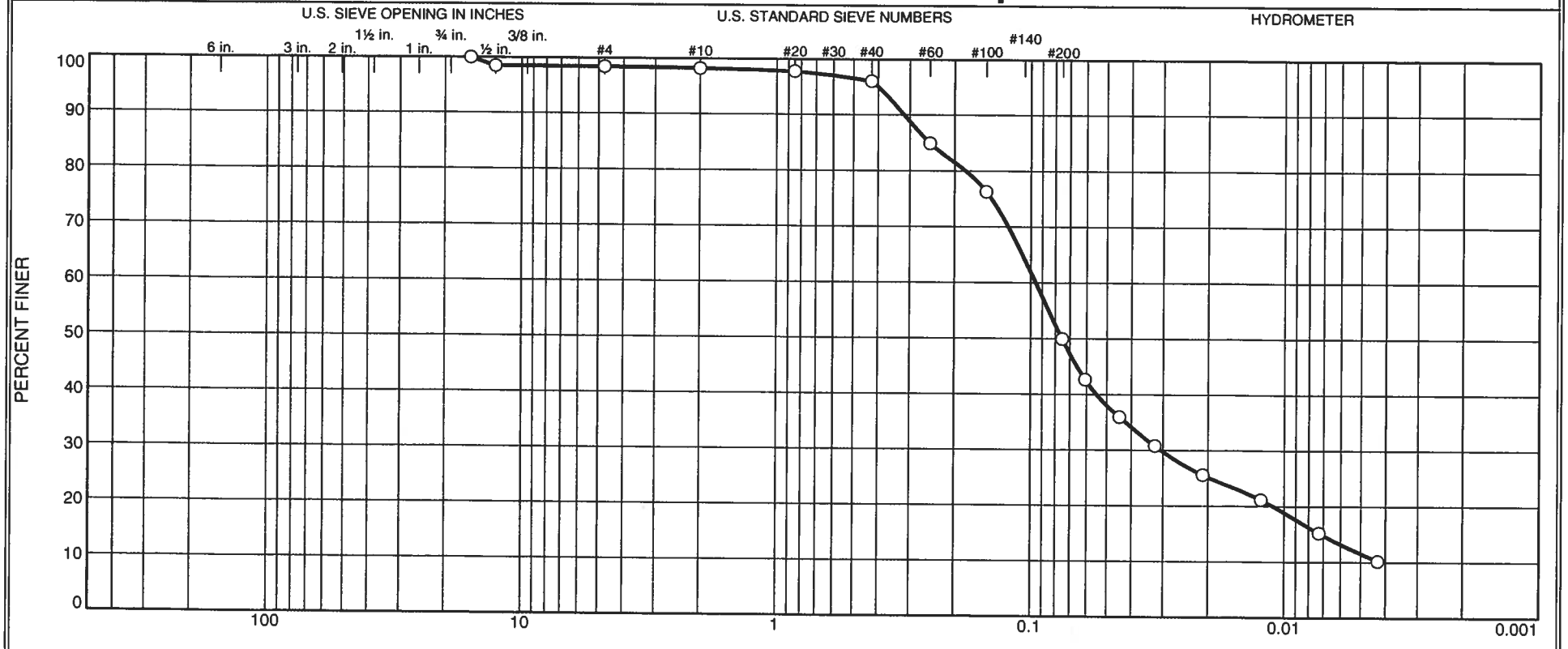
Project No. FL9001 Figure A26

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
O	0.0	0.0	1.6	0.2	2.1	46.2	38.3	11.6

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
O	KCB-14	KC-11-1369	70.0-71.5	10/6/11	SP	Sandy silt	36.5		NP

Client King County

Project County Line Levee Relocation

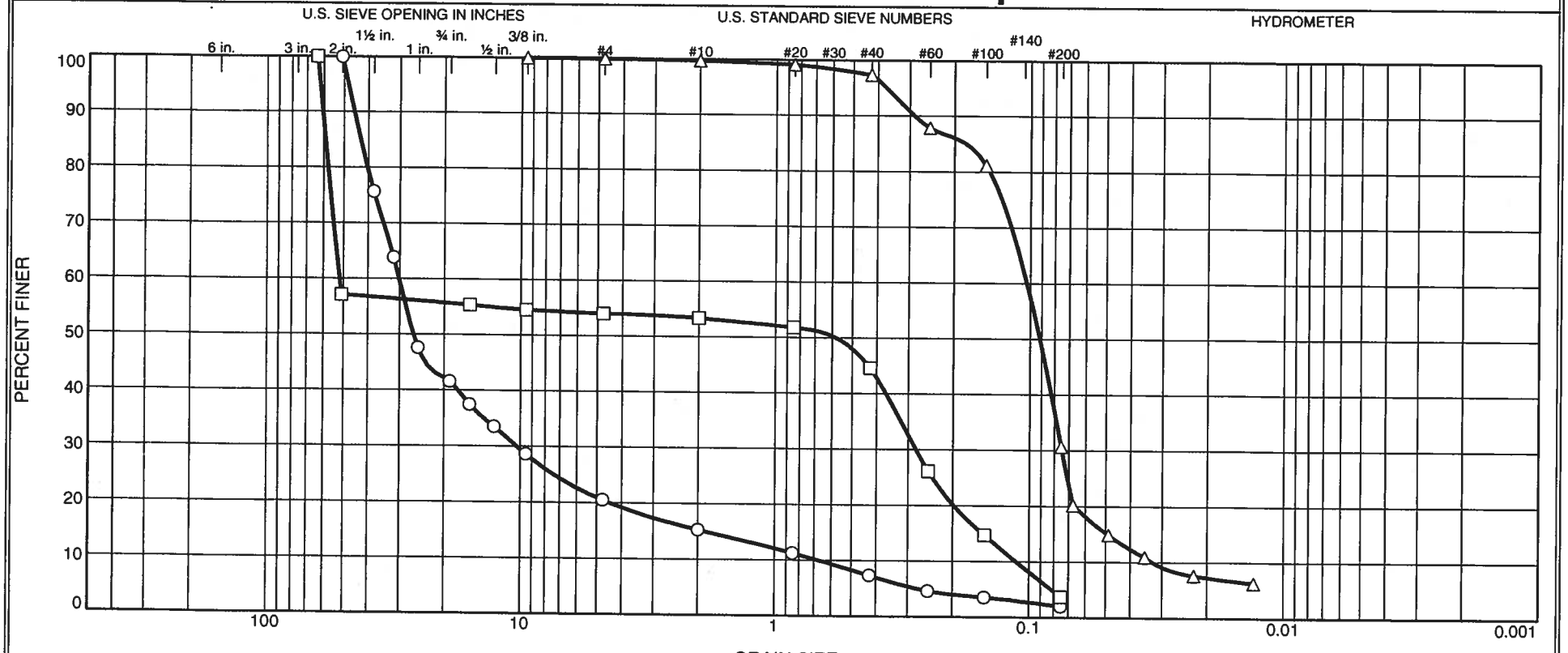
Project No. FL9001 Figure A27

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	58.4	21.1	5.2	7.9	5.4	2.0	
□	0.0	44.3	1.7	0.6	8.8	40.9	3.7	
△	0.0	0.0	0.1	0.2	2.3	66.7	30.7	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-15	KC-11-1370	10.0-11.5	10/6/11	GP	Poorly graded gravel with sand	8.9		
□	KCB-15	KC-11-1371	20.0-21.5	10/6/11	SP	Poorly graded sand with gravel	17.4		
△	KCB-15	KC-11-1372	30.0-31.5	10/6/11	SM	Silty sand	26.7		

Client King County

Project County Line Levee Relocation

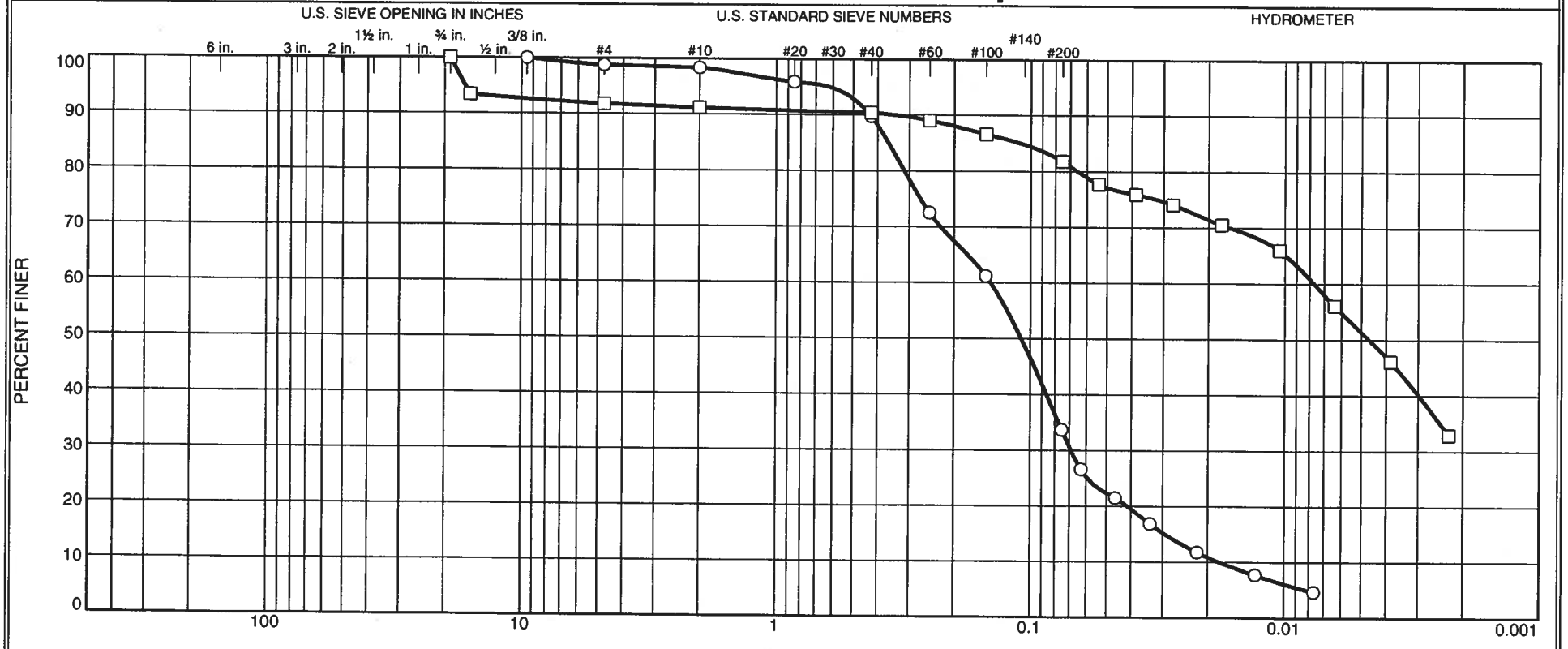
Project No. FL9001 Figure A28

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	1.2	0.4	8.6	56.1	33.7	
□	0.0	0.0	8.2	0.6	0.8	8.6	30.4	51.4

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-15	KC-11-1373	45.0-46.5	10/6/11	SM	Silty sand	26.6		
□	KCB-15	KC-11-1374	60.0-61.5	10/6/11	MH	Elastic silt with sand	76.8	59	42

