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Memorandum

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Subject	**Pine Creek Reservoir – Borrow Source Investigation Findings**
Project Name	Feasibility, Data Analysis, and Environmental Review for the Walla Walla Basin Integrated Flow Enhancement Study
Attention	Chris Hyland, Walla Walla Watershed Management Partnership (WWWMP)
From	Greg Warren, Jacobs Engineering Group, Inc. (Jacobs)
Date	July 2, 2019
Copies to	Brian Wolcott, Walla Walla Basin Watershed Council (WWBWC)

Introduction and Background

A preliminary borrow source investigation was conducted to assess the availability of clay or other suitable materials to use as clay core in the proposed Pine Creek Dam. Jacobs identified potential borrow sources during literature review, discussed potential clay sources with local irrigators, and visited the sites on April 17th to evaluate access and buried utilities. The findings of the literature review and initial site reconnaissance are summarized in the technical memorandum *Initial Field Reconnaissance for Limited Fault Slip Investigation and Borrow Source Identification* (May 6, 2019).

The preliminary borrow source investigation included excavating test pits with a backhoe and examining clean exposures, such as road cuts or creek banks, of soils to identify soil properties. Laboratory testing was conducted to confirm the field classifications of soils. The preliminary borrow source investigation focused on sources within a few miles north, northwest, and south of the proposed dam site.

Test Pit Findings

The test pits were excavated using two rubber-tired backhoes owned and operated by Mike Ingham and Tim Deruwe. Jacobs' geologist logged the test pits and described the soils according to ASTM D-2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedure). Soil grab samples were collected from the test pits and road cut exposures for laboratory analyses, including gradation analyses of soil particles coarser than No. 200 sieve (sand-silt boundary) and Atterberg Limits to evaluate plasticity. The samples were transported to Materials Testing and Inspection in Kennewick, Washington, an Oregon-certified laboratory, for testing.

The geologist prepared test pit logs that describe depth, lithology, presence of groundwater, excavation stability, and other relevant information. Upon completion, the test pits were backfilled to-grade with excavated materials. Table 1 provides a summary of the test pit information. Attachment A shows the as-built locations of soil exposures and test pits. Attachment B contains draft field copies of the test pit logs. Attachment C contains the complete laboratory testing results. Attachment D includes a photo log that shows test pits, subsurface exposures, and other identified features.

Test pit TP-PC-1, and the Milton Freewater Landfill (MF-LF-1) exposure were located along Seven Hills Road, approximately 2 miles northwest of the site. Soils observed in these exposures consisted of silty sand to sandy silt lacustrine flood deposits (Photograph 1). The exposure in the MF Landfill was approximately 35 feet high and consisted of water-deposited layered silts with sandy lenses. Numerous vertically-oriented, 1-inch-wide seams of clean sand, known as clastic dikes, were observed throughout this exposure

(Photograph 2). Silver and Pogue (2002) interpreted these features to be the result of seismically-induced lateral spreading.

The soils in PC-TP-1 consist of an upper layer of uncemented silt with sand, and a lower layer of weakly-cemented silt with sand (Photograph 3). The lower layer was slightly plastic, with a Liquid Limit of 28 and a Plasticity Index of 5. Test pit logs from previous studies of the Milton-Freewater settling ponds (Anderson-Perry, 2002) indicated a layer of silt overlying gravel with sand and silt. The gravel layer ranged in depths from 2 to 11 feet but these gravels were below the water table and thus would be difficult to use. In 2005 the United States Army Corps of Engineers excavated just west of the area where TP-PC-1 is located found only non-plastic silt.

Test pits PC-TP-2 and PC-TP-3 were located in the Pine Creek floodplain, approximately 4.5 to 5 miles northwest of the site. The subsurface stratigraphy in these test pits consisted primarily of sandy silt with very low plasticity (Photographs 4 and 5), with a shallow ash layer. The soils in these test pits are derived from the surrounding glacial flood deposits and have been alluvially-transported and redeposited. Seepage from the test pit walls was observed at depths between about 3 and 6 feet below ground surface. A weakly-cemented hardpan layer was observed from 2 to 2.5 feet in depth in PC-TP-2 that appears to be cemented ash; the landowner (Tim Deruwe) noted that this layer was prevalent on his property and appeared to result in shallow perched water.

A dark green-gray silt/clay layer was found in the lower depths of test pit PC-TP-3, with a Liquid Limit of 41 and a Plasticity Index of 13 (Photograph 6). This is the most “plastic” material found during the investigation. Because this material is situated below the water table, potentially costly measures (for example, drainage, dewatering, and double-handling of material [excavating with large excavators and using dump trucks to spread in thin layers to dry out first before placement in embankment]) may be necessary to use the material.

Two vertical- to near-vertical exposures approximately 25 to 30 feet in height were examined, one along Pine Creek (Cut Bank) approximately 5 miles northwest of the site, and one along Locher Road (RC-1), approximately 7.5 miles northeast of the site. Both exposures provided excellent views of the Missoula flood deposits. The soils in the exposures consisted primarily of multiple layers of silt with sandy lenses (Photograph 7). Many roadcuts and creek exposures in the vicinity are stable at very steep angles, which indicates that these soils have cohesive strength and thus possibly contain clay. Samples were collected to confirm their properties. A composite sample was collected from Road Cut 1 (RC-1). This sample classified as a non-plastic, sandy silt, with 65 percent passing the No. 200 sieve. The originally-horizontal sediment layers exposed in this Road Cut were dipping to the north and also displayed a dazzling array of soft-sediment deformation (Photograph 8). These features can occur while the sediments are still saturated and are rapidly loaded with additional sediments or ice blocks during the glacial floods or they could result from seismic events that occurred while the sediments were still saturated.

