# GEOTECHNICAL EVALUATION LEVEE EVALUATION AND CERTIFICATION 4403 SOUTH DISHMAN-MICA ROAD SPOKANE COUNTY, WASHINGTON

**Inland Pacific Engineering Company Project No. 14-037** 

February 12, 2015 Revised August 29, 2016





February 12, 2015 Project No. 14-037

NAI Black c/o Mr. Bryan Walker 107 South Howard Suite 500 Spokane, WA 99201

### Re: Geotechnical Evaluation Chester Creek Levee Certification 4403 South Dishman-Mica Road Spokane County, WA

Dear Mr. Walker:

We have completed the geotechnical evaluation for the Chester Creek levee Certification at the above-referenced site in Spokane, Washington. The purpose of evaluation was to evaluate the existing levee for conformance to 44 CFR 65.10 of the Code of Federal Regulations for certification by the Federal Emergency Management Agency (FEMA).

We appreciate the opportunity to provide our services to you on this project. If you have any questions or need additional information, please do not hesitate to call me at (509) 209-6262 at your convenience.

Sincerely, Inland Pacific Engineering Company

Paul T. Nelson, P.E. Principal Engineer

Attachment: Geotechnical Evaluation Report

P.O. Box 1566, Veradale, WA 99037 Phone 509-209-6262

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**Prepared for:** 

NAI Black Spokane, Washington



### **TABLE OF CONTENTS**

Project No. 14-037 Levee Evaluation and Certification 4403 South Dishman-Mica Road Spokane County, Washington

	page
1.0 INTRODUCTION	1
1.1 Project Description	
1.2 Purpose	
1.3 Scope	
1.4 Available Information	1
1.5 Locations and Elevations	1
2.0 RESULTS	
2.1 Logs	
2.2 Site Conditions.	2
2.3 Soils	
2.4 Penetration Resistances	
2.5 Groundwater	
2.6 Laboratory Testing	
3.0 ANALYSIS AND RECOMMENDATIONS	3
3.1 History	
3.2 Freeboard	3
3.3 Closures	
3.4 Embankment Protection	. <del>- 1</del>
3.5 Embankment and Foundation Stability	, <del>-</del> . 5
3.6 Settlement	
3.7 Interior Drainage	
3.8 Operation Plans	6
3.9 Maintenance Plan	6
3.10 Certification	6
4.0 PROCEDURES	6
4.1 Excavation and Sampling	6
4.2 Soil Classification	6
5.0 GENERAL RECOMMENDATIONS.	6
5.1 Basis of Recommendations	
5.2 Groundwater Fluctuations	7
5.3 Use of Report	
5.4 Level of Care	
5.5 Professional Certification	
	. /
Appendix A – Site Location Map, NRCS Map, Boring Location Map	
Appendix B – Logs of Borings, Descriptive Terminology	

- Appendix C Laboratory Test Results
- Appendix D Operations and Maintenance Manual

# **1.0 INTRODUCTION**

# **1.1 Project Description**

We understand that the proposed project may consist of a residential development. The site consists of 91 acres currently developed as a golf course. Stormwater runoff will be treated using drywells and/or gravel galleries for subsurface infiltration. These type of facilities will also be used to manage potential floodwaters, if needed.

# 1.2 Purpose

The purpose of our services is to evaluate the existing levee for conformance to 44 CFR 65.10 of the Code of Federal Regulations for certification by the Federal Emergency Management Agency (FEMA).

# 1.3 Scope

Our services were requested by Mr. Bryan Walker of NAI Black. Mr. Walker authorized us to proceed on February 24, 2014. The scope of work agreed upon consisted of the following:

- review of existing geotechnical data and reports for the development, if available
- drill 6 penetration test borings at the site to a depth of 25 feet,
- performing laboratory tests on samples obtained from the test pits,
- classifying the soils and preparing boring logs, and
- submitting a geotechnical report containing logs of the borings, results of our field investigation and laboratory testing, and our analyses, opinions, and recommendations relative to the conformance of the existing levee to FEMA standards.

# **1.4 Available Information**

We were provided a topographic survey for the project site by WCE. This topographic survey showed the existing roadways, existing structures, property lines, and existing ground surface elevation contours. This plan was prepared by WCE and was dated November 7, 2013.

We also performed a preliminary geotechnical evaluation for the property in December 2013. The results of that evaluation, along with our opinions and recommendations, are summarized in our Preliminary Geotechnical Evaluation dated December 31, 2013.

In conjunction with this evaluation, West Consultants, Inc. (WEST) has been contracted by NAI Black to provide a FEMA Conditional Letter of Map Revision submittal (CLOMR). They have provided Inland Pacific Engineering Company (IPEC) water surface elevations and velocity output from their revised RAS model to assist us in our evaluation.

# **1.5 Locations and Elevations**

The borings were drilled at or near locations selected by us. The boring locations are shown on the Boring Location Map in Appendix A. The borings were staked by Whipple Consulting Engineers, Inc. (WCE). Ground surface elevations at the borings were provided by WCE.

# 2.0 RESULTS

# 2.1 Logs

Log of Boring sheets indicating the vertical sequence of soils and materials encountered and groundwater observations are included in Appendix B. The strata changes were inferred from the changes in the penetration test samples and auger cuttings brought to the surface. Please note that the depths shown as changes between the strata are only approximate. The changes are likely transitions and the depths of changes vary between the borings. Geologic origins for each stratum are based on the soil type, available geologic maps, previous geotechnical reports for this and adjacent sites, and available common knowledge of the depositional history of the site.

# **2.2 Site Conditions**

The site was used as a golf course prior to our evaluation. The site is relatively level with some elevated golf greens and excavated areas for water hazards. The site is primarily grass-covered with scattered trees along the fairways and pine trees in the undeveloped area to the northwest. The clubhouse building is present at the southwest corner. The existing levee is on the east side of Chester Creek between Thorpe Road and Dishman-Mica Road. The creek side of the levee is typically at a 2.3:1 to 3:1 (H:V) slope. The land side of the levee is also at a 3:1 slope from the Dishman-Mica Road bridge to approximately 300 feet southeast. Between this point and Thorpe Road, the land side slope is much less and, in some areas, relatively level with the crest.

# 2.3 Soils

Geologic maps indicate the soils in this area consist primarily of alluvial and/or glacially deposited silts, clays, sands, and gravels. According to the Soil Survey of Spokane County, the site soils are classified by the Natural Resource Conservation Service (NRCS) as Narcisse silt loam and Endoaquolls and Fluvaquents. The native soils encountered in the borings were consistent with the NRCS data.

The borings typically encountered existing fill or "possible fill" in the upper 9 to 12 feet (it was considered "possible fill" because it did not appear to be native soil, but no indicator, such as debris, etc., was found to confirm our opinion). Below the fill or "possible fill", the borings encountered water-deposited silty to clayey sands and/or poorly graded sands to their termination depths. Boring B-1 encountered alluvial lean clay below the 18-foot depth. Borings B-2, B-3, and B-5 encountered layers of lean to silty clay embedded in the sands at various depths.

# **2.4 Penetration Resistances**

Penetration resistances (N-values) in the fill or "possible fill" ranged from 2 to 23 blows per foot (BPF) and averaged 11 BPF. Penetration resistances in the sands ranged from 3 to 19 BPF and averaged 10 BPF, indicating that these soils were very loose to medium dense, but were typically loose. Penetration resistances in the clays ranged from 2 to 6 BPF indicating that these soils were soft to medium in consistency.

# 2.5 Groundwater

Groundwater was not encountered in Borings B-1 and B-2 during or immediately after drilling. Boring B-1 was left open for 2 days and groundwater was not observed at that time. Groundwater was encountered in the remaining borings at depths ranging from 7.5 to 18 feet after drilling and/or up to 1 day later. These depths correspond to elevations ranging from 1996.9 to 2007.2. These observed levels are generally below the level of Chester Creek.

Based on our experience in the vicinity of the site, along with numerous test pits excavated on the site previously, it is our opinion that this portion of the creek is the beginning of the recharge section as evidenced by the typical lack of water in the creek further downstream. Also, the test pits previously excavated at the site east of the levee did not encounter groundwater. Well log data in the vicinity of the site indicate that groundwater is typically 50 to 80 feet below the surface.

# **2.6 Laboratory Testing**

We obtained soil samples from the borings during our site investigation. The tests performed included the following:

- 1. ASTM D 6913, Sieve Analysis
- 2. ASTM D 4318, Atterberg Limits'
- 3. ASTM D 5084, Permeability
- 4. ASTM D 3080, Direct Shear
- 5. ASTM D 4767, Consolidated-Undrained Triaxial Compression

These tests were used to aid in classifying the soils and in the engineering analyses and formulation of engineering opinions and recommendations. The tests were performed by outside laboratories subcontracted to Inland Pacific Engineering Company (IPEC). The tests were performed by Budinger & Associates, Inc. and GN Northern, Inc. Attached are data sheets summarizing the tests performed.

# **3.0 ANALYSIS AND RECOMMENDATIONS**

# 3.1 History

The levee was constructed in the early 1990's by the golf course property owner. As such, design plans or as-built drawings are not available. However, an as-built survey was completed by WCE in 2014.

# 3.2 Freeboard

We were provided 100-year flood elevations by WEST. They provided us a plan view of the levee with flood elevations at 5 locations starting at the bridge on Thorpe Road and ending at the bridge on Dishman-Mica Road. The elevations ranged from 2012.1 at Thorpe Road to 2010.4 at Dishman-Mica Road. Please refer to the WEST report for a complete summary of the floodplain analysis.