Client King County

Project County Line Levee Relocation

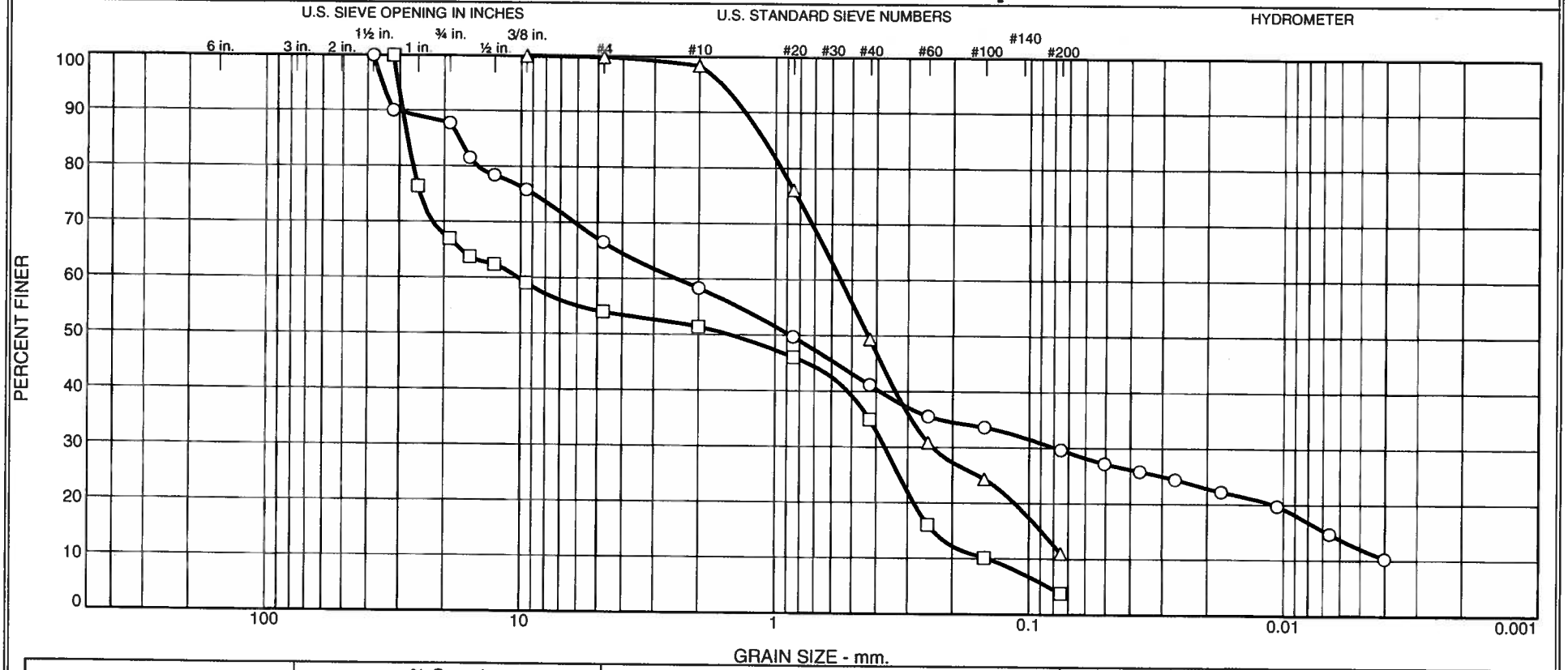
Project No. FL9001 Figure A29

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	12.2	21.3	8.1	17.2	11.6	17.5	12.1
□	0.0	33.1	12.9	2.6	16.5	31.1	3.8	
△	0.0	0.0	0.1	1.5	49.0	38.4	11.0	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-16	KC-11-1375	10.0-11.5	10/6/11	SM	Silty sand with gravel	26.2		
□	KCB-16	KC-11-1376	30.0-31.5	10/6/11	SP	Poorly graded sand with gravel	39.0		
△	KCB-16	KC-11-1377	45.0-46.5	10/6/11	SP-SM	Poorly graded sand with silt	19.2		

Client King County

Project County Line Levee Relocation

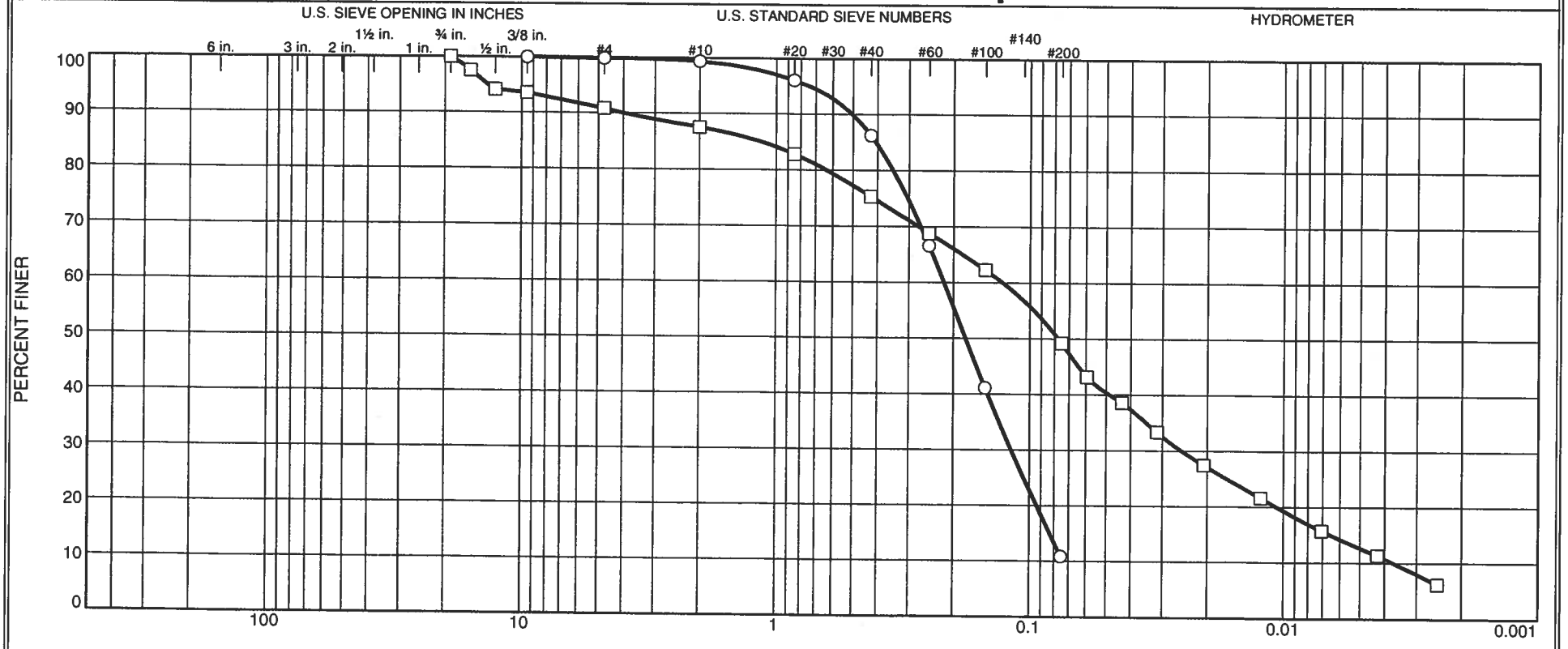
Project No. FL9001 Figure A30

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.1	0.5	13.1	75.5	10.8	
□	0.0	0.0	9.2	3.3	12.2	26.1	36.5	12.7

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	KCB-16	KC-11-1378	60.0-61.5	10/6/11	SP-SM	Poorly graded sand with silt	28.9		
□	KCB-16	KC-11-1379	75.0-76.5	10/6/11	SM	Silty sand	69.3	29	29

Client King County

Project County Line Levee Relocation

Project No. FL9001 Figure A31

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

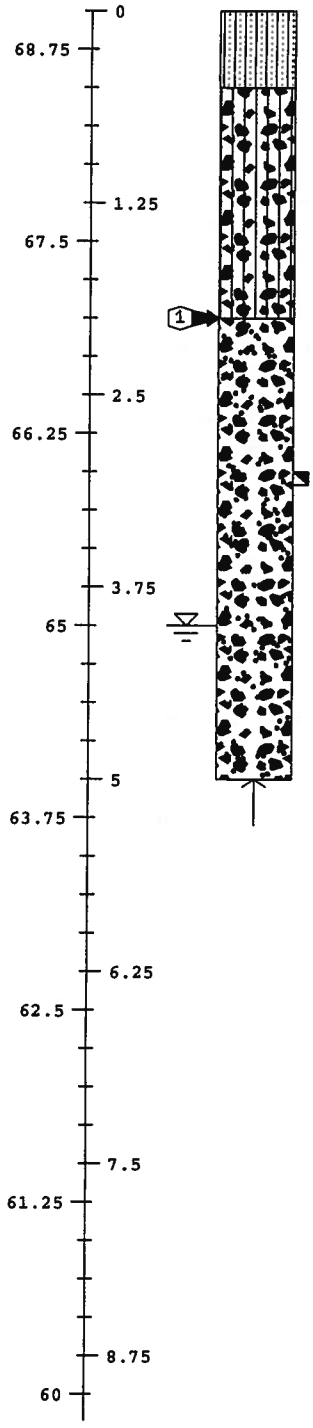
Appendix B

Test Pit Logs and Laboratory Data

TEST PIT LOG
TEST PIT KCTP-1

PROJECT: **Countyline Levee Relocation Project**
TEST PIT LOCATION: **See Location Map**
EXCAVATION METHOD: **Volvo EC140C Excavator**
OPERATOR: **King County Road Services Division**
DEPTH TO - Water: **4'** Caving: **2'**

DATE: **10/14/2011**
START: **N/A**
FINISH: **N/A**
LOGGER: **D. Walters**
DATE CHECKED: **10/14/2011**



ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Dark brown to black silty sand with gravel, scattered organics/roots, wet, loose. (topsoil)			
		GM	Brown silty gravel with occasional cobble, trace organics and roots, mottled, wet, loose to medium dense. (fill)			
		GW	Black to gray poorly graded gravel with sand, numerous cobbles, wet, medium dense to dense.	6.3	1.2	Cobble volume estimated at 20% with a maximum size of about 8 inches in diameter.

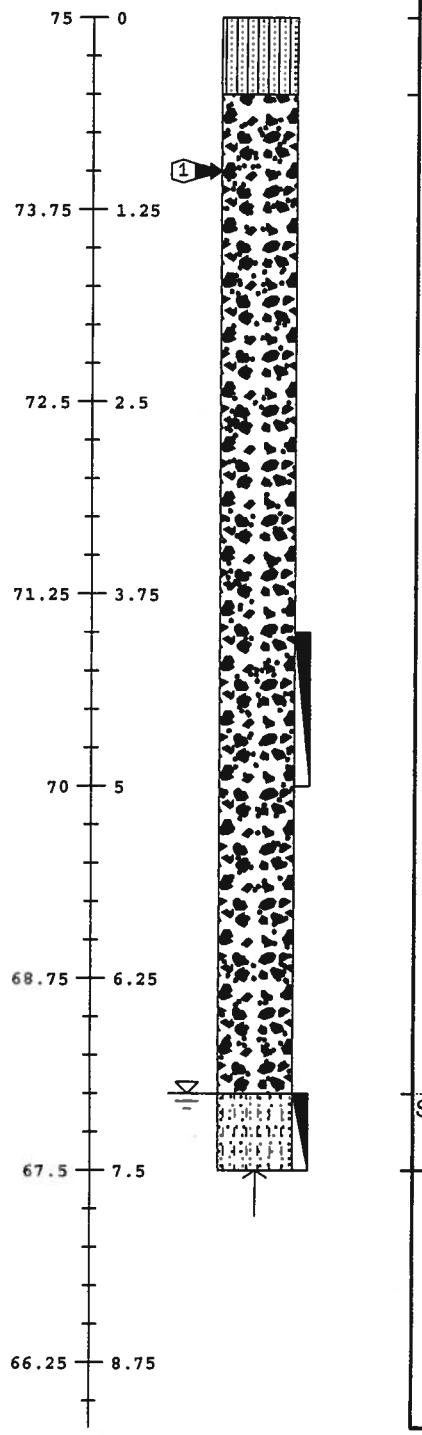
Groundwater was encountered at 4 feet below the ground surface. Test pit sidewalls caved at approximately 2 feet below the ground surface.