The plateau surface south of the site is covered by an “older Loess deposit” (Walker, 1973). This unit is mapped as a windblown layer of silt up to 50 feet thick (Walker, 1973) and noted as having potential clay lenses. Several outcrops of this material were examined. A sample was collected from a 15-foot-high exposure along York Road (YR-1), approximately 9 miles southeast of the site (Photograph 9). Test results indicate this soil consists of non-plastic sandy silt. Several exposures of this soil were observed, and these observations indicated that this formation is widespread and is very uniform in texture.

The Plasticity Chart (Figure 1) shows where the layers plot based on the results of the Atterberg Limit tests. The samples all plot as silt (ML), which indicates generally non-plastic to low plasticity material. Note that only four of the nine samples had enough plasticity to even plot on the chart; the remainder were non-plastic. The horizontal dashed line at a Plasticity Index (PI) of 15 shows the minimum desired PI for material to construct a clay core.

In addition to the test pits and roadcuts logged in detail and samples, additional area-wide exposures were briefly examined to confirm the material types in various geologic deposits and geomorphic surfaces. Correlating the material types in specific geologic units precluded the need to collect a large quantity of samples and excavate many test pits.

Table 1. Pine Creek Test Pit Soil Sample Summary

Test Pit	Sample Depth (feet)	Soil Classification (USCS)	Percent Passing No. 200[a]	Moisture Content (%)	Liquid Limit	Plasticity Index[b]
PC-TP-1	1 to 8	Silt with Sand (ML)	79.8	11.8	NP	NP
PC-TP-1	10 to 12	Silty Sand with Clay (SM-SC)	35.5	13.6	28	5
PC-TP-2	1 to 4	Sandy Silt (ML)	65.4	48.7	NP	NP
PC-TP-2	5 to 8	Sandy Silt (ML)	79.4	35.7	32	6
PC-TP-3	2.5 to 5	Sandy Silt (ML)	71.3	35.0	30	1
PC-TP-3	9 to 11	Sandy Silt (ML)	63.8	41.5	41	13
MF-LF CELL 5	Composite	Sandy Silt (ML) to Silty Sand (SM)	56.4	3.9	NP	NP
YR-1	Composite	Sandy Silt (ML)	62.9	15.1	NP	NP
RC-1	Composite	Sandy Silt (ML)	65.0	7.7	NP	NP

Notes:

[a] No. 200 Sieve is the sand/silt boundary (0.075 millimeter).

[b] Minimum of 15 percent is recommended for a plastic-cored dam.

NP = Non-plastic (granular)

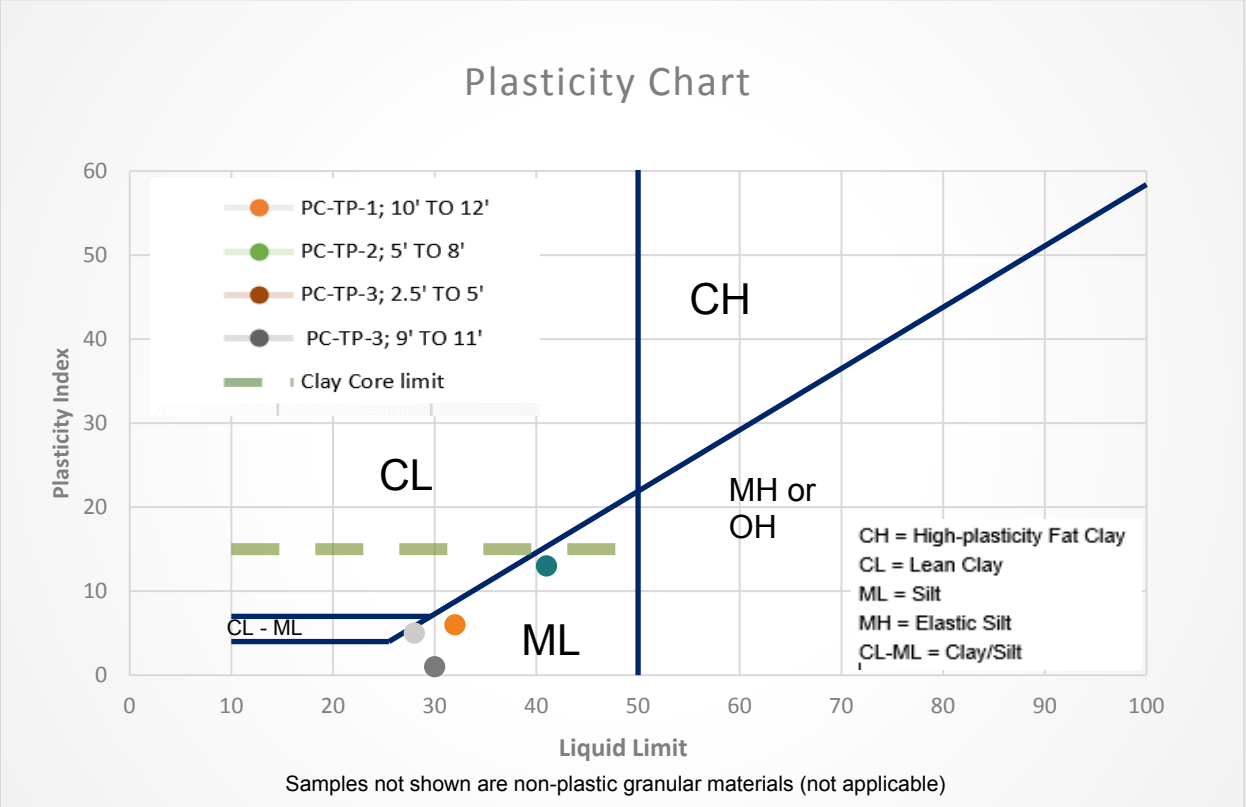


Figure 1. Plasticity Chart with Pine Creek samples plotted.