According to 44 CFR Section 65.10(b)(1), an additional 1 foot of freeboard is required within 100 feet of bridge structures. This will require the top of the levee to be at elevation 2016.1 at the Thorpe Road bridge and extending 100 feet north. Since the existing levee is at elevation 2015 in this area, it will be necessary to raise this portion of the levee to meet the minimum freeboard requirements. This will also be necessary at and between the pedestrian bridges near the middle of the levee alignment. At these bridges, the top of the levee will need to be raised to elevation 2015.1 south of the southern pedestrian bridge to elevation 2014.8 north of the northern pedestrian bridge. The freeboard requirement for the Dishman-Mica Road bridge is adequate.

# **3.3 Closures**

There are no penetrations of the levee so closure devices are not required.

# **3.4 Embankment Protection**

The levee is currently grass-covered for erosion protection. We evaluated the erosion protection for the creek side of the levee using the results of the HEC-RAS analysis by WEST. They provided flow velocities for the 100 and 500-year flood events. The flow velocities are shown in the following table.

<b>River Station</b>	100-year Channel Velocity (ft/sec)	500-year Channel Velocity (ft/sec)
21500		e Road
21482.42	6.9	7.1
21456.36	2.4	2.5
21231.71	2.5	2.6
21013.79	3.4	3.5
20975.95	2.9	3.0
20970	Pedestria	in Bridge
20967.18	2.8	2.9
20928.94	2.0	2.0
20895.90	1.9	1.9
20868.07	1.9	2.0
20838.54	2.2	2.3
20830	Pedestria	an Bridge
20828.27	2.0	2.1
20779.14	2.4	2.4
20554.71	3.2	3.3
20492.77	1.4	1.5
20450	Dishman-	Mica Road

As shown in the table, the average flow velocity is typically less than 3 feet per second. At these velocities, it is our opinion that the vegetative erosion protection is adequate given the age of the levee and that no significant erosion is visible. We did note, however, that vegetation is not present below and adjacent to the pedestrian bridge abutments. We recommend that the levee

slopes at these locations be protected with erosion matting or rip rap. We also recommend erosion matting or rip rap from the Thorpe Road bridge to River Station 21600 due to higher flow velocity. Also, all trees on or adjacent to the levee on the levee side of the creek will need to be removed.

# 3.5 Embankment and Foundation Stability

We evaluated the embankment and foundation stability for conditions described in EM 1110-2-1913, "Design and Construction of Levees, by the US Corps of Engineers dated April 30, 2000, Chapter 6. We analyzed the levee embankment for the following cases:

- 1. CASE I, End of construction.
- 2. CASE II: Sudden drawdown.
- 3. CASE III: Steady state seepage from full flood stage.

We performed slope stability analyses for each case. We analyzed the levee embankment with 2.3:1 slopes. This configuration is considered to have the lowest factor of safety. For our analyses, we used XSTABL software which is based on a software program developed at Purdue University.

For these cases, we calculated the minimum factors of safety as shown in the following table.

CASE	Minimum Factor of Safety
Ι	1.58
II	1.50
III	1.55

For stability, a minimum factor of safety of 1.5 is generally considered acceptable. Based on this analysis, it is our opinion that the levee will be stable with respect to global slope stability provided the recommendations of this report are followed.

# 3.6 Settlement

The average depth of fill is approximately 10 feet. This would result in a loading increase of approximately 1,250 pounds per square foot (psf) on the bearing soils. Based on the data obtained from the borings, the levee was constructed above loose to medium dense sands. Settlement in these soils would have occurred shortly after construction. Also, given the age of the levee, it is our opinion that significant additional long term settlement will not occur.

We did analyze the silty clay layer encountered in Boring B-5 with a 1-foot raise in grade should it be necessary to maintain minimum freeboard. For our analysis, we used a unit weight of 125 pounds per cubic foot (pcf) for the embankment fill soils and a compression index of 0.15 for the silty clay and assumed total saturation of the clay layer. Based on these parameters, we estimated the additional settlement to be less than 0.35 inches or 0.03 feet.

# **3.7 Interior Drainage**

Interior drainage systems have been designed by WCE. We understand that these systems will include detention ponds with multiple drywells to control flood waters and infiltrate them into the ground. Please refer to the WCE report for a comprehensive description of the interior drainage system.

# **3.8 Operation Plans**

The Operation Plan is provided in Appendix D.

### 3.9 Maintenance Plan

The Maintenance Plan is provided in Appendix D.

### **3.10 Certification**

Based on the historical data obtained, the results of the borings and laboratory tests performed, and the available geologic data, we certify that, to the best of our knowledge, that the Chester Creek levee has been constructed in accordance with sound engineering principles and will provide reasonable protection from the 100-year and 500-year floods and meets the requirements of 44 CFR 65.10 provided the recommendations of this report are followed.

# **4.0 PROCEDURES**

# 4.1 Excavation and Sampling

The borings were completed between April 7 and 10, 2014 using a tracked drill rig operated by an independent firm working under subcontract to IPEC. A geotechnical engineer from our firm continuously observed the borings and logged the surface and subsurface conditions. After we logged the borings, they were abandoned in accordance with state requirements.

# 4.2 Soil Classification

The soils encountered in the borings were visually and manually classified in the field by our field personnel in accordance with ASTM D 2488, "Description and Identification of Soils (Visual-Manual Procedures)".

# **5.0 GENERAL RECOMMENDATIONS**

# 5.1 Basis of Recommendations

The analyses and recommendations submitted in this report are based on the data obtained from the borings performed at the locations indicated on the Boring Location Map in Appendix A. It should be recognized that the explorations performed for this evaluation reveal subsurface conditions only at discreet locations across the project site and that actual conditions in other areas could vary. Furthermore, the nature and extent of any such variations would not become evident until additional explorations are performed or until construction activities have begun. If significant variations are observed at that time, we may need to modify our conclusions and recommendations contained in this report to reflect the actual site conditions.

# **5.2 Groundwater Fluctuations**

We made water level observations in the borings at the times and conditions stated on the boring logs. These data were interpreted in the text of this report. The period of observation was relatively short and fluctuation in the groundwater level may occur due to rainfall, flooding, irrigation, spring thaw and other seasonal and annual factors not evident at the time the observations were made. Design drawings and specifications and construction planning should recognize the possibility of fluctuations.

### 5.3 Use of Report

This report is for the exclusive use of the addressee and the copied parties to use in design of the proposed project and to prepare construction documents. In the absence of our written approval, we make no representations and assume no responsibility to other parties regarding this report. The data, analyses, and recommendations may not be appropriate for other structures or purposes. We recommend that parties contemplating other structures or purposes contact us.

### 5.4 Level of Care

Services performed by the geotechnical engineers for this project have been conducted in a manner consistent with that level of care ordinarily exercised by members of the profession currently practicing in this area under similar budget and time restraints. No warranty, expressed or implied, is intended or made.

# **5.5 Professional Certification**

This report was prepared by me or under my direct supervision and I am a duly registered engineer under the laws of the State of Washington.

Paul T. Nelson, P.E. Principal Engineer



# APPENDIX A

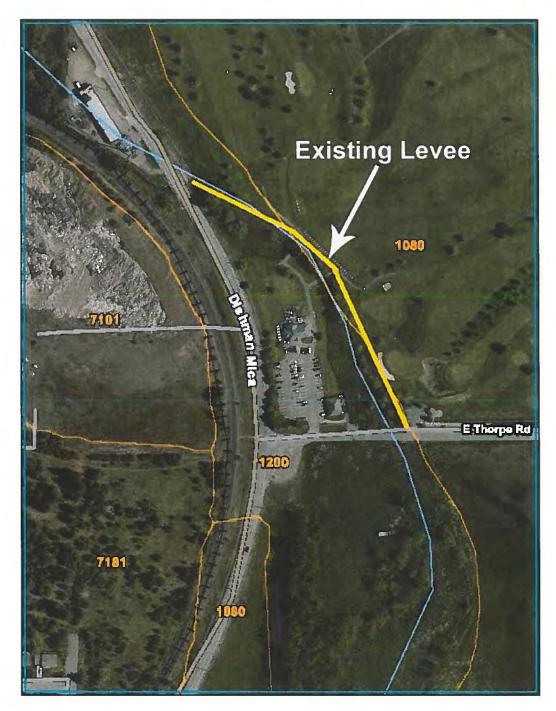
# SITE LOCATION MAP, NRCS MAP, TEST PIT LOCATION MAP

# FIGURE 1

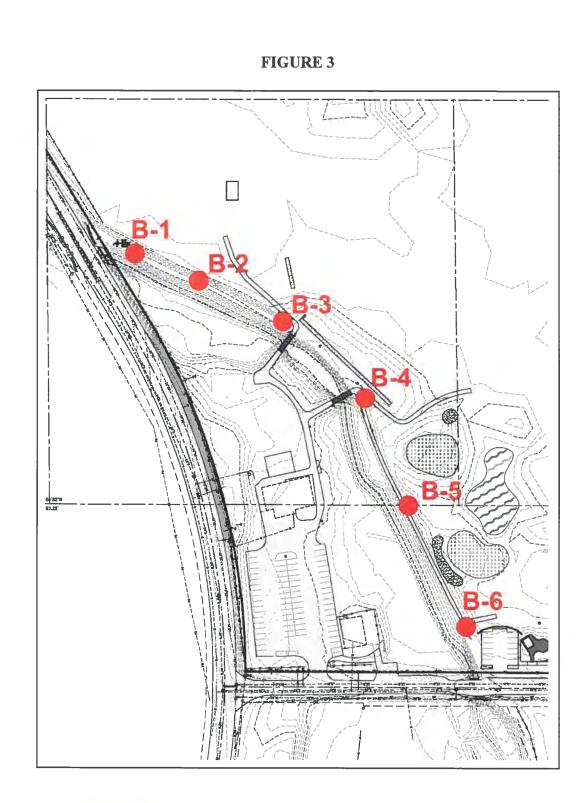


Site Location Map								
IDEC	Project No. 14-037							
IPEC	Painted Hills Golf Course Levee	March 10, 2014						
Inland Pacific Engineering Company	4403 South Dishman-Mica Road	10101011 10, 2011						
Geotechnical Engineering and Consulting	Spokane Valley, WA							