PLATE NUMBER **B1**

TEST PIT LOG
TEST PIT KCTP-2

PROJECT: **Countyline Levee Relocation Project**
TEST PIT LOCATION: **See Location Map**
EXCAVATION METHOD: **Volvo EC140C Excavator**
OPERATOR: **King County Road Services Division**
DEPTH TO - Water: **7'** Caving: **1'**

DATE: **10/14/2011**
START: **N/A**
FINISH: **N/A**
LOGGER: **D. Walters**
DATE CHECKED: **10/14/2011**



ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Dark brown to black silty sand with gravel, scattered organics/roots, wet, loose. (topsoil)			
		GW	Black to gray poorly graded gravel with sand, minor constituent cobble, moist to wet, medium dense to dense. (fill)			Cobble volume estimated at 40% with a maximum size of about 6 inches in diameter.
				2.9	1.5	
		SP-SM	Black poorly graded fine sand with silt and gravel, wet, medium dense.	20.1	5.9	

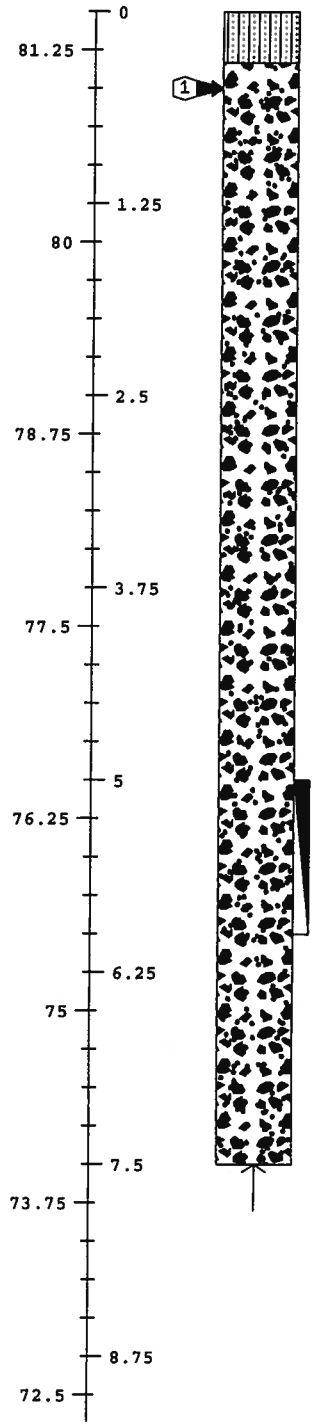
Groundwater was encountered at 7 feet below the ground surface. Test pit sidewalls caved at approximately 1 foot below the ground surface.

PLATE NUMBER **B2**

TEST PIT LOG
TEST PIT KCTP-3

PROJECT: **Countyline Levee Relocation Project**
TEST PIT LOCATION: **See Location Map**
EXCAVATION METHOD: **Volvo EC140C Excavator**
OPERATOR: **King County Road Services Division**
DEPTH TO - Water: **N/A** Caving: **0.5'**

DATE: **10/14/2011**
START: **N/A**
FINISH: **N/A**
LOGGER: **D. Walters**
DATE CHECKED: **10/14/2011**



ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Dark brown to black silty sand with gravel, scattered organics/roots, wet, loose. (topsoil)			
		GW	Black to gray well graded gravel with sand, minor constiuent cobble, dry to moist, medium dense to dense. (fill)			Cobble volume estimated at 40% with a maximum size of about 8 inches in diameter.
				2.3	0.8	

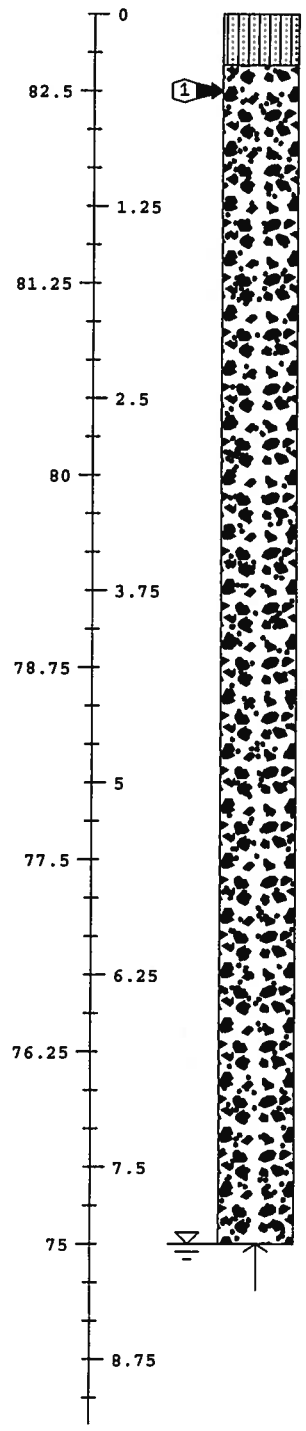
No groundwater was encountered during excavation. Test pit sidewalls caved at approximately 0.5 foot below the ground surface.

PLATE NUMBER **B3**

TEST PIT LOG
TEST PIT KCTP-4

PROJECT: **Countyline Levee Relocation Project**
TEST PIT LOCATION: **See Location Map**
EXCAVATION METHOD: **Volvo EC140C Excavator**
OPERATOR: **King County Road Services Division**
DEPTH TO - Water: **8'** Caving: **0.5'**

DATE: **10/14/2011**
START: **N/A**
FINISH: **N/A**
LOGGER: **D. Walters**
DATE CHECKED: **10/14/2011**



ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Dark brown to black silty sand with gravel, scattered organics/roots, wet, loose. (topsoil)			Cobble volume estimated at 10% to 20% from 0.5 to 4 feet bgs, and 20 to 30 percent below 4 feet. The maximum size was about 8 inches in diameter.
		GW	Black to gray well graded gravel with sand, numerous cobbles, moist to wet, medium dense to dense. (fill)	3.7	2.6	

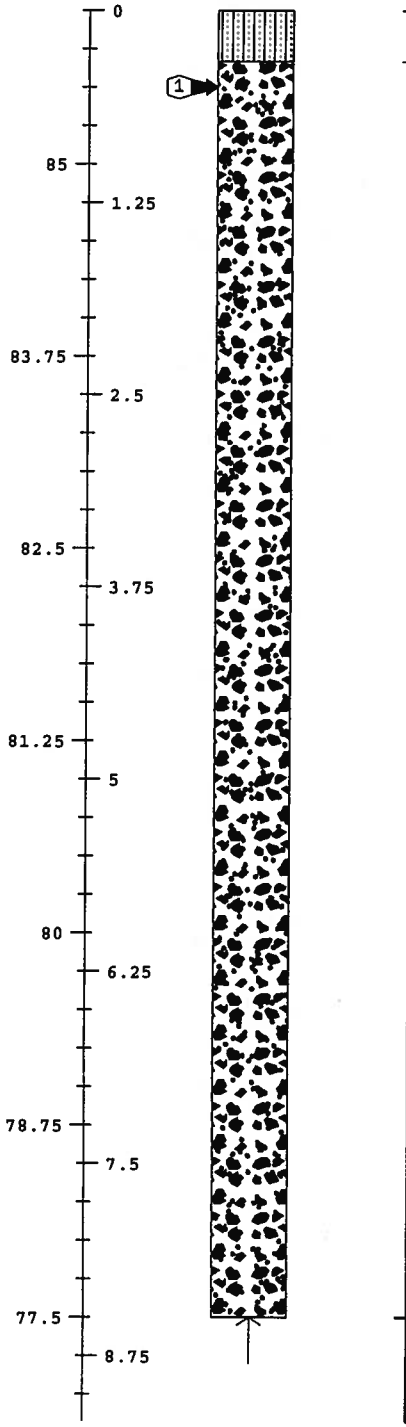
Groundwater was encountered at 8 feet below the ground surface. Test pit sidewalls caved at approximately 0.5 foot below the ground surface.

PLATE NUMBER **B4**

TEST PIT LOG
TEST PIT KCTP-5

PROJECT: **Countyline Levee Relocation Project**
TEST PIT LOCATION: **See Location Map**
EXCAVATION METHOD: **Volvo EC140C Excavator**
OPERATOR: **King County Road Services Division**
DEPTH TO - Water: **N/A** Caving: **0.5'**

DATE: **10/14/2011**
START: **N/A**
FINISH: **N/A**
LOGGER: **D. Walters**
DATE CHECKED: **10/14/2011**



ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Dark brown to black silty sand with gravel, scattered organics/roots, wet, loose. (topsoil)			
		GW	Black to gray poorly graded gravel with sand, numerous cobble, dry to moist, medium dense to dense. (fill)			Cobble volume estimated at 10% to depth of 4 feet and 20% below four feet. The maximum cobble size was about 10 inches in diameter.
				2.8	1.0	

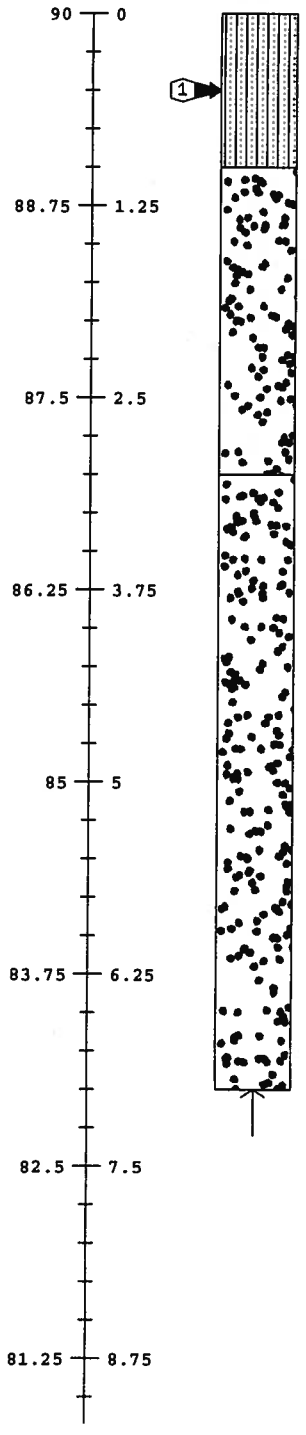
No groundwater was encountered during excavation. Test pit sidewalls caved at approximately 1 foot below the ground surface.