Summary

To evaluate the presence of suitable materials to construct an appropriately-designed, seismically-resistant, clay-cored dam, Jacobs conducted a limited borrow source investigation. The investigation consisted of excavating three test pits, and examining natural and manmade exposures of soils that could possibly be used as construction materials. The initial investigation was limited to within a few miles of the proposed Pine Creek reservoir site.

Based on the findings of this limited borrow source investigation, the soils in the vicinity of the proposed dam site consist primarily of non-plastic to very-low plasticity sandy silt, silt with sand, or silty sand. These materials are anticipated to be highly erodible and do not possess the required plasticity for construction of a clay-cored dam. A layer of iron-mottled, gray-green clay that demonstrated low plasticity was found in the bottom extent of Test Pit. However, because of this soil sample's high liquid limit and a plasticity index of 13 (lower than the desired plasticity index of 15), this material classified as silt. In addition, this layer was found in the floodplain below the shallow water table and is interpreted to be a localized layer deposited along a low-gradient creek channel.

An expanded search for suitable clay materials could be conducted to evaluate if more distant sources of suitable core material could be economically used. For example, the Ringold formation is mapped approximately 30 miles away and consists of interlayered sand, silt, and clay, and also gravelly conglomerate. Investigations into this potential resource could indicate whether this material could be suitable for construction and used economically.

References

Anderson-Perry Assoc. Inc. (Anderson-Perry). 2002. City of Milton-Freewater, Oregon, Wastewater Storage Pond Improvements, Phase III. unpublished drawings.

Jacobs Engineering Group, Inc. (Jacobs). 2019. Pine Creek Reservoir – Initial Field Reconnaissance for Limited Fault Slip Investigation and Borrow Source Identification. Prepared for Walla Walla Watershed Management Partnership (WWWMP). May.

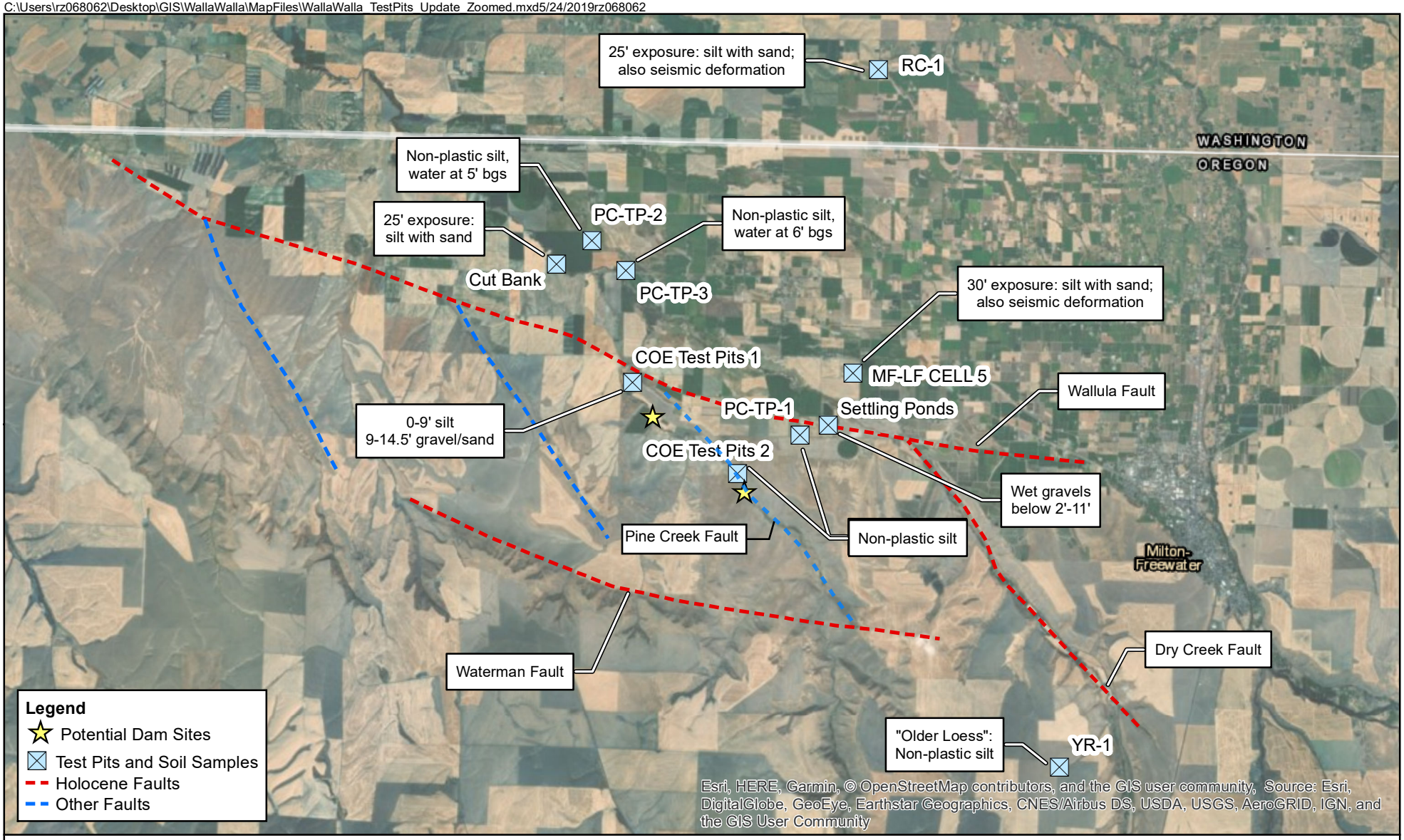
Silver, M. H. and POGUE, K. R., 2002. Analysis Of Plan-View Geometry Of Clastic Dike Networks In Missoula Flood Slackwater Sediments (Touchet Beds), Southeastern Washington Geological Society of America, Cordilleran Section - 98th Annual Meeting Session No. 13 Catastrophic Glacial Outburst Floods in the Pacific Northwest

U.S. Army Corps of Engineers (USACE). 2010. *Walla Walla River Basin Feasibility Study*. Jan.