# FIGURE 2



	NRCS Map	
IDEC	Project No. 14-037	
IPEC	Painted Hills Golf Course Levee	March 10, 2014
Inland Pacific Engineering Company Geotechnical Engineering and Consulting	4403 South Dishman-Mica Road	
Geotechnical Engineering and Consulting	Spokane Valley, WA	



	Boring Location Map	
IDEC	Project No. 14-037	
IPEC	Painted Hills Golf Course Levee	March 10, 2014
Inland Pacific Engineering Company	4403 South Dishman-Mica Road	Waren 10, 2014
Geotechnical Engineering and Consulting	Spokane Valley, WA	

# APPENDIX B

# LOGS OF TEST PITS, DECRIPTIVE TERMINOLOGY

Inland Pacific Engineering Company

						G	eotech	nical E	ngineering	, and	Company Consultin
PROJE		4-037 evee Eva	aluation and Certification	BO			i: DN:	Soc	Boring		ation
	P 4	ainted H 403 Sou	tills Golf Course Property oth Dishman-Mica Road County, WA					Ma	p		
				DA	TE	::	4/7/1	.4	SCALE	:	1"=4'
ELEV. 2015.5		ASTM D2487 SYMBOL	DESCRIPTION OF MATERIALS			N	WL	т	ESTS O	RI	NOTES
2014.0	1.5	FILL	Silty Sand, fine to medium grained, with roots, dark brown, moist.								
			Sandy Silt, gray-brown to brown, moist.	X	14	4					
		FILL		X	1:	2					
2007.5	18.0			M	7	7					
2004.5	11.0	FILL	Poorly Graded Sand, fine to medium grained, gray-brown to brown, moist.	X	1(	0					
			SILTY CLAYEY SAND, fine to medium grained, brown, moist to wet, medium dense. (Alluvium)								
		SC-SM		X	14	4					
.997.5	18.0										
			LEAN CLAY, brown, wet, medium. (Alluvium)	X	6	5					
		CL							e from 2 e from 2		
1990.5	25.0		End of Doving							4	
			End of Boring. Groundwater not encountered with 24' of hollow-stem auger in the ground. Groundwater not encountered immediately after withdrawal. Groundwater not encountered 2 days after withdrawal. Boring then grouted to surface.								

Inland Pacific Engineering Company Geotechnical Engineering and Consulting

7

				-	seotecim	icai ring	meening a	nd Consulting
							<b>B-2</b>	
P: 4	ainted H 403 Sou	lills Golf Course Property th Dishman-Mica Road	LOC	CATI	ON:	See B Map	oring Lo	ocation
S	pokane	County, WA	DA	TE:	4/7/14	1	1"=4'	
				N	WL	TES	STS OR	NOTES
1.5	FILL							
	i.		X	3				
			Į					
	EU 1		X	4				
	FILL		X	4				
			Í					
10.0		SILTY CLAYEY SAND fine grained brown wet you	N N	3				
12.0	SC-SM	loose.						
	SP	POORLY GRADED SAND, fine to medium grained, brown, water-bearing, loose. (Alluvium)	X	8				
20.5			X	7				
	CL	(Alluvium)	Π	Thi	 nwall s	ample	from 21	'-23'
23.0		SILTY SAND fine grained brown water bearing	_Ц			•		
24.0	SM	(Alluvium)						
25.5	SP	POORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense.	X	13				
		(Alluvium) End of Boring.						
		Groundwater not encountered with 24' of hollow-stem auger in the ground. Groundwater not encountered immediately after withdrawal. Boring then grouted to surface.						
	Lee Pa 4 5 DEPTH 0.0 1.5 10.0 12.0 12.0 20.5 23.0 24.0	Levee Eva Painted H 4403 Sou Spokane ASTM D2487 0.0 FILL 1.5 FILL 1.5 FILL 10.0 SC-SM 12.0 SC-SM 20.5 SP	Levee Evaluation and Certification         Painted Hills Golf Course Property         4403 South Dishman-Mica Road         Spokane County, WA         DEPTH         0.0       SYMBOL         1.5       FILL         Clayey Sand, fine to medium grained, with roots, dark brown, wet.         1.5       FILL         Silty Sand, fine to medium grained, dark brown, moist to wet.         10.0       SILTY CLAYEY SAND, fine grained, brown, wet, vei loose.         12.0       SILTY CLAYEY SAND, fine to medium grained, brown, wet, vei loose.         12.0       SILTY GRADED SAND, fine to medium grained, brown, wet, vei loose.         20.5       Kalluvium)         20.5       EEAN CLAY, brown, wet.         20.5       LEAN CLAY, brown, wet.         20.5       Kalluvium)         20.5       SILTY SAND, fine grained, brown, water-bearing.         21.0       SILTY SAND, fine grained, brown, water-bearing.         22.0       FILT         23.0       SILTY SAND, fine grained, brown, water-bearing.         24.0       SM         SILTY SAND, fine grained, brown, water-bearing.         (Alluvium)       End of Boring.         25.5       SP         POORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense.	Levee Evaluation and Certification       LOC         Painted Hills Golf Course Property       4403 South Dishman-Mica Road         Spokane County, WA       DA         DEPTH       D2487         0.0       SYMBOL         1.5       FILL         Clayey Sand, fine to medium grained, with roots, dark brown, wet.         1.5       Silty Sand, fine to medium grained, dark brown, moist to wet.         10.0       Siltry CLAYEY SAND, fine grained, brown, wet, very Nose.         12.0       SC-SM loose.         (Alluvium)       POORLY GRADED SAND, fine to medium grained, brown, wet, very Norw, water-bearing, loose.         12.0       SP         20.5       ELEAN CLAY, brown, wet.         20.5       LEAN CLAY, brown, wet.         20.5       CL         20.5       POORLY GRADED SAND, fine to medium grained, brown, water-bearing, loose.         20.5       CL         20.5       POORLY GRADED SAND, fine to medium grained, brown, water-bearing.         21.0       SM         SILTY SAND, fine grained, brown, water-bearing.         21.0       SM         SP       POORLY GRADED SAND, fine to medium grained, brown, water-bearing.         21.0       Groundwater not encountered with 24' of hollow-stem auger in the ground.         Groundwa	Levee Evaluation and Certification Painted Hills Golf Course Property 4403 South Dishman-Mica Road Spokane County, WA DATE: ASTM 0.0 SYMBOL 0.0 SYMBOL 0.0 SYMBOL 1.5 FILL 1.5 FILL 1.5 FILL 1.5 SIIty Sand, fine to medium grained, with roots, dark brown, wet. 12.0 SILTY CLAYEY SAND, fine grained, brown, wet, very 12.0 SLTY CLAYEY SAND, fine grained, brown, wet, very 12.0 SC-SM 14.10vium) 20.5 SC-SM 20.5 CL 20.5 LEAN CLAY, brown, wet. (Alluvium) 23.0 SILTY SAND, fine grained, brown, water-bearing, (Alluvium) 23.0 SM 24.0 SM 24.0 SM 25.5 SP 20.5 S	Levee Evaluation and Certification Painted Hills Golf Course Property 4403 South Dishman-Mica Road Spokane County, WA DEPTH D2487 0.0 SYMBOL 0.0 SYMBOL 1.5 FILL Clayey Sand, fine to medium grained, with roots, 1.5 FILL Clayey Sand, fine to medium grained, dark brown, moist to wet. 10.0 FILL Silty Sand, fine to medium grained, dark brown, moist to wet. 10.0 SILTY CLAYEY SAND, fine grained, brown, wet, very 12.0 SOUTH SAND, fine grained, brown, wet, very 12.0 SOUTH SAND, fine grained, brown, wet, very 12.0 CL LEAN CLAY, brown, wet. (Alluvium) 20.5 SP 20.5 SILTY SAND, fine grained, brown, water-bearing. (Alluvium) 23.0 SILTY SAND, fine grained, brown, water-bearing. (Alluvium) 25.5 SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, noose. (Alluvium) 25.5 SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense. (Alluvium) 25.5 SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense. (Alluvium) 26.5 SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense. (Alluvium) 26.5 SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense. (Alluvium) 27.5 SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense. (Alluvium) 27.5 SP POORLY GRADED SAND, fine to medium grained, brown, water not encountered with 24' of hollow-stem auger in the ground. Groundwater not encountered with 24' of hollow-stem auger in the ground. Groundwater not encountered with 24' of hollow-stem auger in the ground. Groundwater not encountered immediately after withdrawal.	Levee Evaluation and Certification Painted Hills Golf Course Property 4403 South Dishman-Mica Road Spokane County, WA DEPTH D2487 DEPTH D2487 DESCRIPTION OF MATERIALS 0.0 sYMBOL 0.0 SYMBOL 1.5 FILL Clayey Sand, fine to medium grained, with roots, dark brown, wet. 1.5 FILL SILTY CLAYEY SAND, fine grained, brown, wet, very 1.0.0 SILTY CLAYEY SAND, fine grained, brown, wet, very 1.0.0 SC-SM loose. (Alluvium) 20.5 CL 20.5 CL 20.5 CL 20.5 CL 20.5 SP PORLY GRADED SAND, fine to medium grained, brown, water-bearing, loose. (Alluvium) 23.0 SILTY SAND, fine grained, brown, water-bearing. (Alluvium) 23.0 SLTY SAND, fine grained, brown, water-bearing. (Alluvium) 25.5 SP PORLY GRADED SAND, fine to medium grained, brown, water-bearing, loose. (Alluvium) 25.5 SP PORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense. (Alluvium) 25.5 SP PORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense. (Alluvium) 26.5 SP CL 20.5 CL	Levee Evaluation and Certification Painted Hills Golf Course Property 4403 South Dishman-Mica Road Spokane County, WA DEPTH D2487 0.0 SYMBOL 1.5 FILL Clayey Sand, fine to medium grained, with roots, dark brown, wet. Silty Sand, fine to medium grained, dark brown, moist to wet. 10.0 SULTY CLAYEY SAND, fine grained, brown, wet, very 12.0 SC-SM loose. (Alluvium) SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, loose. (Alluvium) SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, loose. (Alluvium) 22.5 SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, loose. (Alluvium) SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, loose. (Alluvium) 3 3 1 4 4 4 4 4 4 4 4 4 4 4 5 5 5 SP POORLY GRADED SAND, fine to medium grained, brown, water-bearing, medium dense. (Alluvium) 3 4 4 7 7 1 Thinwall sample from 21 13