PLATE NUMBER **B5**

TEST PIT LOG
TEST PIT KCTP-6

PROJECT: **Countyline Levee Relocation Project**
TEST PIT LOCATION: **See Location Map**
EXCAVATION METHOD: **Volvo EC140C Excavator**
OPERATOR: **King County Road Services Division**
DEPTH TO - Water: **N/A** Caving: **0.5'**

DATE: **10/14/2011**
START: **N/A**
FINISH: **N/A**
LOGGER: **D. Walters**
DATE CHECKED: **10/14/2011**



ELEVATION/ DEPTH	SOIL SYMBOLS SAMPLER SYMBOLS AND FIELD TEST DATA	USCS	Description	Moist (%)	-200 (%)	Remarks
		SM	Dark brown to black silty sand with gravel, scattered organics/roots, wet, loose. (topsoil)			
		GP	Black to gray poorly graded gravel with sand, scattered cobble, ocassional boulder, dry to moist, medium dense to dense. (fill)			Cobble volume estimated at 10% to depth of 3 feet and 20% below 3 feet. The maximum cobble size was about 8 inches in diameter though an 18 inch diameter boulder was encountered at 2 feet below the ground surface.
		GP	Gray poorly graded gravel with sand, numerous cobble, dry, medium dense to dense. (fill)	3.2	1.4	

No groundwater was encountered during excavation. Test pit sidewalls caved at approximately 1 foot below the ground surface.

PLATE NUMBER **B6**

KEY TO SYMBOLS

Symbol Description

Strata symbols

Silty sand

Silty gravel

Well graded gravel

Poorly graded sand with silt

Poorly graded gravel

Misc. Symbols

Water table during drilling

Depth to caving

Drill rejection

Soil Samplers

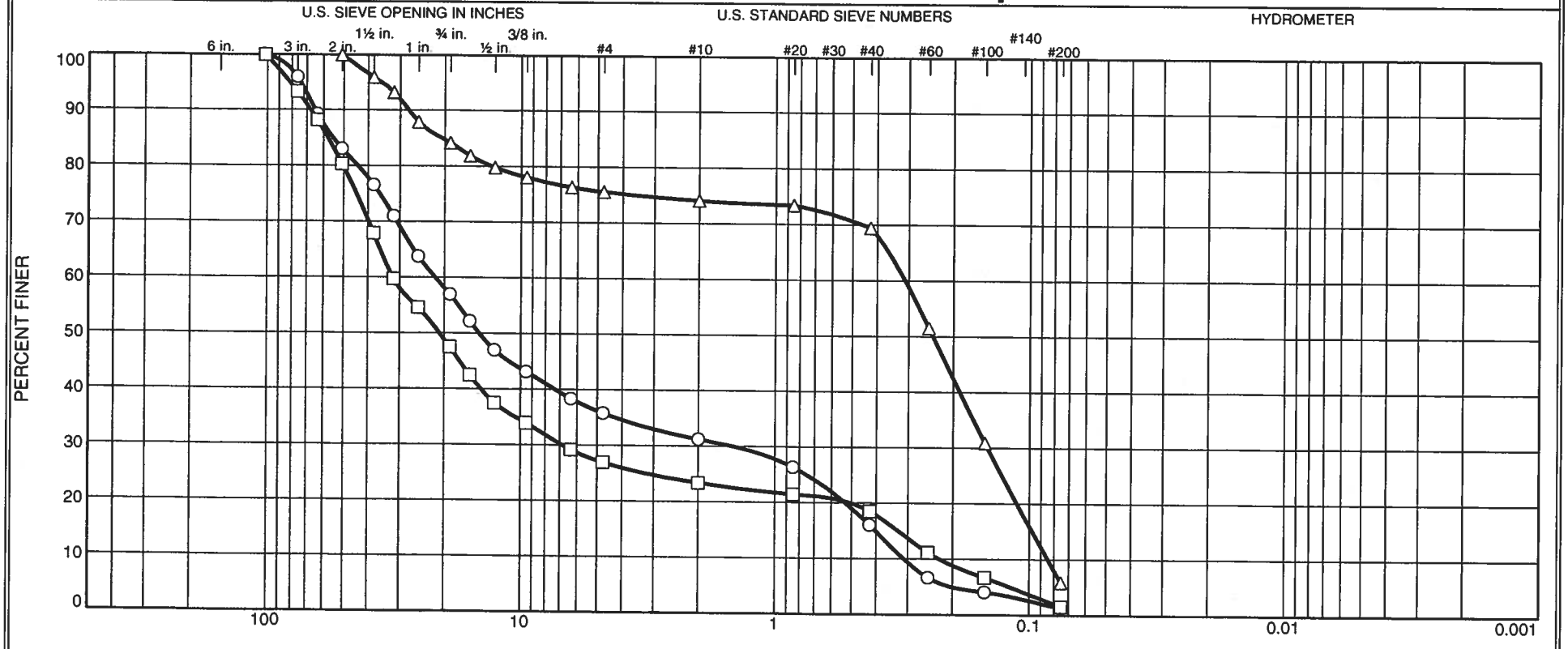
Bulk/Grab sample

Notes:

1. Six test pits were excavated on October 14, 2011 with a Volvo EC140C Excavator with a 3-foot wide digging bucket.

2. These logs are subject to the limitations, conclusions, and recommendations in this report.

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	4.0	39.0	21.2	4.6	15.1	14.9	1.2	
□	6.7	45.8	20.5	3.6	4.9	17.0	1.5	
△	0.0	15.8	8.7	1.4	4.7	63.5	5.9	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	TP-1	KC-11-1494	3 - 4	10/17/11	GP	Poorly graded gravel with sand	6.3		
□	TP-2	KC-11-1495	4 - 5	10/17/11	GP	Poorly graded gravel with sand	2.9		
△	TP-2	KC-11-1496	7 - 8	10/17/11	SP-SM	Poorly graded sand with silt and gravel	20.1		

Client King County

Project County Line Levee Relocation

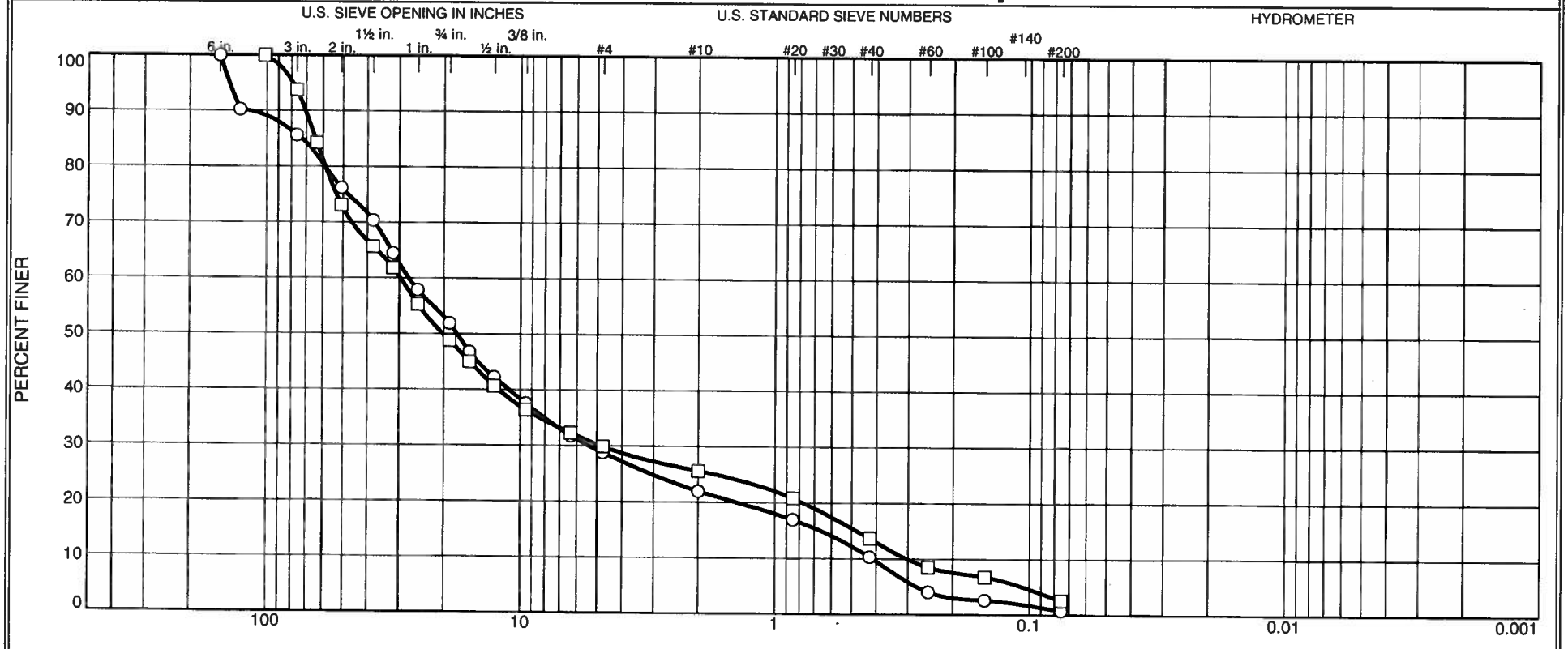
Project No. FL9001 Figure B1

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	14.3	33.8	23.1	6.8	11.6	9.6	0.8	
□	6.2	45.0	18.9	4.3	11.9	11.1	2.6	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	TP-3	KC-11-1497	5 - 6	10/17/11	GW	Well-graded gravel with sand and cobbles	2.3		
□	TP-4	KC-11-1498	3 -4	10/17/11	GW	Well-graded gravel with sand	3.7		

Client King County

Project County Line Levee Relocation

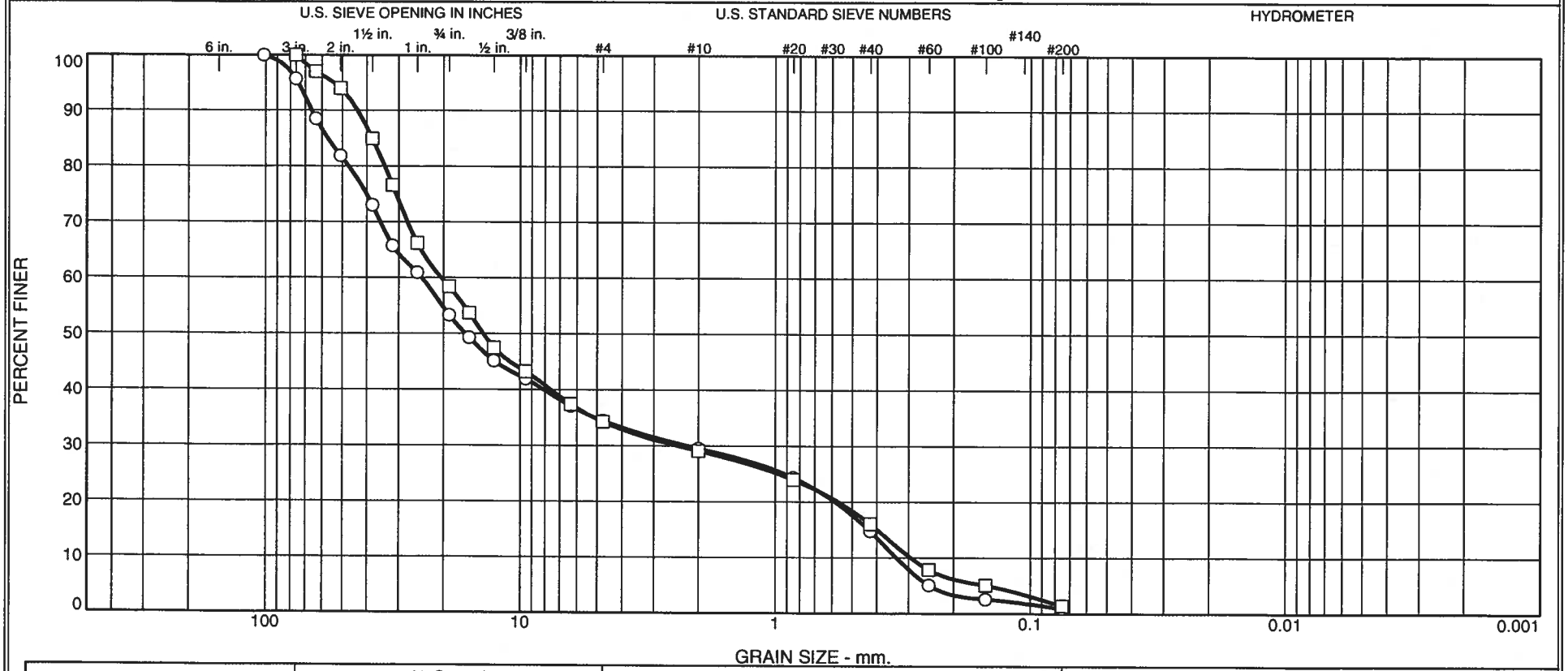
Project No. FL9001 Figure B2

KING COUNTY

MATERIALS LABORATORY

Tested By: vw

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	4.3	42.4	18.8	5.0	14.7	13.8	1.0	
□	0.0	41.6	24.1	5.2	13.0	14.7	1.4	