Walker, G. W., 1973. *Reconnaissance Geologic Map of the Pendleton Quadrangle, Oregon and Washington* [U. S. Geological Survey Miscellaneous Geologic Investigations Map I-727]. Scale 1:250,000.

Attachment A
Test Pit and Soil Sample Locations

C:\Users\rz068062\Desktop\GIS\WallaWalla\MapFiles\WallaWalla_TestPits_Update_Zoomed.mxd5/24/2019rz068062



N
W E
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0 5 10 Miles

Test Pit and Soil Sample Locations
Walla Walla Basin Integrated Flow Enhancment Study

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Attachment B
Test Pit Logs

	PROJECT NUMBER:	TEST PIT NUMBER:
JACOBS	707425CH	MF-LF-1 SHEET 1 OF 1

TEST PIT LOG

PROJECT: Pine Creek Dam Borrow Source LOCATION: Milton-Freewater LOGGER: G. Warren, P. G.

ELEVATION: ~700 CONTRACTOR : DeRuwe

EXCAVATION EQUIPMENT USED: Man-Made exposure DATE EXCAVATED: 5/15/2019

WATER LEVEL: Dry APPROX. DIMENS: Length: --- Width: --- Max. Depth: 30+ feet high

DEPTH BELOW SURFACE (FT)	INTERVAL (FT) / NUMBER AND TYPE	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS: DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, WATER SEEPAGE, GRADATIONAL CONTACTS, TESTS, OTHER
5			
10			Vertical exposure, 30+ feet tall, stands straight up vertically
15	Composite Grab	Silt and sandy silt (ML-SP), with fine-medium sandy lenses, tan, dry, stratified layers, sand lenses are cross-bedded lenses (Touchet Beds)	
20		Numerous vertical sand clastic dikes, approx. 1" wide. Vertical erosion along dikes.	
25			
30			No groundwater or seepage
35			
40			

	PROJECT NUMBER: 707425CH	TEST PIT NUMBER: PC-TP-1 SHEET 1 OF 1
JACOBS	**TEST PIT LOG**	

PROJECT: Pine Creek Dam Borrow Source LOCATION: Umapine, OR LOGGER: G. Warren, P. G.
ELEVATION: ~700 CONTRACTOR : DeRuwe
EXCAVATION EQUIPMENT USED: RT Backhoe extendahoe DATE EXCAVATED: 5/15/2019
WATER LEVEL: Dry APPROX. DIMENS: Length: 10' Width: 4' Max. Depth: 14.5'

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	NUMBER AND TYPE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, WATER SEEPAGE, GRADATIONAL CONTACTS, TESTS, OTHER
1	1 to 8	Baggie	Grass/plants at surface	
2			Silt (ML), tan to light brown, dry, firm, massive, non-plastic	
3				
4				
5				Pit walls staying vertical, only minor sluffage
6				Collect bucket with bulk sample
7				
8				
9			At 8.5 ft, harder - weakly cemented silt, medium dry strength, possible calcareous cement	
10				
11	10 to 12	Baggie	At 10.5, weak layer of volcanic ash mixed in with silt, whitish-colored	
12				
13				Dry - no groundwater found
14			Hard silt/cemented	T.D.= 14.5 ft Harder digging, end of reach

	PROJECT NUMBER: 707425CH	TEST PIT NUMBER: PC-TP-2 SHEET 1 OF 1
JACOBS	**TEST PIT LOG**	

PROJECT: Pine Creek Dam Borrow Source LOCATION: DeRuwe Farm LOGGER: G. Warren, P. G.

ELEVATION: ~700 CONTRACTOR : DeRuwe

EXCAVATION EQUIPMENT USED: RT Backhoe extendahoe DATE EXCAVATED: 5/15/2019

WATER LEVEL: Dry APPROX. DIMENS: Length: 10' Width: 4' Max. Depth: 8.5'

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	NUMBER AND TYPE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, WATER SEEPAGE, GRADATIONAL CONTACTS, TESTS, OTHER
1			Grass at surface	
			Silt (ML) brown, dry, firm, non-plastic	
2				
			2 - 2.5 Weakly cemented layer	Tim DeRuwe notes that a hardpan layer is pervasive throughout his land; it appears to cause perched water and ranges in depth
	1 to 4	Baggie		
3				
			continue Silt (ML), brown, wet, non-plastic, highly dilatant	
4				Seepage from walls, couple gpm
5				
			Below 5 feet, Silt (ML) with very slight plasticity, brown, wet, reworked Touchet beds/loess	
6				
	5 to 8	Baggie		
7				Caving walls
8				TD = 8.5 feet; wet/messy No gravel found
9				
10				
11				
12				
13				
14				

	PROJECT NUMBER: 707425CH	TEST PIT NUMBER: PC-TP-3 SHEET 1 OF 1
JACOBS	**TEST PIT LOG**	

PROJECT: Pine Creek Dam Borrow Source LOCATION: Ray Williams compost LOGGER: G. Warren, P. G.