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DDCIT	OT						ical cue		ind Consultin
PROJE		4-037			RINO			<b>B-</b> 3	
	P 4	ainted H 403 Sou	Evaluation and Certification       LOCATION:       See         I Hills Golf Course Property       Map         Duth Dishman-Mica Road       DATE       Map						ocation
				DA	TE:	4/7/14		SCALE:	1"=4'
ELEV. 2014.6		ASTM D2487 SYMBOL			N	WL	TES	STS OR	NOTES
2013.1	1.5	FILL	Clayey Sand, fine to medium grained, with roots, black, wet.						
		FILL	Silty Sand, fine to medium grained, dark brown, moist.	X	8				
2009.6	5.0		Poorly Graded Sand, fine to medium grained, brown	$-\overline{X}$	5				
			moist.						
		FILL		X	23				
2004.6	10.0		CANDY LEAN CLAY brown wat modium		6				
2002.6	12.0	CL	SANDY LEAN CLAY, brown, wet, medium. (Alluvium)						
			CLAYEY SAND, fine to medium grained, with seams of Poorly Graded Sand, brown, wet to water-bearing, loose to medium dense. (Alluvium)	X	7				
		SC		X	13				
1989.1	25.5			X	14				
			End of Boring. Groundwater down 10.5' with 24' of hollow-stem auger in the ground. Groundwater down 10.5' immediately after withdrawal. Boring then grouted to surface.	J					



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PROJE		4-037			-						
	-				RING			-4			
	P 4	Levee Evaluation and Certification Painted Hills Golf Course Property 4403 South Dishman-Mica Road		LO	CATI	ON:	See Boring Location Map				
	د 		County, WA	DA	TE:	4/8/14	I SCAL	.E:	1"=4'		
ELEV. 2014.9	•	ASTM D2487 SYMBOL	DESCRIPTION OF MATERIALS		N	WL	TESTS	OR	NOTES		
			Silty to Silty Clayey Sand, fine to medium grained, with roots, dark gray, moist.								
2010.0		FILL		K	18						
2010.9	4.0		Silty Sand, fine grained, brown to gray, moist.	-X	14						
		FILL			45						
2005.9	9.0			<u> </u>	15						
		SP-SM	POORLY GRADED SAND WITH SILT, fine to medium grained, moist, medium dense. (Alluvium)	X	13						
2000.9	14.0										
		SC	CLAYEY SAND, fine to medium grained, brown, wet, loose. (Alluvium)	X	7						
1996.9	18.0				Thir	nwall sa 	ample from	16'	-18'		
			POORLY GRADED SAND WITH SILT, fine to medium grained, brown, water-bearing, medium dense. (Alluvium)	X	19						
	2	SP-SM									
1989.4	25.5				17						
			End of Boring.								
			Groundwater down 19' with 24' of hollow-stem auge in the ground. Groundwater down 19' immediately after withdrawa								
			Groundwater down 18' 1 day after withdrawal.								
			Boring then grouted to surface.								

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					G	eotech	nical E	ngmeern	ng ar	d Consultin
PROJE		4-037		BO	RINC	ì:		E	-5	
	P 4	ainted H 403 Sou	aluation and Certification Hills Golf Course Property Ith Dishman-Mica Road	LO	CATI	ON:	See Ma		g Lo	cation
	S	pokane	County, WA	DA	TE:	4/10/	'14	SCA	-E:	1"=4'
ELEV. 2014.6	0.0	ASTM D2487 SYMBOL	DESCRIPTION OF MATERIALS		N	WL	т	ESTS	OR	NOTES
2014.1	0.5	FILL	Silty Sand, fine to medium grained, with roots, dark							
010 6	4.0	FILL	brown, moist. Clayey Sand, fine grained, dark-gray to gray brown, moist to wet.		3					
2010.6	4.0		Silty Sand, fine to mediun grained, dark brown, moi							
		FILL	to wet.		6					
2007.6	7.0									
2005.6	9.0	CL-ML	SANDY SILTY CLAY, brown, wet, soft. (Alluvium)	X	2					
		SC-SM	SILTY CLAYEY SAND, fine grained, with/seams of Poorly Graded Sand, brown, wet to water bearing, loose to very loose. (Alluvium)		5 Thir 3	nwall s	sampl	e from	11'	-13'
1997.6	17.0	SP	POORLY GRADED SAND, fine to medium grained, brown, water-bearing, loose to medium dense. (Alluvium)	X	8					
1989.1	25.5			X	16					
		Υ.	End of Boring. Groundwater down 17.5' with 24' of hollow-stem auger in the ground. Groundwater down 8.5' immediately after withdraw Groundwater down 8.5' 3 hours after withdrawal. Boring then grouted to surface.	-0	I					



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						seotecn	nical Er	ngmeenr	ıg ar	id Consulting
PROJ		.4-037		BO	RINC	à:		B	-6	
	F	Painted H 1403 Sou	Hills Golf Course Property Mi uth Dishman-Mica Road							cation
			County, WA	DATE: 4/10/			'14	SCAL	.E:	1"=4'
ELEV. 2014.7		ASTM D2487 SYMBOL	DESCRIPTION OF MATERIALS		N	WL	Τí	ESTS (	OR	NOTES
2013.7	1.0	FILL	Silty Sand, very fine to medium grained, with roots, dark brown, moist.							
2010.7	4.0	FILL	Silty Sand, fine to medium grained, gray-brown, moist.	X	4					
		SC	Clayey Sand, very fine to fine grained, dark gray, we (Possible Fill)	t. K	4					
2007.7	7.0			-						
		SM	SILTY SAND, fine to medium grained, brown-gray, wet to water-bearing, very loose. (Possible Fill)	X	2					
2002.7	12.0			X	3 Thir	wall s	ample	e from	11'	-12'
		SM	SILTY SAND, fine to medium grained, brown, water-bearing, medium dense. (Alluvium)	X	8					
1996.7	18.0									
		SP	POORLY GRADED SAND, fine to medium grained, with seams of Clayey Sand, brown, water-bearing, loose. (Alluvium)	X	8					
1989.2	25.5			X	8					
			End of Boring.	-13						
			Groundwater down 22.5' with 24' of hollow-stem auger in the ground. Groundwater down 7.5' immediately after withdrawa Boring then grouted to surface.	al.						



RELA	TIVE DENSITY OR COM	<b>NSISTENCY VERSUS SPT</b>	N-VALVE
COARSE-C	GRAINED SOILS	FINE-GRAI	NED SOILS
DENSITY	N(BLOWS/FT)	CONSISTENCY	N(BLOWS/FT)
Very Loose	0 - 4	Very Soft	0 - 1
Loose	4 - 10	Soft	2 - 3
Madium Danas	11 - 30	Rather Soft	4 - 5
Medium-Dense	11 - 30	Medium	6 - 8
David	21 50	Rather Stiff	9 - 12
Dense	31 - 50	Stiff	13 - 16
Marri Danas	5.50	Very Stiff	17 - 30
Very Dense	> 50	Hard	> 30

	USCS SOIL	CLASSIFI	CATION	V	
I	MAJOR DIVISIONS			GROUP DESCR	IPTIONS
Coarse-	Gravel and	Gravel	GW	Well Graded Grav	el
Grained	Gravelly Soils	(with little or no fines)	GP	Poorly Graded Gra	avel
Soils	<50% coarse fraction	Gravel	GM	Silty Gravel	
	passes #4 sieve	(with >12% fines)	GC	Clayey Gravel	
<50%	Sandy and	Sand	SW	Well Graded Sand	
passes #200	Sandy Soils	(with little or no fines)	SP	Poorly Graded Sar	nd
sieve	>50% coarse fraction	Sand	SM	Silty Sand	
	passes #4 sieve	(with >12% fines)	SC	Clayey Sand	
Fine-			ML	Silt	
Grained	Silt and Clay		CL	Lean Clay	
Soils	Liquid Limit < 50		OL	Organic Silt and C	lay (low plasticity)
>50%			MH	Inorganic Silt	
passes #200	Salt and Clay		CH	Fat Clay	
sieve	Liquid Limit > 50		OH	Organic Clay and S	ilt (med to high plasticity)
	Highly Organic Soils		РТ	Peat	Muck

MODIF	IERS
DESCRIPTION	RANGE
Occasional	<5%
Trace	5% - 12%
With	>12%

M	OISTURE CONTENT
DESCRIPTION	FIELD OBSERVATION
Dry	Absence of moisture, dusty, dry to the touch
Moist	Dry of optimum moisture content
Wet	Wet of optimum moisture content