	Source	Sample #	Depth/Elev.	Date Sampled	USCS	Material Description	NM %	LL	PL
○	TP-5	KC-11-1499	7 - 8	10/17/11	GP	Poorly graded gravel with sand	2.8		
□	TP-6	KC-11-1500	6 - 7	10/17/11	GP	Poorly graded gravel with sand	3.2		

Client King County

Project County Line Levee Relocation

Project No. FL9001 Figure B3

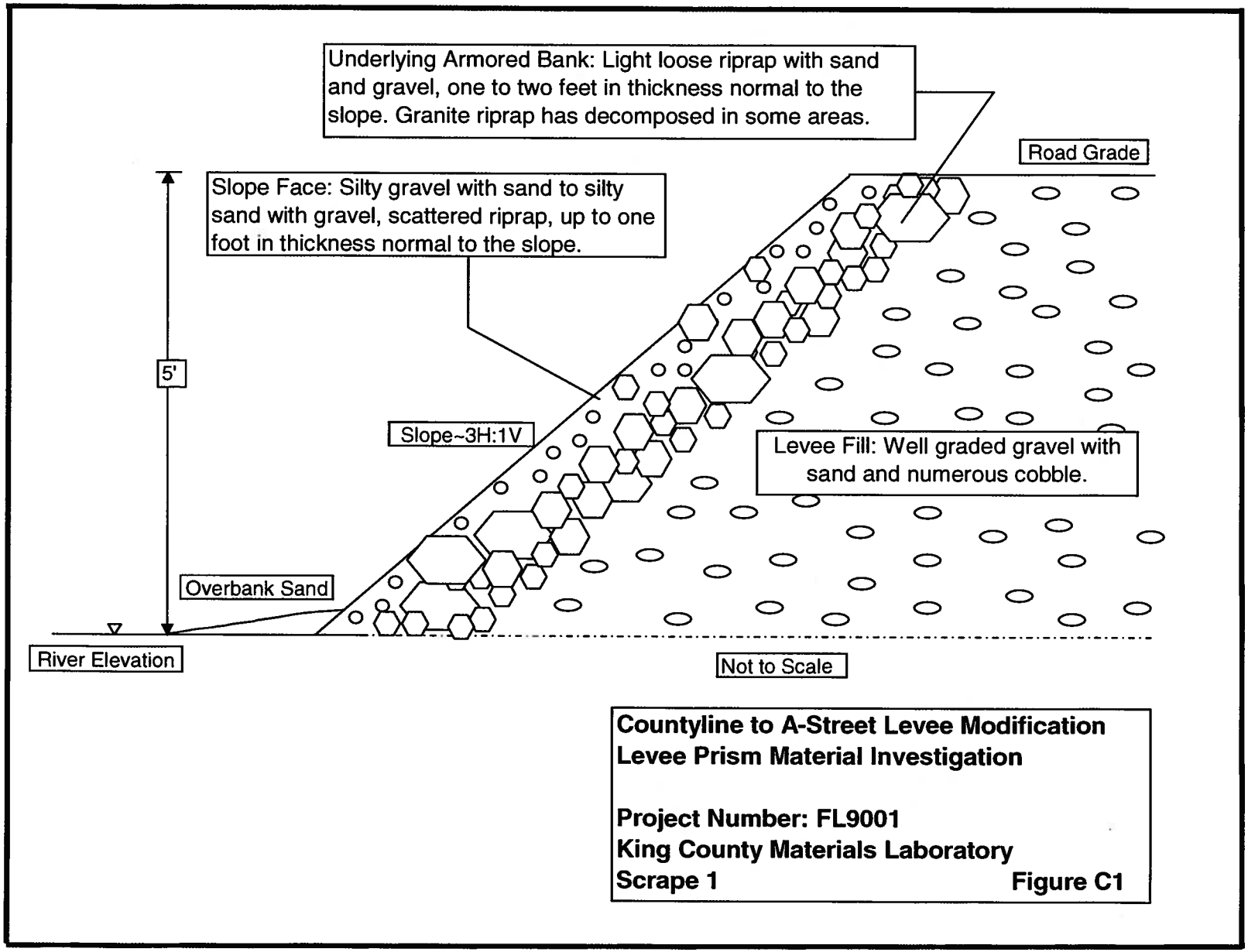
KING COUNTY

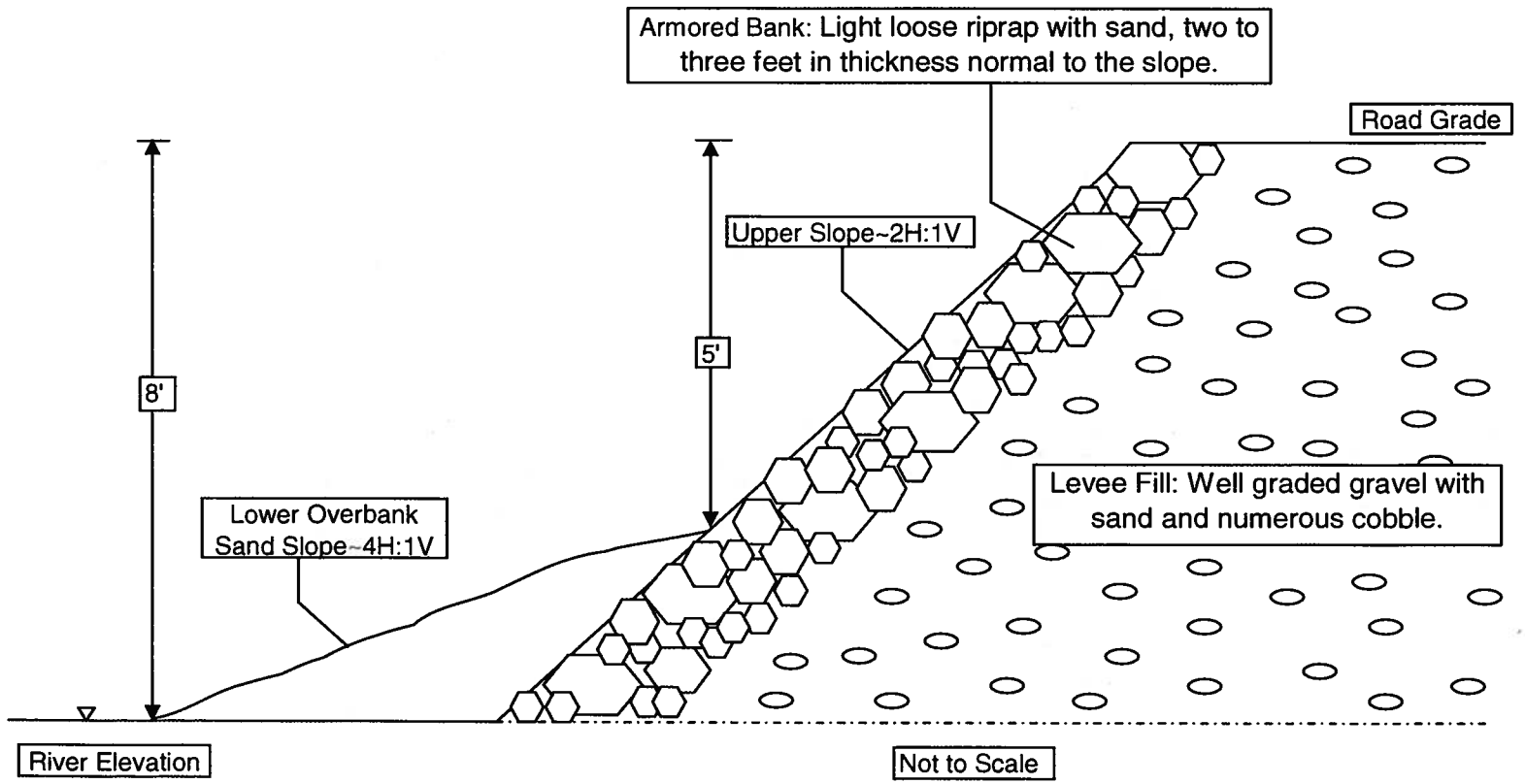
MATERIALS LABORATORY

Tested By: vw

Appendix C

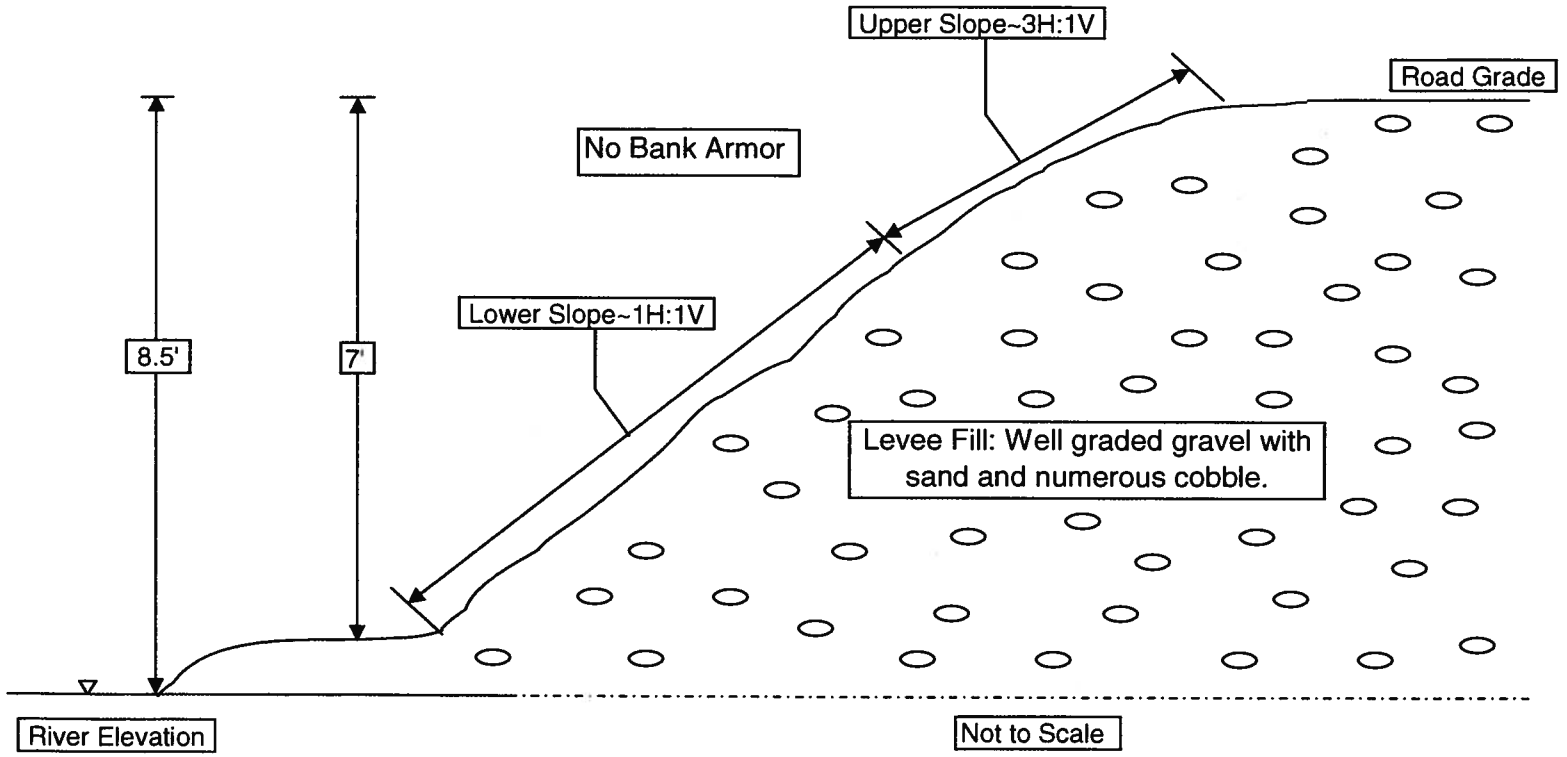
Scrapes


Underlying Armored Bank: Light loose riprap with sand and gravel, one to two feet in thickness normal to the slope. Granite riprap has decomposed in some areas.
Road Grade
Slope Face: Silty gravel with sand to silty sand with gravel, scattered riprap, up to one foot in thickness normal to the slope.
5'
Slope~3H:1V
Levee Fill: Well graded gravel with sand and numerous cobble.
Overbank Sand
River Elevation
Not to Scale
Countyline to A-Street Levee Modification
Levee Prism Material Investigation
Project Number: FL9001
King County Materials Laboratory