ELEVATION: ~700 CONTRACTOR : DeRuwe

EXCAVATION EQUIPMENT USED: RT Backhoe extendahoe DATE EXCAVATED: 5/15/2019

WATER LEVEL: Dry APPROX. DIMENS: Length: 10' Width: 4' Max. Depth: 11'

DEPTH BELOW SURFACE (FT)	INTERVAL (FT) / NUMBER AND TYPE	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	COMMENTS DIFFICULTY IN EXCAVATION, RUNNING GRAVEL CONDITION, COLLAPSE OF WALLS, SAND HEAVE, DEBRIS ENCOUNTERED, WATER SEEPAGE, GRADATIONAL CONTACTS, TESTS, OTHER
1		Grass Silt (ML) dark brown, dry, soft to firm	
2		2 - 2.5 silt/ash pinkish-colored hardpan.	
3	2.5 - 5 Baggie	Silt (ML), trace clay, brown, moist, very low plasticity	Vertical walls
4			
5			
6			Seepage coming in ~6 feet
7			
8			Walls vertical, minor collapse
9			Seepage coming in; filling up bottom of pit
10	9 to 11 Baggie	Silt (ML) dark greenish-gray, trace clay, moist, low-plasticity (possible CL-ML), mottled with orange FeOx stains in dark gray matrix	
11			TD = 11 feet
12			

Attachment C
Laboratory Testing

MATERIALS TESTING & INSPECTION

MATERIAL FINER THAN THE #200 SIEVE - SOIL

❑ Environmental Services ❑ Geotechnical Engineering ❑ Construction Materials Testing ❑ Special Inspections

Chris Hyland
Walla Walla Watershed Management Partnership
500 Tausick Road
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Phone: 509-524-5217
Fax:
Other: E-REPORTS ONLY

Project: **Walla Walla Watershed Alliance, 2019 Laboratory Testing**
Project Manager: **Steve Griffith**
Lab Technician: **Leo Perales**
Test Date: **May 24, 2019**

As requested MTI has performed wash sieve testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory were as follows:

Source:	PC-TP-1 10' TO 12', Soil							
Date Obtained:	May 16, 2019							
Sample ID:	18-2601							
Sampling and Preparation:	ASTM D2216:	X	AASHTO T2:		ASTM D421:	X	AASHTO T87:	
Test Standard:	ASTM D1140:	X						

Sample Soak Time if Any (hr)	N/A
Initial Dry Mass (g)	188.4
Initial Dry Mass Determined By	Direct Method
Procedure Used	A - Washing with Plain Water
Percent Passing the #200 Sieve	**35.5**

Sample of More than One Material Type?	No
Any Material Excluded from Testing?	No
Drying Temperature (°C)	110 ± 5
Dry Mass of Sample (g)	364.8
Moisture Content (%)	13.6

** Test sample mass was less than the minimum indicated in 8.2 of ASTM D 2216.

If there are questions concerning this report (*R190029l-052819=L=S-200WASH182601*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

Dominic Vasquez
Laboratory Supervisor

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cc:

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Project Manager: **Steve Griffith**
Lab Technician: **Leo Perales**
Test Date: **May 24, 2019**

As requested MTI has performed wash sieve testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory were as follows:

Source:	PC-TP-2 1' TO 4', Soil							
Date Obtained:	May 16, 2019							
Sample ID:	18-2602							
Sampling and Preparation:	ASTM D2216:	X	AASHTO T2:		ASTM D421:	X	AASHTO T87:	
Test Standard:	ASTM D1140:	X						

Sample Soak Time if Any (hr)	N/A
Initial Dry Mass (g)	197.9
Initial Dry Mass Determined By	Direct Method
Procedure Used	A - Washing with Plain Water
Percent Passing the #200 Sieve	**65.4**

Sample of More than One Material Type?	No
Any Material Excluded from Testing?	No
Drying Temperature (°C)	110 ± 5
Dry Mass of Sample (g)	377.6
Moisture Content (%)	48.7

** Test sample mass was less than the minimum indicated in 8.2 of ASTM D 2216.

If there are questions concerning this report (*R190029l-052819=L=S-200WASH182602*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

Dominic Vasquez
Laboratory Supervisor

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Project Manager: **Steve Griffith**
Lab Technician: **Leo Perales**
Test Date: **May 24, 2019**

As requested MTI has performed wash sieve testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory were as follows:

Source:	PC-TP-2 5' TO 8', Soil							
Date Obtained:	May 16, 2019							
Sample ID:	18-2603							
Sampling and Preparation:	ASTM D2216:	X	AASHTO T2:		ASTM D421:	X	AASHTO T87:	
Test Standard:	ASTM D1140:	X						

Sample Soak Time if Any (hr)	N/A
Initial Dry Mass (g)	285.0
Initial Dry Mass Determined By	Direct Method
Procedure Used	A - Washing with Plain Water
Percent Passing the #200 Sieve	**79.4**

Sample of More than One Material Type?	No
Any Material Excluded from Testing?	No
Drying Temperature (°C)	110 ± 5
Dry Mass of Sample (g)	454.5
Moisture Content (%)	35.7

** Test sample mass was less than the minimum indicated in 8.2 of ASTM D 2216.

If there are questions concerning this report (*R190029l-052819=L=S-200WASH182603*), please contact the project manager at 971-217-3815.