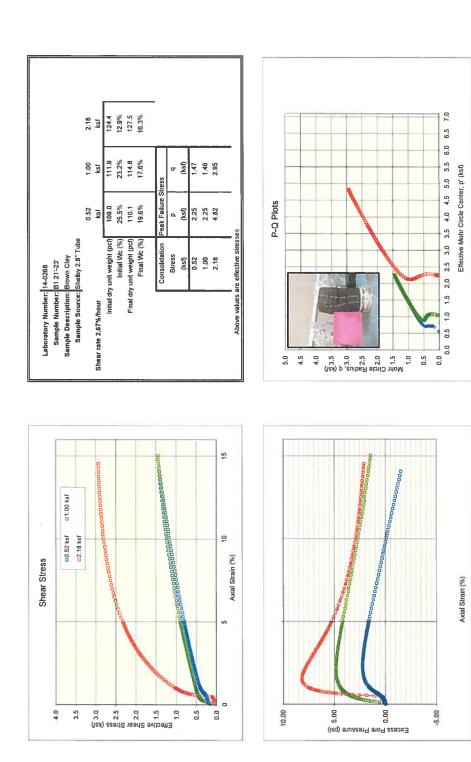
•

	MA	JOR DIVISI	ONS WITH	I GRAIN S	SIZE		
		SI	EVE SIZE				
	12"	3" 3	/4"	4 1	0 4	0 2	200
		GRAIN	SIZE (INC	CHES)			
	12	3	0.75	0.19 0	0.079 0	.0171	0.0029
Douldons	Cabbles	Gr	avel		Sand		Silt and Clay
Boulders	Cobbles	Coarse	Fine	Coarse	Medium	Fine	

# APPENDIX C

# LABORATORY TEST RESULTS

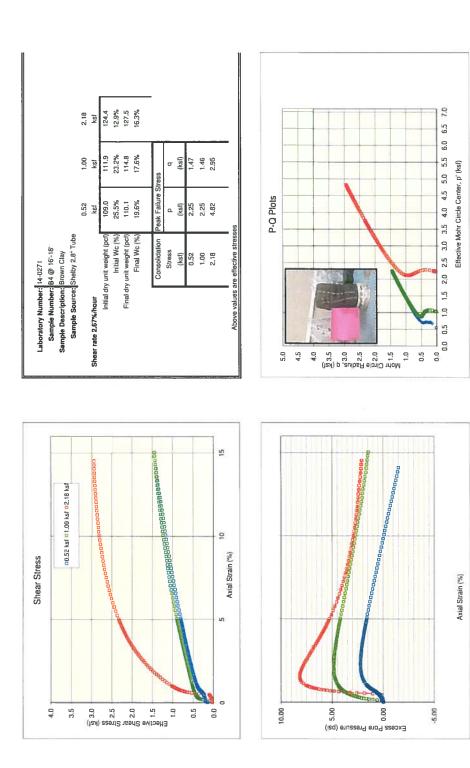
Report of CU Triaxial Shear Test ASTM D4767-11



TRIAXIAL SHEAR TEST RESULTS Project: Painted Hills Levee Location: 4403 S Dishman-Mica Rd, Spokane Valley, WA Project Number: L14183



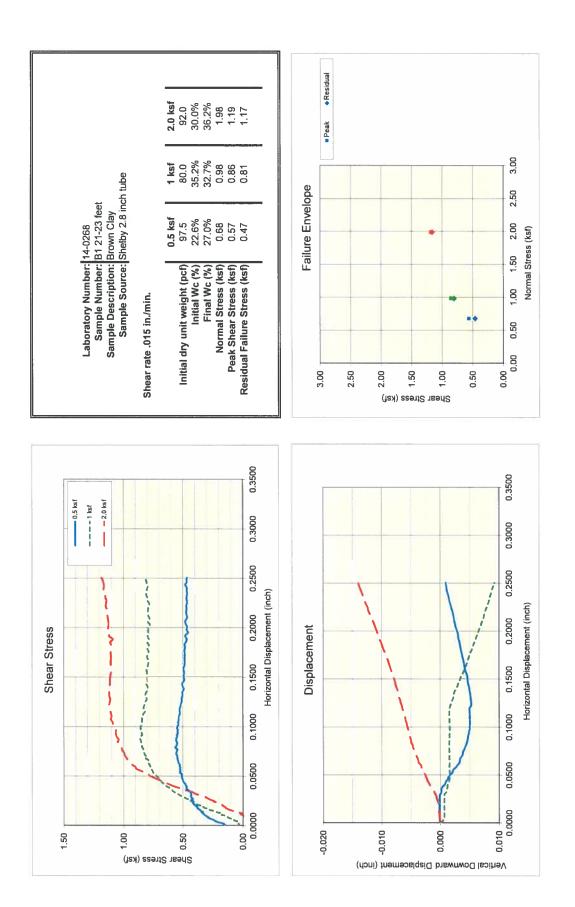
Report of CU Triaxial Shear Test ASTM D4767-11



TRIAXIAL SHEAR TEST RESULTS Project: Painted Hills Levee Location: 4403 S Dishman-Mica Rd, Spokune Valley, WA Project Number: L14183



Report of Direct Shear Test ASTM D3080

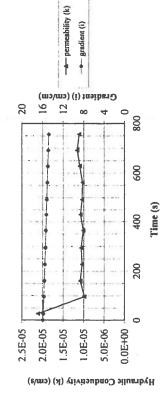


DIRECT SHEAR TEST RESULTS Project: Painted Hills Levee Location: 4403 S Dishman-Mica Rd, Spokane Valley, WA Project Number: L14183



LI4183 Painted Hills Levee - permeability (flex wall)