Scrape 1
Figure C1



Countyline to A-Street Levee Modification
Levee Prism Material Investigation

Project Number: FL9001
King County Materials Laboratory
Scrape 2 **Figure C2**



Countyline to A-Street Levee Modification
Levee Prism Material Investigation

Project Number: FL9001
King County Materials Laboratory
Scrape 3 **Figure C3**

Appendix D

Hydraulic Conductivity Testing

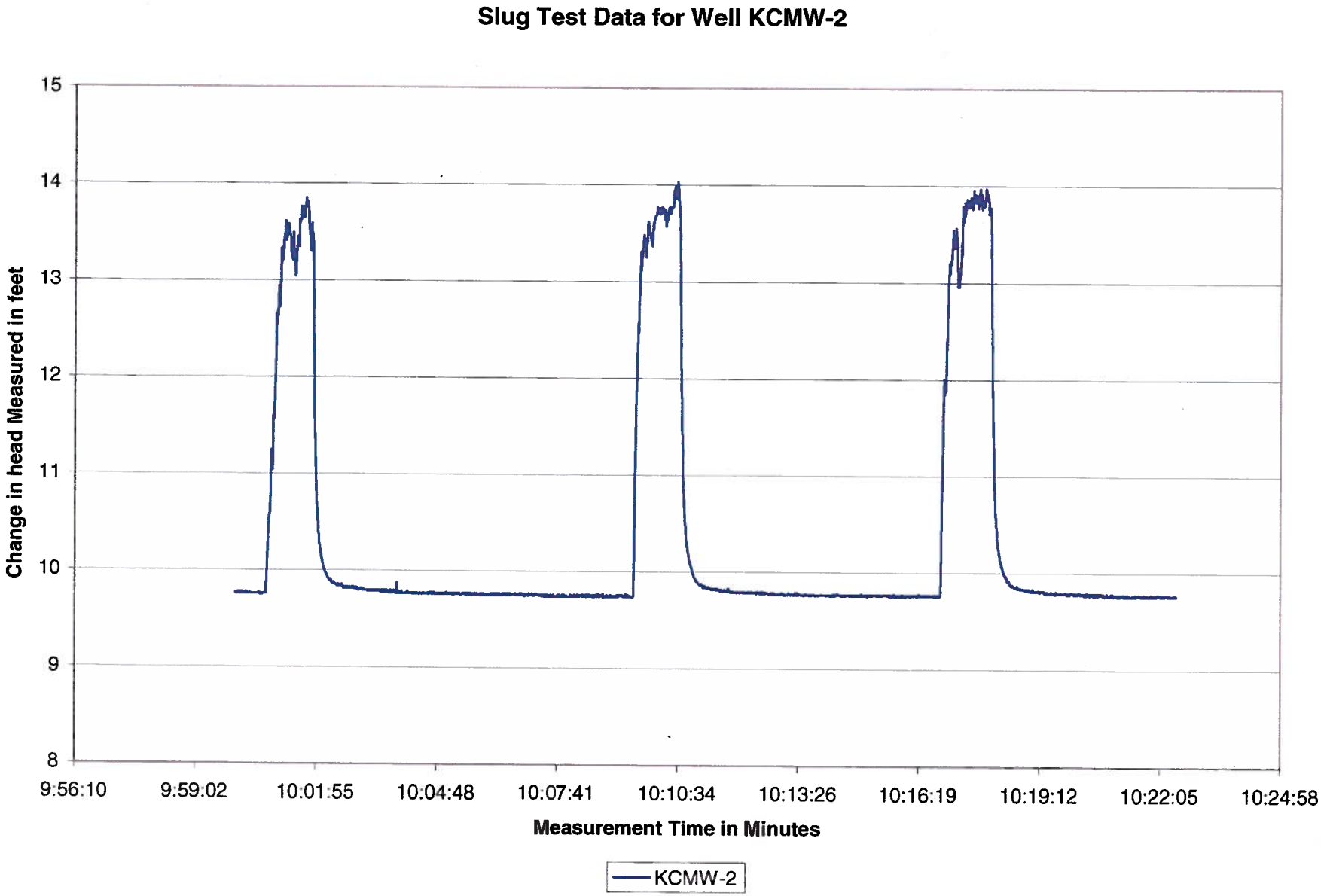

Slug Test Data for Well KCMW-2
Change in head Measured in feet
15
14
13
12
11
10
9
8
9:56:10
9:59:02
10:01:55
10:04:48
10:07:41
10:10:34
10:13:26
10:16:19
10:19:12
10:22:05
10:24:58
Measurement Time in Minutes
KCMW-2

FIGURE D1

Slug Test of Well KCMW-4

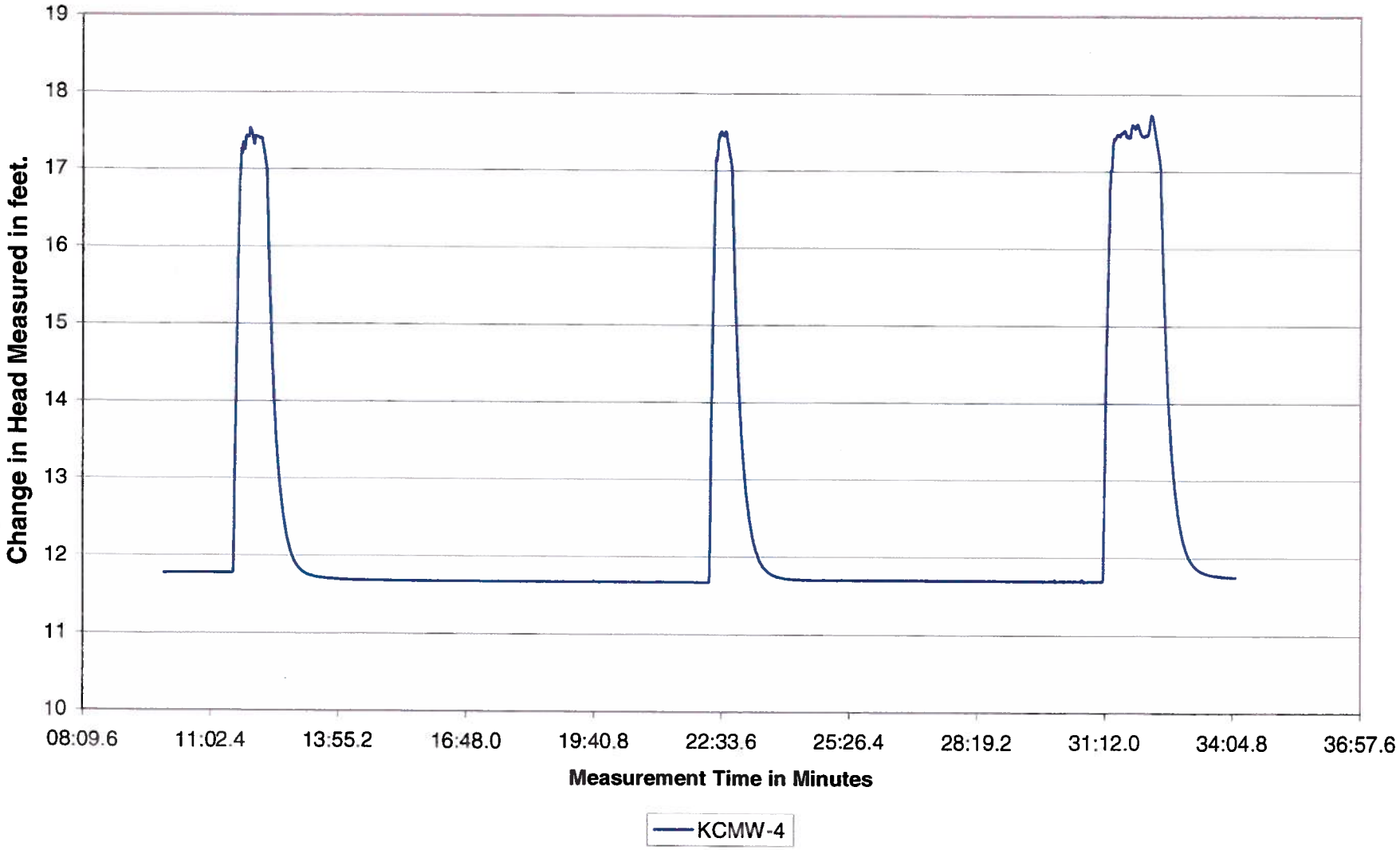


FIGURE D2

County Line Levee Slug Test 1 at KCMW-2

Local ID: S-1292
Date: 11/4/2010
Time: 10:01

INPUT

Construction:

Casing dia. (d_c)	2 Inch
Annulus dia. (d_w)	6 Inch
Screen Length (L)	10 Feet

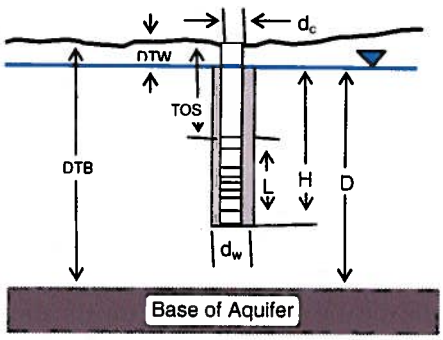
Depths to:

water level (DTW)	2 Feet
top of screen (TOS)	20 Feet
Base of Aquifer (DTB)	75 Feet