Respectfully submitted,
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Project: **Walla Walla Watershed Alliance, 2019 Laboratory Testing**
Project Manager: **Steve Griffith**
Lab Technician: **Leo Perales**
Test Date: **May 24, 2019**

As requested MTI has performed wash sieve testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory were as follows:

Source:	PC-TP-3 2.5' TO 5', Soil							
Date Obtained:	May 16, 2019							
Sample ID:	18-2604							
Sampling and Preparation:	ASTM D2216:	X	AASHTO T2:		ASTM D421:	X	AASHTO T87:	
Test Standard:	ASTM D1140:	X						

Sample Soak Time if Any (hr)	N/A
Initial Dry Mass (g)	406.8
Initial Dry Mass Determined By	Direct Method
Procedure Used	A - Washing with Plain Water
Percent Passing the #200 Sieve	**71.3**

Sample of More than One Material Type?	No
Any Material Excluded from Testing?	No
Drying Temperature (°C)	110 ± 5
Dry Mass of Sample (g)	578.9
Moisture Content (%)	35.0

** Test sample mass was less than the minimum indicated in 8.2 of ASTM D 2216.

If there are questions concerning this report (*R190029l-052819=L=S-200WASH182604*), please contact the project manager at 971-217-3815.

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Project: **Walla Walla Watershed Alliance, 2019 Laboratory Testing**
Project Manager: **Steve Griffith**
Lab Technician: **Leo Perales**
Test Date: **May 24, 2019**

As requested MTI has performed wash sieve testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory were as follows:

Source:	PC-TP-3 9' TO 11', Soil							
Date Obtained:	May 16, 2019							
Sample ID:	18-2605							
Sampling and Preparation:	ASTM D2216:	X	AASHTO T2:		ASTM D421:	X	AASHTO T87:	
Test Standard:	ASTM D1140:	X						

Sample Soak Time if Any (hr)	N/A
Initial Dry Mass (g)	449.1
Initial Dry Mass Determined By	Direct Method
Procedure Used	A - Washing with Plain Water
Percent Passing the #200 Sieve	**63.8**

Sample of More than One Material Type?	No
Any Material Excluded from Testing?	No
Drying Temperature (°C)	110 ± 5
Dry Mass of Sample (g)	622.0
Moisture Content (%)	41.5

** Test sample mass was less than the minimum indicated in 8.2 of ASTM D 2216.

If there are questions concerning this report (*R190029l-052819=L=S-200WASH182605*), please contact the project manager at 971-217-3815.

Respectfully submitted,
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MATERIAL FINER THAN THE #200 SIEVE - SOIL

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Project Manager: **Steve Griffith**
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Test Date: **May 24, 2019**

As requested MTI has performed wash sieve testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory were as follows:

Source:	MF-LF CELL 5 COMPOSITE, Soil							
Date Obtained:	May 16, 2019							
Sample ID:	18-2606							
Sampling and Preparation:	ASTM D2216:	X	AASHTO T2:		ASTM D421:	X	AASHTO T87:	
Test Standard:	ASTM D1140:	X						

Sample Soak Time if Any (hr)	N/A
Initial Dry Mass (g)	1287.4
Initial Dry Mass Determined By	Direct Method
Procedure Used	A - Washing with Plain Water
Percent Passing the #200 Sieve	**56.4**

Sample of More than One Material Type?	No
Any Material Excluded from Testing?	No
Drying Temperature (°C)	110 ± 5
Dry Mass of Sample (g)	1471.6
Moisture Content (%)	3.9

** Test sample mass was less than the minimum indicated in 8.2 of ASTM D 2216.

If there are questions concerning this report (*R190029l-052819=L=S-200WASH182606*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

D. Vasquez

Dominic Vasquez
Laboratory Supervisor

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MATERIALS TESTING & INSPECTION

MATERIAL FINER THAN THE #200 SIEVE - SOIL

❑ Environmental Services ❑ Geotechnical Engineering ❑ Construction Materials Testing ❑ Special Inspections

Chris Hyland
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Walla Walla, WA 99362

Phone: 509-524-5217
Fax:
Other: E-REPORTS ONLY

Project: **Walla Walla Watershed Alliance, 2019 Laboratory Testing**
Project Manager: **Steve Griffith**
Lab Technician: **Leo Perales**
Test Date: **May 24, 2019**

As requested MTI has performed wash sieve testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory were as follows:

Source:	RC-1 COMPOSITE, Soil							
Date Obtained:	May 16, 2019							
Sample ID:	18-2607							
Sampling and Preparation:	ASTM D2216:	X	AASHTO T2:		ASTM D421:	X	AASHTO T87:	
Test Standard:	ASTM D1140:	X						

Sample Soak Time if Any (hr)	N/A
Initial Dry Mass (g)	221.8
Initial Dry Mass Determined By	Direct Method
Procedure Used	A - Washing with Plain Water
Percent Passing the #200 Sieve	**65.0**

Sample of More than One Material Type?	No
Any Material Excluded from Testing?	No
Drying Temperature (°C)	110 ± 5
Dry Mass of Sample (g)	407.4
Moisture Content (%)	7.7

** Test sample mass was less than the minimum indicated in 8.2 of ASTM D 2216.

If there are questions concerning this report (*R190029l-052819=L=S-200WASH182607*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

Dominic Vasquez
Laboratory Supervisor

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MATERIAL FINER THAN THE #200 SIEVE - SOIL

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Project: **Walla Walla Watershed Alliance, 2019 Laboratory Testing**
Project Manager: **Steve Griffith**
Lab Technician: **Leo Perales**
Test Date: **May 24, 2019**

As requested MTI has performed wash sieve testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory were as follows:

Source:	YR-1 COMPOSITE, Soil							
Date Obtained:	May 16, 2019							
Sample ID:	18-2608							
Sampling and Preparation:	ASTM D2216:	X	AASHTO T2:		ASTM D421:	X	AASHTO T87:	
Test Standard:	ASTM D1140:	X						