Sample ID: Tealed Py: Sample Discription:         Rest (b): Tealed Py: Tealed Py: Sample Discription:         Sample Discription: Tealed Py: Tealed Py: Teale	Display         Example         Description: Tital Dy Description: EXA         Tital Dy Description: Tital Dy Dy Distribution: Tital Dy	DD:         Bit matched Bit Tit/2         Stand Tit/2         Tit/2         Stand Tit/2         Tit/2         Stand Tit/2         Sta	ASTM D 5084 Permeability (F	ASTM D 5084 Permeability (Flexible Wall) Test Data Results Project No.: <u>L14183</u>	Data Results L14183			Project Location:	۲	Painted Hills Levee	8468					Remolded			
OFIN:         Dial         Trant Modular Context:         Dial         Trant Modular Context:         Dial         Trant Modular Context:         Dial         Dial <thdia< th=""> <thdia< th="">         Dia</thdia<></thdia<>	ef 69. <u>a 60.1.</u> <u>a 60.1.</u> <u>a 60.1.1.</u> <u>a 60.1.1.</u> <u>a 60.1.1.</u> <u>a 60.1.1.</u> <u>a 60.1.1.</u> <u>a 60.1.1.1.</u> <u>a 60.1.1.1.</u> <u>a 60.1.1.1.</u> <u>a 60.1.1.1.</u> <u>a 60.1.1.1.</u> <u>a 60.1.1.1.</u> <u>a 60.1.1.1.1.</u> <u>a 60.1.1.1.1.</u> <u>a 60.1.1.1.1.1.1.</u> <u>a 60.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1.1</u>	efekt. <u>BA</u> efekt. <u>BA</u> <u>efekt. <u>BA</u> <u>efekt. <u>10,0</u> <u>efekt.</u> <u>10,0</u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u></u> <u>efekt. <u>10,0</u> <u>efekt. <u>10,0</u> <u>efekt.</u> <u>10,0</u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u></u>	σř	ample ID: ested Bv:	B6 @ 11'-12' TB		- w	sample Descripti	ion:	silt with some	sand				×	Undisturbed			
Or Nic.         14-0273         Date Tested:         5/07/4         4/0         0.000         Chamber         0.000 <thchamber< th=""> <thchamber< th=""> <thcham< td=""><td>Orbit         14-0273         Date Tealet:         SR/14 Sec 1         SR/14 Sec 1         Chember 330         Chember 330         SR/14 Sec 1         Advantation         0.900 cm           Thm         Temp         Upper         330         Final Length, L, 300         Final Length, L, 300         Paration         0.900 cm           Time         Temp         Deretification         41.0         Final Length, L, 40.0         Paration         40.466           (a)         "C         R, Vu(1)         Vu(1)         Vu(1)         Vu(1)         Paration         43.74         40.466           (b)         "C         R, Vu(1)         Vu(1)         Vu(1)         Vu(1)         Paration         Reading         Paration         Paration         Paration         0.466</td><td>Or No.         14-0273         Date Tealet:         SR14 Sec         Chember 330         SR14 4         A mean tealet         SR14 300         A mean tealet         Oper 330         Chember 330         Oper 410         SR14 410         A mean tealet         Oper 330         Chember 410         Oper 410         SR14 410         A mean tealet         Oper 410         Oper 410</td><td>Sa</td><td>impled By:</td><td>B&amp;A</td><td></td><td>Fin</td><td>tal Moisture Con</td><td>vy. Itent:</td><td>19.7%</td><td>3</td><td></td><td></td><td></td><td></td><td></td></thcham<></thchamber<></thchamber<>	Orbit         14-0273         Date Tealet:         SR/14 Sec 1         SR/14 Sec 1         Chember 330         Chember 330         SR/14 Sec 1         Advantation         0.900 cm           Thm         Temp         Upper         330         Final Length, L, 300         Final Length, L, 300         Paration         0.900 cm           Time         Temp         Deretification         41.0         Final Length, L, 40.0         Paration         40.466           (a)         "C         R, Vu(1)         Vu(1)         Vu(1)         Vu(1)         Paration         43.74         40.466           (b)         "C         R, Vu(1)         Vu(1)         Vu(1)         Vu(1)         Paration         Reading         Paration         Paration         Paration         0.466	Or No.         14-0273         Date Tealet:         SR14 Sec         Chember 330         SR14 4         A mean tealet         SR14 300         A mean tealet         Oper 330         Chember 330         Oper 410         SR14 410         A mean tealet         Oper 330         Chember 410         Oper 410         SR14 410         A mean tealet         Oper 410	Sa	impled By:	B&A		Fin	tal Moisture Con	vy. Itent:	19.7%	3								
Chamber         420         manusure         0.000         manusure         manusure         0.000         manusure         manusure         0.000         manusure         0.000         manusure         manusure         manusure         manusure         manusure         manusure         manusure <th cols<="" td=""><td>Condition         Condition         420         Feature in 10         Condition         Feature in 10         Condin         Conditio         Conditio<td>Chamber         420           Chamber         Chamber         Chamber         Chamber         Clamber         <th 2"="" <="" <th="" colspan="2" final="" length="" light="" td="" time=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Chamber</td><td>42.C</td><td>_</td><td></td><td><b>B</b> influent burrett</td><td>0.906</td><td>sm²</td></th></td></td></th>	<td>Condition         Condition         420         Feature in 10         Condition         Feature in 10         Condin         Conditio         Conditio<td>Chamber         420           Chamber         Chamber         Chamber         Chamber         Clamber         <th 2"="" <="" <th="" colspan="2" final="" length="" light="" td="" time=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Chamber</td><td>42.C</td><td>_</td><td></td><td><b>B</b> influent burrett</td><td>0.906</td><td>sm²</td></th></td></td>	Condition         Condition         420         Feature in 10         Condition         Feature in 10         Condin         Conditio         Conditio <td>Chamber         420           Chamber         Chamber         Chamber         Chamber         Clamber         <th 2"="" <="" <th="" colspan="2" final="" length="" light="" td="" time=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Chamber</td><td>42.C</td><td>_</td><td></td><td><b>B</b> influent burrett</td><td>0.906</td><td>sm²</td></th></td>	Chamber         420           Chamber         Chamber         Chamber         Chamber         Clamber         Clamber <th 2"="" <="" <th="" colspan="2" final="" length="" light="" td="" time=""><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>Chamber</td><td>42.C</td><td>_</td><td></td><td><b>B</b> influent burrett</td><td>0.906</td><td>sm²</td></th>	<td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td>Chamber</td> <td>42.C</td> <td>_</td> <td></td> <td><b>B</b> influent burrett</td> <td>0.906</td> <td>sm²</td>									Chamber	42.C	_		<b>B</b> influent burrett	0.906	sm²
Lover         410         Final Area, A         40.466         colspan="6"         410         Final Area, A         40.466         colspan="6"         410         Final Area, A         40.466         colspan="6"         410         Colspan="6"         Final Area, A         40.466         colspan="6"         410  <	Time         Time <th< td=""><td>Lover         410         Final Area, A         40.066 cm           Time         Tenp         Tenp         Tent gradient         11.3         Final Area, A         40.066 cm           (a)         °C         Rr,         Upper changes         Incommand Flow         Antimative         Antive         &lt;</td><td>System Constan</td><td>1ť, C</td><td>0.906</td><td>1 (cm<sup>2</sup>)</td><td></td><td></td><td></td><td>Upper</td><td>39.0</td><td></td><td></td><td>Final Length, Lr</td><td>9.860</td><td>m</td></th<>	Lover         410         Final Area, A         40.066 cm           Time         Tenp         Tenp         Tent gradient         11.3         Final Area, A         40.066 cm           (a)         °C         Rr,         Upper changes         Incommand Flow         Antimative         Antive         <	System Constan	1ť, C	0.906	1 (cm <sup>2</sup> )				Upper	39.0			Final Length, Lr	9.860	m			
Time         Tent         Tast gradient         14.3           Time         Temp         Buretia         Indextringia         Indextringia         ASTM           (a)         °C         Rr         Upper         Indextringia         Indextringia         Haution           (a)         °C         Rr         Upper         Indextringia         Haution         Ratio         Head Inference           (a)         °C         Rr         Upper         Indow         Outforw         Ratio         Head Inference         Ratio	Time         Test gradient         14.3           Time         Terry         Readings         Incremental Flow         Partimiser         ATM           (a)         °C         R,         Upper         Lower         Lower         Math         Partimiser         AtM           (a)         °C         R,         Upper         Lower         Lower         Math         Partimiser         AtM           (a)         °C         R,         Unitser         Lower         Lower         Math         Partimiser         AtM	Time         Test gradient         143         Test gradient         143           1         0         <								Lower	41.0			Final Area, Ar	40.496	am <sup>4</sup>			
Time         Temp         Temp         Temp         Temp         Ast Main	$ \begin{array}{c c c c c c c c c c c c c c c c c c c $	Time         Temp         Burette         Incremental Flow           (a)         "C         Rr         Upper         Lower         Infow         Outflow         Ratio         Head Offference         Rating Head         Rating H	2							Test gradient	14.3	1							
°C         R1         Upper         Lover         Inflow         Cuttor         Ratio         Heed Officence'         Gcadient         Peed Immary         Final'           0         Vu(t)         Vu(t)         Vu(t)         Vu(t)         (coven)         (upper)         Inflow         Ratio         Heed Officence'         Gcadient         Peed Officence'         KAL         Kau           0         21         0.980         195         27         (cov         (cor)         (cor)         KAL         Kau         MAL         MAL         Kau         MAL         MAL <td><sup>1</sup>C         R<sub>1</sub>         Upper Lower         Inflow Low         Inflow         Cuttow Low         Ratio Low         Head Offference         Result Ava.         Pealinnary (monty)         Final Final Ava.           0         21         0.000         19.5         2.7         (cc)         (cc</td> <td><sup>0</sup>C         R<sub>1</sub>         Upper (w)         Lower (w)         Infow (w)         Cuttow (w)         Ratio (w)         Head Offference (w)         Restor (w)         Frainmary         Frain         Kau         Cut         Cut<td>Date</td><td>Time (s)</td><td>Ψ I</td><td>dwa</td><td>Re Re</td><td>urette adings</td><td></td><td>Incremental Flov</td><td>2</td><td></td><td></td><td></td><td>ASTM Falling Head</td><td>ASTM Constant</td></td>	<sup>1</sup> C         R <sub>1</sub> Upper Lower         Inflow Low         Inflow         Cuttow Low         Ratio Low         Head Offference         Result Ava.         Pealinnary (monty)         Final Final Ava.           0         21         0.000         19.5         2.7         (cc)         (cc	<sup>0</sup> C         R <sub>1</sub> Upper (w)         Lower (w)         Infow (w)         Cuttow (w)         Ratio (w)         Head Offference (w)         Restor (w)         Frainmary         Frain         Kau         Cut         Cut <td>Date</td> <td>Time (s)</td> <td>Ψ I</td> <td>dwa</td> <td>Re Re</td> <td>urette adings</td> <td></td> <td>Incremental Flov</td> <td>2</td> <td></td> <td></td> <td></td> <td>ASTM Falling Head</td> <td>ASTM Constant</td>	Date	Time (s)	Ψ I	dwa	Re Re	urette adings		Incremental Flov	2				ASTM Falling Head	ASTM Constant			