Annular Fill:

across screen -- Medium Sand
above screen -- Bentonite

Aquifer Material -- Medium Sand



COMPUTED

L_{wetted}	10 Feet
D =	73 Feet
H =	28 Feet
L/r_w =	40.00
$y_{0\text{-DISPLACEMENT}}$ =	1.95 Feet
$y_{0\text{-SLUG}}$ =	2.14 Feet

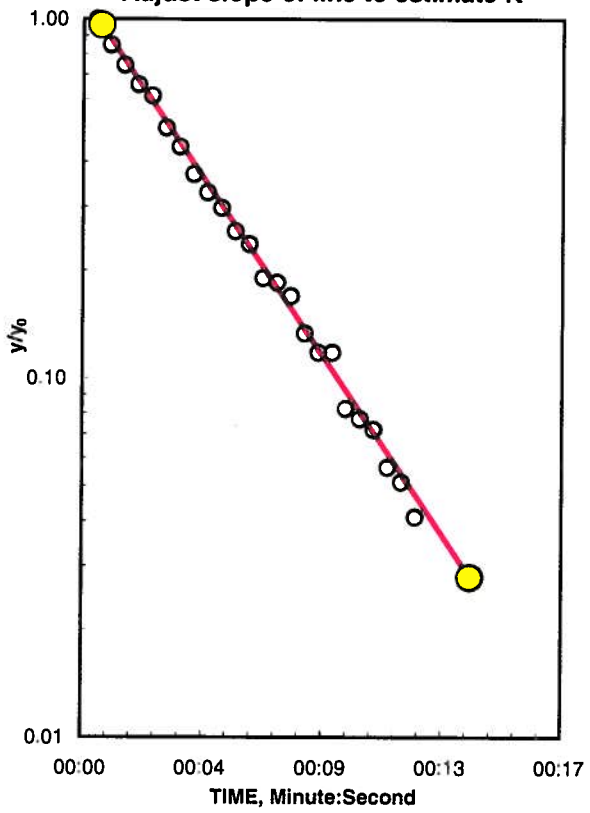
From look-up table using L/r_w

Partial penetrate A =	2.840
B =	0.460
ln(Re/rw) =	2.749
Re =	3.91 Feet
Slope =	0.115366 $\log_{10}$/sec
$t_{90\%}$ recovery =	9 sec

Input is consistent.

K = 22 Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

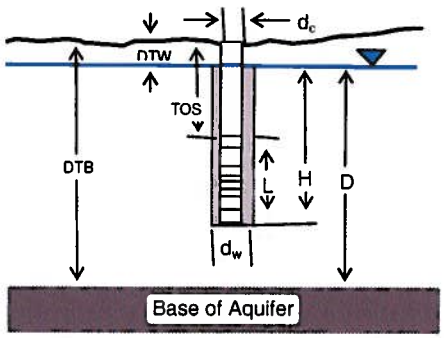
County Line Levee Project. Test 1 at KCMW-2. Test date November 4, 2010 between 10:00 AM and 10:30 AM.

County Line Levee Slug Test 2 at KCMW-2

Local ID: S-1292
Date: 11/4/2010
Time: 10:10

INPUT

Construction:	
Casing dia. (d_c)	2 Inch
Annulus dia. (d_w)	6 Inch
Screen Length (L)	10 Feet
Depths to:	
water level (DTW)	2 Feet
top of screen (TOS)	20 Feet
Base of Aquifer (DTB)	75 Feet
Annular Fill:	
across screen --	Medium Sand
above screen --	Bentonite
Aquifer Material --	Medium Sand

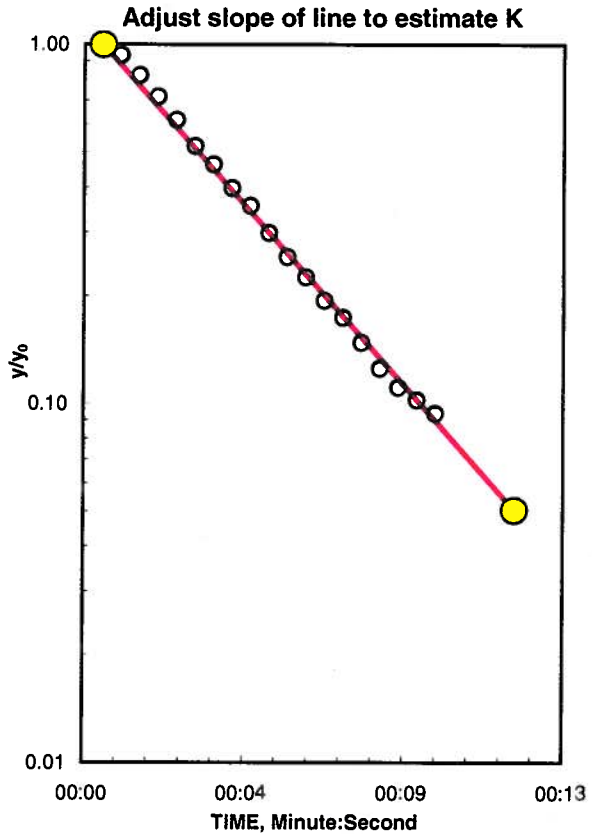


COMPUTED

L_{wetted}	10 Feet
D =	73 Feet
H =	28 Feet
L/r_w =	40.00
$y_{0\text{-DISPLACEMENT}}$ =	3.52 Feet
$y_{0\text{-SLUG}}$ =	3.49 Feet
From look-up table using L/r_w	
Partial penetrate A =	2.840
B =	0.460
ln(Re/rw) =	2.749
Re =	3.91 Feet
Slope =	0.116549 $\log_{10}$/sec
$t_{90\%}$ recovery =	9 sec

Input is consistent.

K = 22 Feet/Day



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

County Line Levee Project. Test 2 at KCMW-2. Test date Novermber 4, 2010 10:00 to 10:30 AM.

Figure D4

County Line Levee Slug Test 3 at KCMW-2

Local ID: S-1292
Date: 11/4/2010
Time: 10:18

INPUT

Construction:

Casing dia. (d_c)	2 Inch
Annulus dia. (d_w)	6 Inch
Screen Length (L)	10 Feet

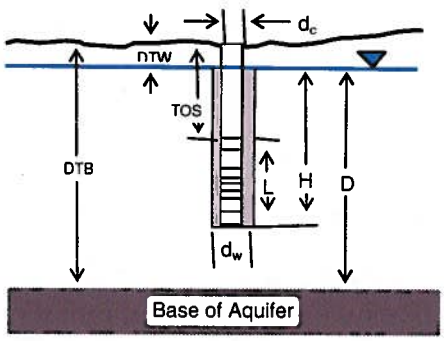
Depths to:

water level (DTW)	2 Feet
top of screen (TOS)	20 Feet
Base of Aquifer (DTB)	75 Feet

Annular Fill:

across screen -- Medium Sand
above screen -- Bentonite

Aquifer Material -- Medium Sand



COMPUTED

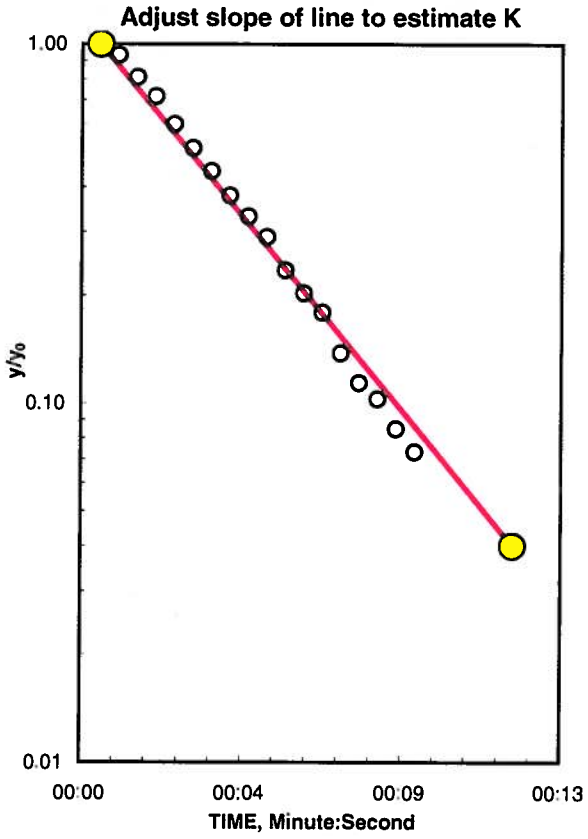
L_{wetted}	10 Feet
D =	73 Feet
H =	28 Feet
L/r_w =	40.00
$y_{0\text{-DISPLACEMENT}}$ =	3.41 Feet
$y_{0\text{-SLUG}}$ =	3.37 Feet

From look-up table using L/r_w

Partial penetrate A =	2.840
B =	0.460
ln(Re/rw) =	2.749
Re =	3.91 Feet
Slope =	0.125334 $\log_{10}$/sec
$t_{90\%}$ recovery =	8 sec

Input is consistent.

K = 24 Feet/Day



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

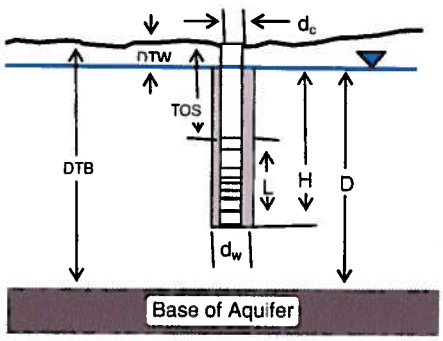
County Line Levee Project. Test 3 at KCMW-2. Test date Novermber 4, 2010 10:00 to 10:30 AM.

County Line Levee Slug Test 1 at KCMW-4

Local ID: S-1292
Date: 11/4/2010
Time: 11:12

INPUT

Construction:	
Casing dia. (d_c)	2 Inch
Annulus dia. (d_w)	6 Inch
Screen Length (L)	20 Feet
Depths to:	
water level (DTW)	2 Feet
top of screen (TOS)	10 Feet
Base of Aquifer (DTB)	60 Feet
Annular Fill:	
across screen --	Fine Sand
above screen --	Bentonite
Aquifer Material --	Fine Sand



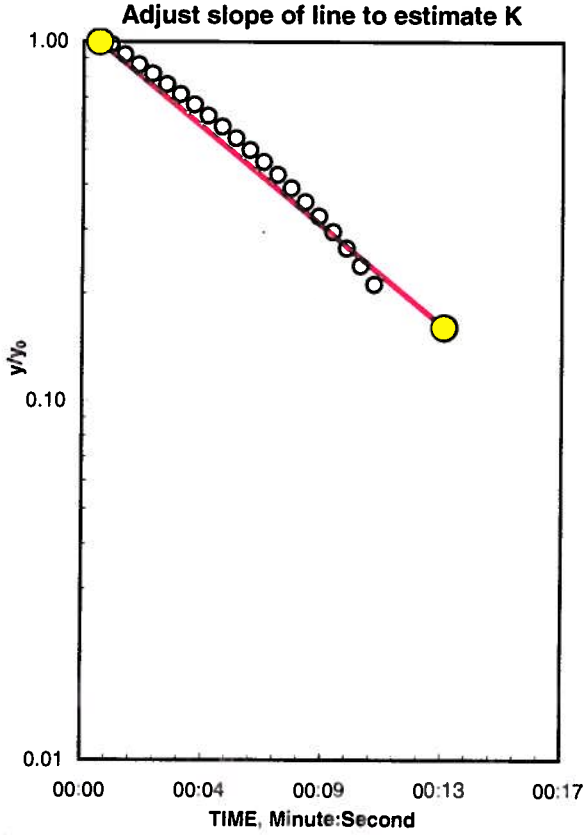
COMPUTED

L_{wetted}	20 Feet
D =	58 Feet
H =	28 Feet
L/r_w =	80.00
$y_{0\text{-DISPLACEMENT}}$ =	3.70 Feet
$y_{0\text{-SLUG}}$ =	4.11 Feet
From look-up table using L/r_w	
Partial penetrate A =	3.980
B =	0.658
ln(Re/rw) =	3.103
Re =	5.57 Feet
Slope =	0.063935 $\log_{10}$/sec
$t_{90\%}$ recovery =	16 sec

Input is consistent.