Sample Soak Time if Any (hr)	N/A
Initial Dry Mass (g)	188.1
Initial Dry Mass Determined By	Direct Method
Procedure Used	A - Washing with Plain Water
Percent Passing the #200 Sieve	**62.9**

Sample of More than One Material Type?	No
Any Material Excluded from Testing?	No
Drying Temperature (°C)	110 ± 5
Dry Mass of Sample (g)	378.3
Moisture Content (%)	15.1

** Test sample mass was less than the minimum indicated in 8.2 of ASTM D 2216.

If there are questions concerning this report (*R190029l-052819=L=S-200WASH182608*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

Dominic Vasquez
Laboratory Supervisor

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MATERIAL FINER THAN THE #200 SIEVE - SOIL

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Project: **Walla Walla Watershed Alliance, 2019 Laboratory Testing**
Project Manager: **Steve Griffith**
Lab Technician: **Leo Perales**
Test Date: **May 24, 2019**

As requested MTI has performed wash sieve testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory were as follows:

Source:	PC-TP-1, Soil							
Date Obtained:	May 16, 2019							
Sample ID:	18-2609							
Sampling and Preparation:	ASTM D2216:	X	AASHTO T2:		ASTM D421:	X	AASHTO T87:	
Test Standard:	ASTM D1140:	X						

Sample Soak Time if Any (hr)	N/A
Initial Dry Mass (g)	355.2
Initial Dry Mass Determined By	Direct Method
Procedure Used	A - Washing with Plain Water
Percent Passing the #200 Sieve	**79.8**

Sample of More than One Material Type?	No
Any Material Excluded from Testing?	No
Drying Temperature (°C)	110 ± 5
Dry Mass of Sample (g)	526.8
Moisture Content (%)	11.8

** Test sample mass was less than the minimum indicated in 8.2 of ASTM D 2216.

If there are questions concerning this report (*R190029l-052819=L=S-200WASH182609*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

Dominic Vasquez
Laboratory Supervisor

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Project: **2019 Miscellaneous Laboratory Testing-Walla Walla Watershed Alliance**
Project Manager: **Steve Griffith**
Lab Technician: **Dominic Vasquez**
Test Date: **May 20, 2019**

As requested MTI has performed Atterberg limits testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory are as follows:

Source and Description:	PC-TP-1 10' TO 12', Soil										
Date Obtained:	May 16, 2019										
Sample ID:	18-2601										
Sampling and Preparation:	ASTM D75:		AASHTO T2:		ASTM D421:	X	AASHTO T87:				
Test Standard:	ASTM D4318:	X	AASHTO T89/90:								

Dried	Air
Method	Multi Point
Estimated % Retained on #40	11
Liquid Limit	28
Plastic Limit	23
Plasticity Index	5

If there are questions concerning this report (*R190029l-061419=L=S-ATT182601*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

D. Vasquez

Dominic Vasquez
Laboratory Supervisor

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Project: **2019 Miscellaneous Laboratory Testing-Walla Walla Watershed Alliance**
Project Manager: **Steve Griffith**
Lab Technician: **Dominic Vasquez**
Test Date: **May 20, 2019**

As requested MTI has performed Atterberg limits testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory are as follows:

Source and Description:	PC-TP-2 5' TO 8', Soil										
Date Obtained:	May 16, 2019										
Sample ID:	18-2603										
Sampling and Preparation:	ASTM D75:		AASHTO T2:		ASTM D421:	X	AASHTO T87:				
Test Standard:	ASTM D4318:	X	AASHTO T89/90:								

Dried	Air
Method	Multi Point
Estimated % Retained on #40	10
Liquid Limit	32
Plastic Limit	26
Plasticity Index	6

If there are questions concerning this report (*R190029l-061419=L=S-ATT182603*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

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Project: **2019 Miscellaneous Laboratory Testing-Walla Walla Watershed Alliance**
Project Manager: **Steve Griffith**
Lab Technician: **Dominic Vasquez**
Test Date: **May 20, 2019**

As requested MTI has performed Atterberg limits testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory are as follows:

Source and Description:	PC-TP-3 2.5' TO 5', Soil										
Date Obtained:	May 16, 2019										
Sample ID:	18-2604										
Sampling and Preparation:	ASTM D75:		AASHTO T2:		ASTM D421:	X	AASHTO T87:				
Test Standard:	ASTM D4318:	X	AASHTO T89/90:								

Dried	Air
Method	Multi Point
Estimated % Retained on #40	11
Liquid Limit	30
Plastic Limit	29
Plasticity Index	1

If there are questions concerning this report (*R190029l-061419=L=S-ATT182604*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

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MATERIALS TESTING & INSPECTION

ATTERBERG LIMITS

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Project: **2019 Miscellaneous Laboratory Testing-Walla Walla Watershed Alliance**
Project Manager: **Steve Griffith**
Lab Technician: **Dominic Vasquez**
Test Date: **May 20, 2019**

As requested MTI has performed Atterberg limits testing on the sample referenced below. The testing was performed in accordance with current standards indicated below. The results obtained in our laboratory are as follows:

Source and Description:	PC-TP-3 9' TO 11', Soil										
Date Obtained:	May 16, 2019										
Sample ID:	18-2605										
Sampling and Preparation:	ASTM D75:		AASHTO T2:		ASTM D421:	X	AASHTO T87:				
Test Standard:	ASTM D4318:	X	AASHTO T89/90:								

Dried	Air
Method	Multi Point
Estimated % Retained on #40	14
Liquid Limit	41
Plastic Limit	28
Plasticity Index	13

If there are questions concerning this report (*R190029l-061419=L=S-ATT182605*), please contact the project manager at 971-217-3815.