Vu(t)         Vu(t) <th< td=""><td><math display="block"> \begin{array}{ c c c c c c c c c c c c c c c c c c c</math></td><td>Multiple         Vu(l)         Vu(l)</td><td>-</td><td></td><td>ပ္</td><td>R</td><td>Upper</td><td>Lower</td><td>Inflow</td><td>Outflow</td><td>Ratio</td><td>Head Difference</td><td>Gradient</td><td>Prelimnary</td><td>Final</td><td>Head</td></th<>	$ \begin{array}{ c c c c c c c c c c c c c c c c c c c$	Multiple         Vu(l)	-		ပ္	R	Upper	Lower	Inflow	Outflow	Ratio	Head Difference	Gradient	Prelimnary	Final	Head			
0         (cc)         (c	0         (cc)         (c	0         21         0.990         195         27         0.990         197.5         157.6         (cm) <sup>1</sup> /sec.)					(ΩnΛ	ر۱) ۷ <sub>۱</sub> (۱)	(lower)	(npper)	In/Out	(1) H		KAVL	k <sub>20</sub> (x107)	¥			
0         21         0900         195         27         157.5         1530         89E-05         21E-05         2           26         21         0390         100         10         30         05         10         155.7         15.90         89E-05         21E-05         2           160         21         0390         165         35         05         10         155.7         15.90         89E-05         21E-05         39E-05         21E-05         39E-05         11E-05         39E-05         10E-05         39E-05         10E-05         39E-05 <td>0         21         0.990         195         21           26         21         0.990         190         55         15         15         16         15         16         &lt;</td> <td>0         21         0390         195         21         1530         1530         1530         1530         1530         1530         1530         1530         1530         1530         1530         1530         1530         1550         1550         1550         1550         1550         1550         1650         <th1650< th=""> <th1650< th="">         1650</th1650<></th1650<></td> <td></td> <td></td> <td></td> <td></td> <td>(cc)</td> <td>(33)</td> <td>(C)</td> <td>(33)</td> <td></td> <td>(cm)</td> <td></td> <td>(cm<sup>2</sup>/sec)</td> <td>(cm/sec)</td> <td>(cm/sec)</td>	0         21         0.990         195         21           26         21         0.990         190         55         15         15         16         15         16         <	0         21         0390         195         21         1530         1530         1530         1530         1530         1530         1530         1530         1530         1530         1530         1530         1530         1550         1550         1550         1550         1550         1550         1650 <th1650< th=""> <th1650< th="">         1650</th1650<></th1650<>					(cc)	(33)	(C)	(33)		(cm)		(cm <sup>2</sup> /sec)	(cm/sec)	(cm/sec)			
26         21         0390         160         30         05         05         156.7         156.7         156.0         82E-05         2.1E-05         39E-06         2.1E-05         39E-06         11E-05         39E-06 <td>26         21         0.990         190         30         05         165         156.7         1590         38-05         2.1E-05           96         21         0.990         18.5         3.5         0.5         0.6         156.7         15.90         38-05         2.1E-05         99-06           160         21         0.990         18.5         3.5         0.5         0.6         156.7         15.90         4.E-05         11E-05         99-06         11E-05         11E-05</td> <td>26         21         0380         180         30         05         16         15.7         15.80         885-05         216.05         160         165.7         16.90         165.7         16.90         165.7         16.90         160         165.7         16.90         160         165.7         16.90         160         165.7         16.90         160         165.7         16.90         160         160         165.7         16.90         160</td> <td>5/8/14</td> <td>0</td> <td>21</td> <td>0.980</td> <td>19.5</td> <td>2.7</td> <td></td> <td></td> <td></td> <td>157.5</td> <td>15.98</td> <td></td> <td></td> <td></td>	26         21         0.990         190         30         05         165         156.7         1590         38-05         2.1E-05           96         21         0.990         18.5         3.5         0.5         0.6         156.7         15.90         38-05         2.1E-05         99-06           160         21         0.990         18.5         3.5         0.5         0.6         156.7         15.90         4.E-05         11E-05         99-06         11E-05	26         21         0380         180         30         05         16         15.7         15.80         885-05         216.05         160         165.7         16.90         165.7         16.90         165.7         16.90         160         165.7         16.90         160         165.7         16.90         160         165.7         16.90         160         165.7         16.90         160         160         165.7         16.90         160	5/8/14	0	21	0.980	19.5	2.7				157.5	15.98						
96         21         0.980         18.5         3.5         0.5         1.0         15.7         15.79         4.1E-05         9.9E-06           160         21         0.980         18.0         4.0         0.5         0.5         1.0         15.7         15.86         1.4E-05         9.9E-06           21         0.980         17.5         4.5         0.5         0.5         1.0         15.77         15.69         4.4E-05         1.1E-05           233         21         0.980         17.5         4.5         0.5         0.5         1.0         15.77         15.89         4.4E-05         1.1E-05           243         21         0.980         16.0         6.5         0.5         0.5         1.0         15.77         15.89         4.4E-05         1.1E-05           363         21         0.980         16.0         6.0         0.5         0.5         1.0         16.77         15.39         4.4E-05         1.1E-05           641         21         0.980         15.0         0.5         0.5         1.0         14.78         4.4E-05         1.1E-05           650         21         0.980         15.0         0.5         0.5	96         21         0.990         165         35         0.05         1.0         155.7         15.79         4.1E-05         992.06           160         21         0.990         160         50         0.5         1.0         153.7         15.80         4.4E-05         11E-05           223         21         0.990         11.6         5.0         0.5         0.5         1.0         152.7         15.49         4.4E-05         11E-05           223         21         0.990         16.5         5.5         0.5         1.0         152.7         15.49         4.4E-05         11E-05           363         21         0.990         16.5         5.5         0.5         0.5         1.0         152.7         15.49         4.4E-05         11E-05           363         21         0.980         16.5         6.6         0.5         0.5         0.0         1.16-05           361         21         0.980         14.5         7.4         0.5         0.5         1.0         14.95         1.1E-05           570         21         0.980         13.5         7.4         0.5         1.0         14.95         1.1E-05           581	96         21         0.980         185         35         0.5         10         155.7         15.79         4.1E-05         9.9E-06           221         0.980         180         4.0         0.5         0.5         1.0         154.7         15.89         4.4E-05         1.1E-05           221         0.980         17.0         5.0         0.5         0.5         1.0         152.7         15.99         4.4E-05         1.1E-05           283         21         0.980         16.5         6.5         0.5         1.0         152.7         15.99         4.4E-05         1.1E-05           363         21         0.980         16.5         6.4         0.5         0.5         1.0         157.7         15.39         4.2E-05         1.1E-05           491         21         0.980         16.5         6.4         0.5         0.5         1.0         145.05         1.1E-05           501         21         0.980         15.5         6.4         0.5         0.5         1.0         14.79         4.2E-05         1.1E-05           502         21         0.980         15.5         6.5         0.5         1.0         14.19         4.2E-05		26	21	0.980	19.0	3.0	0.3	0.5	0.6	156.7	15.90	8.9E-05	2.1E-05	2.4E-05			
160     21     0960     180     40     05     05     10     1547     1568     46E 05     1E05       227     21     0390     175     45     05     05     10     1537     1558     46E 05     10E 05       233     21     0390     175     55     05     10     1517     1539     45E 05     10E 05       233     21     0390     160     60     05     05     10     1517     1539     45E 05     10E 05       363     21     0390     160     60     05     05     10     1517     1539     45E 05     11E 05       41     21     0390     155     64     0.4     0.5     0.6     160     16.05       561     21     0390     135     84     0.5     0.5     1.0     1478     1.4505     1.1E 05       560     21     0390     135     84     0.5     0.5     1.0     1478     1.4505     1.1E 05       570     21     0390     135     84     0.5     0.5     1.0     1478     1.4505     1.1E 05       580     21     0390     135     0.5     0.5     1.0     1	160     21     0.990     180     40     05     05     10     1547     15.69     4.4E-05     1.1E-05       227     21     0.990     17.5     4.5     0.5     0.5     10     1537     15.59     4.4E-05     1.0E-05       283     21     0.980     165     5.5     0.5     0.5     10     1517     15.39     4.2E-05     1.1E-05       383     21     0.980     165     5.5     0.5     0.5     10     1517     15.39     4.2E-05     1.1E-05       383     21     0.980     165     6.4     0.4     0.5     0.5     10     151.7     15.39     4.2E-05     1.1E-05       491     21     0.980     165     6.4     0.4     0.5     0.5     10     141.7     15.39     4.2E-05     1.1E-05       581     21     0.980     140     7.4     0.5     0.5     0.5     1.0     141.8     1.4E-05     1.1E-05       580     21     0.980     140     7.4     0.5     0.5     0.5     1.0     141.8     1.4E-05     1.1E-05       581     21     0.980     13.5     7.4     0.5     0.5     0.5     1.0	160     21     0390     180     40     05     10     1547     1580     48E-05     11E-05       227     21     0390     17.5     55     0.5     10     1537     1539     48E-05     110-05       283     21     0390     17.5     55     0.5     0.5     10     1517     1539     48E-05     110-05       383     21     0390     16.5     55     0.5     0.5     10     1517     1539     42E-05     116-05       383     21     0390     16.5     55     0.5     0.5     10     1517     1539     42E-05     116-05       383     21     0390     15.0     6.0     0.5     0.5     1.0     1517     15.20     43E-05     11E-05       581     21     0390     13.5     8.4     0.5     0.5     1.0     1418     1489     14E-05     11E-05       580     21     0380     13.5     8.4     0.5     0.5     1.0     1418     1489     14E-05     11E-05       580     21     0380     13.5     8.4     0.5     0.5     1.0     1418     14505     14E-05     11E-05       581     21 </td <td></td> <td>8</td> <td>21</td> <td>0.980</td> <td>18.5</td> <td>3.5</td> <td>0.5</td> <td>0.5</td> <td>1.0</td> <td>155.7</td> <td>15.79</td> <td>4.1E-05</td> <td>9.9E-06</td> <td>1.1E-05</td>		8	21	0.980	18.5	3.5	0.5	0.5	1.0	155.7	15.79	4.1E-05	9.9E-06	1.1E-05			