K = 6.8 Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

County Line Levee Project. Test 1 atl KCMW-4. Test date November 4, 2010 between 11:00 AM and 11:45 AM

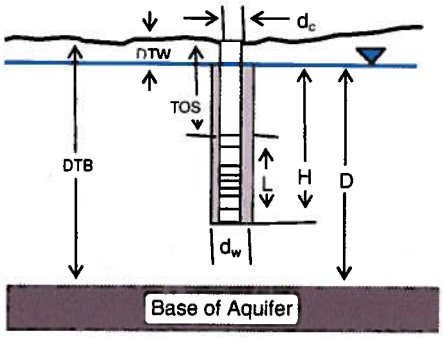
Figure D6

County Line Levee Slug Test 2 at KCMW-4

Local ID: S-1292
Date: 11/4/2010
Time: 11:22

INPUT

Construction:	
Casing dia. (d_c)	2 Inch
Annulus dia. (d_w)	6 Inch
Screen Length (L)	20 Feet
Depths to:	
water level (DTW)	2 Feet
top of screen (TOS)	10 Feet
Base of Aquifer (DTB)	60 Feet
Annular Fill:	
across screen --	Fine Sand
above screen --	Bentonite
Aquifer Material --	Fine Sand



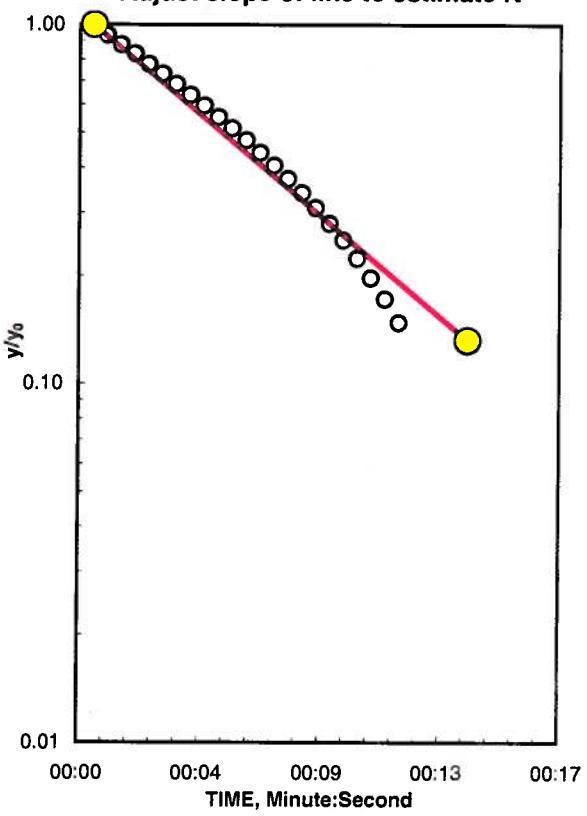
COMPUTED

L_{wetted}	20 Feet
D =	58 Feet
H =	28 Feet
L/r_w =	80.00
$y_{0\text{-DISPLACEMENT}}$ =	3.63 Feet
$y_{0\text{-SLUG}}$ =	4.11 Feet
From look-up table using L/r_w	
Partial penetrate A =	3.980
B =	0.658
ln(Re/rw) =	3.103
Re =	5.57 Feet
Slope =	0.06529 $\log_{10}$/sec
$t_{90\%}$ recovery =	15 sec

Input is consistent.

K = 7 Feet/Day

Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

County Line Levee Project. Test 2 at KCMW-4. Test date November 4, 2010 Between 11:00 AM and 11:45 AM

Figure D7

County Line Levee Slug Test 3 at KCMW-4

Local ID: S-1292
Date: 11/4/2010
Time: 11:32

INPUT

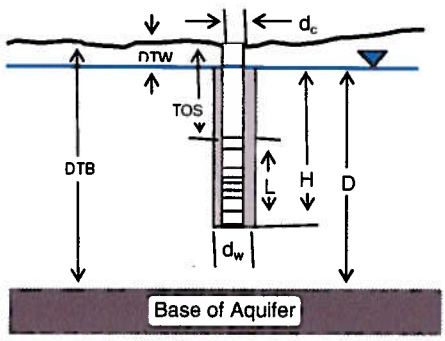
Construction:	
Casing dia. (d_c)	2 Inch
Annulus dia. (d_w)	6 Inch
Screen Length (L)	20 Feet
Depths to:	
water level (DTW)	2 Feet
top of screen (TOS)	10 Feet
Base of Aquifer (DTB)	60 Feet
Annular Fill:	
across screen --	Fine Sand
above screen --	Bentonite
Aquifer Material --	Fine Sand

COMPUTED

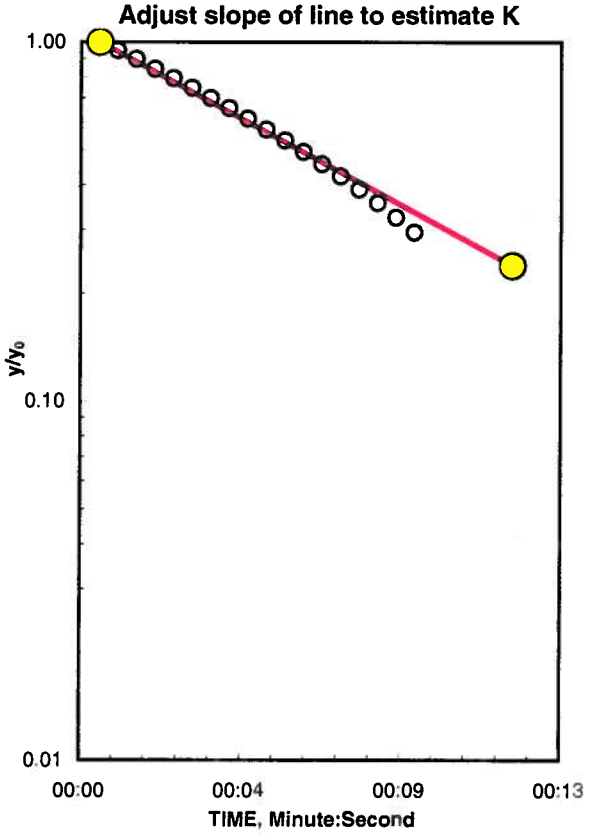
L_{wetted}	20 Feet
D =	58 Feet
H =	28 Feet
L/r_w =	80.00
$y_{0\text{-DISPLACEMENT}}$ =	3.40 Feet
$y_{0\text{-SLUG}}$ =	4.11 Feet
From look-up table using L/r_w	
Partial penetrate A =	3.980
B =	0.658
ln(Re/rw) =	3.103
Re =	5.57 Feet
Slope =	0.055896 $\log_{10}$/sec
$t_{90\%}$ recovery =	18 sec

Input is consistent.

K = 6 Feet/Day



Adjust slope of line to estimate K



REMARKS:

Bouwer and Rice analysis of slug test, WRR 1976

County Line Levee Project. Test 2 at KCMW-4. Test date November 4, 2010 Between 11:00 AM and 11:45 AM

Figure D8

Common Rock Properties

Aquifer Material	Extreme Kmin, ft/d	Likely Kmin, ft/d	Likely Kmax, ft/d	Extreme Kmax, ft/d	Rock Type	Ref
Gravel	90	300	3000	3000	Unconsolidated Sedimentary Rock	1,5
Sand and Gravel Mixes	1	30	300	300	Unconsolidated Sedimentary Rock	1
Coarse Sand	50	70	300	300	Unconsolidated Sedimentary Rock	1
Medium Sand	1	20	70	200	Unconsolidated Sedimentary Rock	1,5
Fine Sand	0.05	3	20	20	Unconsolidated Sedimentary Rock	1,5
Gulf Coast Aquifer Systems (6603 values)	2	30	200	800	Unconsolidated Sedimentary Rock	2
Stream Terrace Deposit, Fort Worth, Texas (59 values)	0.01	1	100	300	Unconsolidated Sedimentary Rock	3
Surficial Aquifer, central Florida (fine sand and silt, 55 values)	0.01	0.1	30	50	Unconsolidated Sedimentary Rock	4
Silt, Loess	0.0003	0.001	0.1	6	Unconsolidated Sedimentary Rock	5
Till	3E-07	0.003	0.3	0.6	Unconsolidated Sedimentary Rock	1,5
Clay soils (surface)	0.01	0.01	1	1	Unconsolidated Sedimentary Rock	1
Clay	0.000001	0.00001	0.0001	0.001	Unconsolidated Sedimentary Rock	5,7
Unweathered Marine Clay	2E-07	2E-07	0.0006	0.0006	Carbonate Rocks	5
Karst	0.3	10	1000	10000	Carbonate Rocks	4,5,8
Reef Limestone	0.3	10	1000	6000	Carbonate Rocks	5
Limestone, Dolomite	0.0003	0.004	0.1	2	Carbonate Rocks	5
Fine-Grained Sandstone	0.0001	0.001	1	6	Indurated Sedimentary Rock	1,6
Medium-Grained Sandstone	0.001	1	10	80	Indurated Sedimentary Rock	6,9
Siltstone	0.000001	0.00001	0.005	0.04	Indurated Sedimentary Rock	6
Claystone	3E-09	0.000001	0.00001	0.00003	Indurated Sedimentary Rock	6,7,10
Anhydrite	1E-07	1E-07	0.006	0.006	Indurated Sedimentary Rock	5
Shale	1E-08	1E-07	0.0001	1	Metamorphic or Volcanic Rock	7
Permeable Basalt	0.1	1	100	6000	Metamorphic or Volcanic Rock	5
Fractured Igneous and Metamorphic Rock	0.001	0.05	10	100	Metamorphic or Volcanic Rock	1
Weathered Granite	0.1	1	10	20	Metamorphic or Volcanic Rock	6
Weathered Gabbro	0.1	0.1	1	1	Metamorphic or Volcanic Rock	6
Basalt	0	0.03	0.1	0.1	Metamorphic or Volcanic Rock	5
Unfractured Igneous and Metamorphic Rock	0	9E-09	0.00006	0.00006	Metamorphic or Volcanic Rock	1,5

1 Bouwer, 1978 (order of magnitude in meter/day)
2 Prudic, 1991
3 Sonia A. Jones, USGS, Written commun., 1998
4 Slug Test Results1998-2001, Orlando Subdistrict, USGS
5 Domenico and Schwartz, 1990
6 Morris and Johnson, 1967
7 Wolff, 1982
8 Reese and Cunningham, 2000
9 Kuniansky and Hamrick, 1998
10 Neuzil, 1994

FIGURE D9