Respectfully submitted,
MATERIALS TESTING & INSPECTION, INC.

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Dominic Vasquez
Laboratory Supervisor

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Attachment D
Photo Log

PHOTOGRAPH 1: Exposure at Milton Freewater Landfill (MF-LF-1). Rod is 30 feet tall. Soils include silt, sandy silt, silty sand, and sand. Vertical erosion follows steep clastic dikes, possibly formed during a seismic event.

PHOTOGRAPH 2: Close-up of clastic dike in MF-LF-1. Medium-coarse sand in the dike "flowed" upward during either a seismic lateral-spread event, or uneven loading during deposition.

PHOTOGRAPH 3: Test Pit TP-PC-1. Predominantly massive silt.

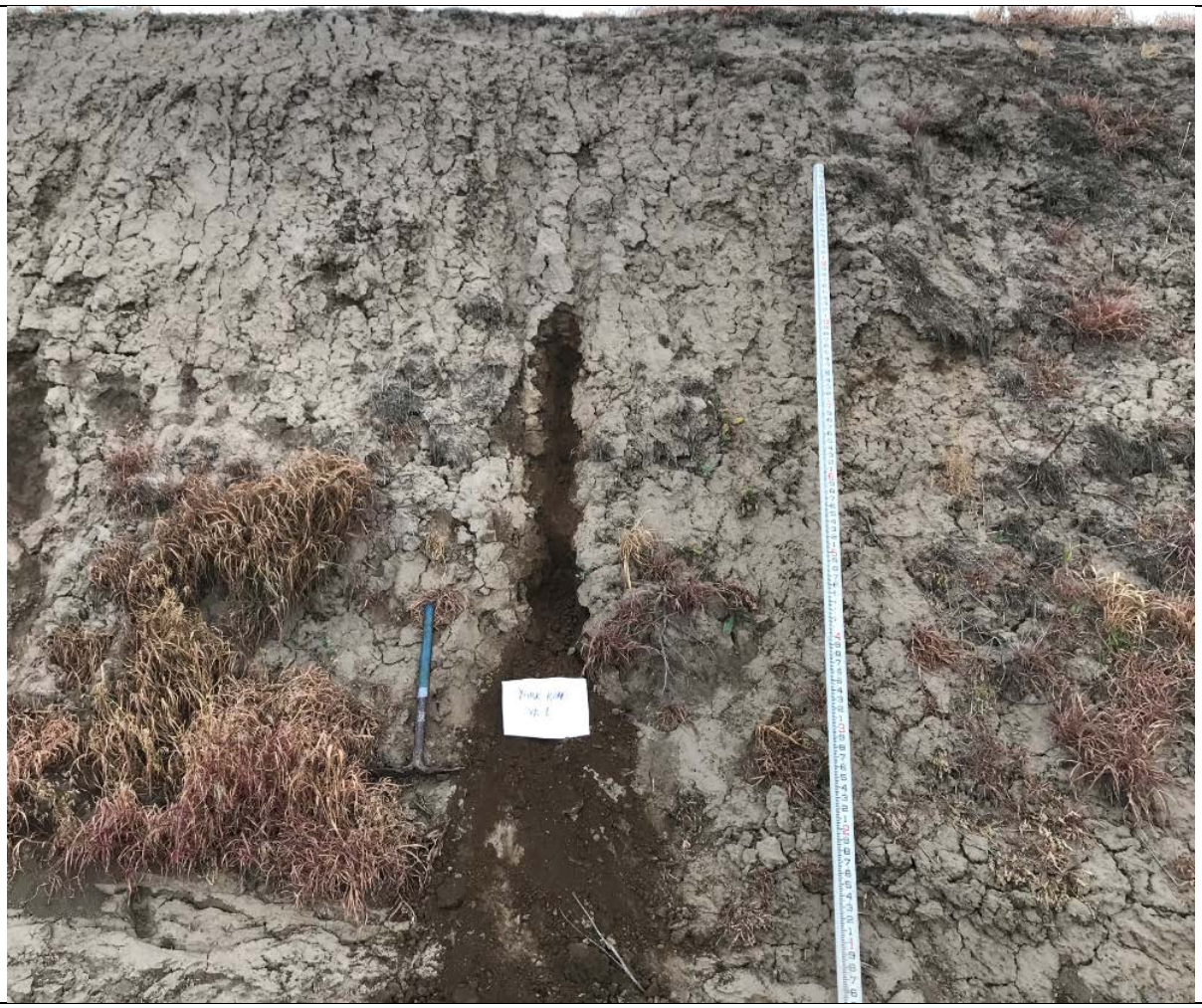
PHOTOGRAPH 4: Test Pit TP-PC-2. Note lighter colored “hardpan” at 2.5 feet in depth. Also, rapid filling of seepage water.

PHOTOGRAPH 5: Test Pit PC-TP-3. Note pinkish-colored “hardpan” with volcanic ash (?) at 2.5 feet in depth. Also, filling of seepage water.

PHOTOGRAPH 6: Test Pit PC-TP-3. Gray-green clay near bottom of pit. This was the most “plastic” soil found, with a Liquid Limit of 41 and a Plasticity Index of 13.

PHOTOGRAPH 7: Road Cut exposure RC-1. Layers of flood sediments that are primarily silt with interbedded sands. These sediments were likely deposited horizontally; now they are dipping to the north.

PHOTOGRAPH 8: Road Cut exposure RC-1. Intensely-deformed [originally horizontal] layers from either seismic events or soft-sediment deformation during deposition while soils were saturated.



PHOTOGRAPH 9: Road Cut along York Road (YR-1). Darker-colored massive silt ("older Loess"). However, still non-plastic.