227     21     0.880     175     4,5     0,5     0,5     10     153.7     15,59     4,4E,05     1,1E-05       233     21     0.980     16,5     5,0     0,5     0,5     1,0     152.7     15,49     4,4E,05     1,1E-05     1       33     21     0.980     16,5     5,5     0,5     0,5     1,0     15,7     15,49     4,4E,05     1,1E-05     1       491     21     0.980     15,5     6,4     0,5     0,5     0,8     1,93     15,20     4,4E,05     1,1E-05     1       61     21     0.980     15,5     6,4     0,5     0,5     0,8     1,49     4,4E,05     1,1E-05     1       620     21     0.980     14,5     7,4     0,5     0,5     1,0     147,8     1,45,05     1,1E-05     1       630     21     0.980     13,5     8,4     0,5     0,5     1,0     1,45,8     1,45,05     1,1E-05     1       756     21     0.980     13,5     8,4     0,5     0,5     1,0     1,45,8     1,45,05     1,1E-05       756     21     0.980     13,5     8,4     0,5     0,5     1,0     1,45,8 <t< td=""><td>227     21     0.980     17.5     4.5     0.5     0.5     10     15.37     15.59     4.4E-05     1.1E-05       233     21     0.980     16.0     55     0.5     0.5     10     15.27     15.49     4.5E-05     1.1E-05     1       333     21     0.980     16.5     5.5     0.5     0.5     10     15.77     15.49     4.5E-05     1.1E-05     1       333     21     0.980     16.5     6.0     0.5     0.5     10     150.17     15.29     4.4E-05     1.1E-05     1       491     21     0.980     15.5     6.4     0.4     0.5     0.3     10     14.0     1.5.09     4.4E-05     1.1E-05     1       561     21     0.980     15.5     6.4     0.5     0.5     1.0     14.08     15.09     4.4E-05     1.1E-05       630     21     0.980     13.5     8.4     0.5     0.5     1.0     14.69     4.4E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     1.0     14.79     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     1.0</td><td>227     21     0.980     17.5     4.5     0.6     0.5     1.0     153.7     15.59     4.4€-05     1.0E-05       233     21     0.980     16.5     5.0     0.5     0.5     1.0     15.7     15.49     4.8E-05     1.1E-05     1       363     21     0.980     16.5     6.5     0.5     0.5     1.0     15.7     15.39     4.8E-05     1.1E-05     1       491     21     0.980     16.5     6.4     0.4     0.5     0.5     1.0     15.0     4.8E-05     1.1E-05     1       561     21     0.980     15.0     6.9     0.5     0.5     0.6     1.0     15.0     4.8E-05     1.1E-05     1       561     21     0.980     15.0     6.9     0.5     0.5     0.6     1.0     14.08     1.4E-05     1.1E-05       576     21     0.980     13.5     8.4     0.5     0.5     0.5     1.0     1.46.05     1.0E-05     1       576     21     0.980     13.5     8.4     0.5     0.5     1.0     1.41.8     4.8E-05     1.1E-05       576     21     0.980     13.5     8.4     0.5     0.5     1.0     1</td><td></td><td>160</td><td>21</td><td>0.980</td><td>18.0</td><td>4.0</td><td>0.5</td><td>0.5</td><td>1.0</td><td>154.7</td><td>15.69</td><td>· 4.6E-05</td><td>1.1E-05</td><td>1.2E-05</td></t<>	227     21     0.980     17.5     4.5     0.5     0.5     10     15.37     15.59     4.4E-05     1.1E-05       233     21     0.980     16.0     55     0.5     0.5     10     15.27     15.49     4.5E-05     1.1E-05     1       333     21     0.980     16.5     5.5     0.5     0.5     10     15.77     15.49     4.5E-05     1.1E-05     1       333     21     0.980     16.5     6.0     0.5     0.5     10     150.17     15.29     4.4E-05     1.1E-05     1       491     21     0.980     15.5     6.4     0.4     0.5     0.3     10     14.0     1.5.09     4.4E-05     1.1E-05     1       561     21     0.980     15.5     6.4     0.5     0.5     1.0     14.08     15.09     4.4E-05     1.1E-05       630     21     0.980     13.5     8.4     0.5     0.5     1.0     14.69     4.4E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     1.0     14.79     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     1.0	227     21     0.980     17.5     4.5     0.6     0.5     1.0     153.7     15.59     4.4€-05     1.0E-05       233     21     0.980     16.5     5.0     0.5     0.5     1.0     15.7     15.49     4.8E-05     1.1E-05     1       363     21     0.980     16.5     6.5     0.5     0.5     1.0     15.7     15.39     4.8E-05     1.1E-05     1       491     21     0.980     16.5     6.4     0.4     0.5     0.5     1.0     15.0     4.8E-05     1.1E-05     1       561     21     0.980     15.0     6.9     0.5     0.5     0.6     1.0     15.0     4.8E-05     1.1E-05     1       561     21     0.980     15.0     6.9     0.5     0.5     0.6     1.0     14.08     1.4E-05     1.1E-05       576     21     0.980     13.5     8.4     0.5     0.5     0.5     1.0     1.46.05     1.0E-05     1       576     21     0.980     13.5     8.4     0.5     0.5     1.0     1.41.8     4.8E-05     1.1E-05       576     21     0.980     13.5     8.4     0.5     0.5     1.0     1		160	21	0.980	18.0	4.0	0.5	0.5	1.0	154.7	15.69	· 4.6E-05	1.1E-05	1.2E-05			
233     21     0.890     17.0     5.0     0.5     0.5     1.0     15.7     15.49     4.5E-05     1.1E-05       333     21     0.990     16.5     5.5     0.5     1.0     161.7     15.39     4.2E-05     1.0E-05     1       429     21     0.990     15.5     6.4     0.4     0.5     0.5     1.0     161.7     15.20     4.4E-05     1.0E-05     1       421     21     0.990     15.5     6.4     0.4     0.5     0.5     0.8     149.8     15.20     4.4E-05     1.0E-05     1       421     21     0.990     15.5     6.4     0.5     0.5     1.0     147.8     1.6E-05     1     1.6E-05     1       561     21     0.990     14.5     7.4     0.5     0.5     1.0     147.8     1.4E-05     1.1E-05     1       563     21     0.990     13.5     8.4     0.5     0.5     1.0     1.46.8     1.489     4.9E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     1.418     1.429     4.7E-05     1.1E-05       756     21     0.990     13.5     8.4	233     21     0.880     17.0     5.0     0.5     0.5     1.0     15.7     15.49     4.5E-05     1.1E-05       333     21     0.980     16.5     5.5     0.5     1.0     151.7     15.39     4.2E-05     1.0E-05     1       421     21     0.980     16.5     6.4     0.5     0.5     1.0     15.7     15.39     4.2E-05     1.0E-05     1       421     21     0.980     15.5     6.4     0.5     0.5     1.0     147.8     1.55.29     4.2E-05     1.1E-05     1       421     21     0.980     15.5     6.4     0.5     0.5     1.0     147.8     1.6E-05     1       561     21     0.980     14.5     7.4     0.5     0.5     1.0     147.8     1.4E-05     1.1E-05       563     21     0.980     13.5     8.4     0.5     0.5     1.0     146.8     1.1E-05     1.1E-05       563     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.1E-05     1.1E-05       563     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.47.9     4.7E-05     1.1E-05	233     21     0380     170     50     05     05     10     1527     1549     45E-05     11E-05       383     21     0380     165     55     0.5     0.5     0.5     10     1617     15.39     42E-05     10E-05     1       461     21     0380     155     6.4     0.5     0.5     0.6     149.8     15.20     43E-05     10E-05     1       261     21     0380     15.0     6.9     0.5     0.5     0.6     1.49.8     15.00     42E-05     10E-05     1       627     21     0380     15.0     6.9     0.5     0.5     1.0     143.8     15.09     43E-05     11E-05       756     21     0380     13.5     8.4     0.5     0.5     1.0     145.8     14.78     45E-05     11E-05       756     21     0380     13.5     8.4     0.5     0.5     1.6     0.5     0.5     1.4.88     1.6E-05     1.1E-05       756     21     0380     13.5     8.4     0.5     0.5     0.6     1.4.88     1.4.89     1.4.605     1.1E-05       758     21     0380     13.5     8.4     0.5     0.5		227	21	0.980	17.5	4.5	0.5	0.5	1.0	153.7	15.59	4.4E-05	1.0E-05	1.2E-05			
363     21     0.800     165     5.5     0.5     0.5     1.0     151.7     15.39     4.2E-05     1.0E-05     1       423     21     0.800     16.0     6.0     0.5     0.5     0.5     1.0     151.7     15.39     4.2E-05     1.1E-05     1       431     21     0.980     15.0     6.9     0.5     0.5     1.0     143.8     15.09     4.3E-05     1.1E-05     1       561     21     0.980     15.0     6.9     0.5     0.5     1.0     147.8     1.6E-05     1     1.6E-05     1       630     21     0.980     15.0     6.9     0.5     0.5     1.0     147.8     1.47.9     4.7E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     146.8     1.489     4.7E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.7E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.7E-05     1.1E-05     1       7     14.0 <td< td=""><td>363     21     0.800     165     5.5     0.5     0.5     10     1517     15.39     4.25-05     1.0E-05     1       423     21     0.890     16.0     6.0     0.5     0.5     0.5     1.0     15.29     4.25-05     1.1E-05     1       431     21     0.980     15.5     6.4     0.4     0.5     0.5     1.0     145.8     1.1E-05     1       561     21     0.980     15.0     6.9     0.5     0.5     1.0     147.8     1.52.03     4.4E-05     1.1E-05     1       620     21     0.980     15.0     6.9     0.5     0.5     1.0     147.8     1.47.9     4.7E-05     1.1E-05     1       630     21     0.980     13.5     8.4     0.5     0.5     1.0     146.8     1.47.9     4.7E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     4.7E-05     1.1E-05     1       600     13.5     8.4     0.5     0.5     1.0     145.8     4.7E-05     1.1E-05     1       756     13.5     0.5     1.0     145.8     1.4778     1.7E-05     1   <td>383     21     0.890     165     5.5     0.5     10     1517     1539     4.25-05     1.0E-05     1       429     21     0.890     16.0     6.0     0.5     0.5     0.5     1.0     160.7     15.29     4.26-05     1.1E-05     1       431     21     0.980     15.0     6.9     0.5     0.5     1.0     147.8     15.20     4.8E-05     1.1E-05     1       561     21     0.980     14.5     7.4     0.5     0.5     1.0     147.8     1.52.09     4.8E-05     1.1E-05     1       650     21     0.980     14.0     7.9     0.5     0.5     1.0     147.8     1.6E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     147.8     1.6E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     147.8     1.6E-05     1       756     21     0.980     13.5     0.5     0.5     1.0     147.8     4.7E-05     1.1E-05       756     21     0.980     13.5     0.5     0.5     1.0     145.8     4.7E-05     1.1E-05       756     21<!--</td--><td></td><td>293</td><td>21</td><td>0.980</td><td>17.0</td><td>5.0</td><td>0.5</td><td>0.5</td><td>1.0</td><td>152.7</td><td>15.49</td><td>4.5E-05</td><td>1.1E-05</td><td>1.2E-05</td></td></td></td<>	363     21     0.800     165     5.5     0.5     0.5     10     1517     15.39     4.25-05     1.0E-05     1       423     21     0.890     16.0     6.0     0.5     0.5     0.5     1.0     15.29     4.25-05     1.1E-05     1       431     21     0.980     15.5     6.4     0.4     0.5     0.5     1.0     145.8     1.1E-05     1       561     21     0.980     15.0     6.9     0.5     0.5     1.0     147.8     1.52.03     4.4E-05     1.1E-05     1       620     21     0.980     15.0     6.9     0.5     0.5     1.0     147.8     1.47.9     4.7E-05     1.1E-05     1       630     21     0.980     13.5     8.4     0.5     0.5     1.0     146.8     1.47.9     4.7E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     4.7E-05     1.1E-05     1       600     13.5     8.4     0.5     0.5     1.0     145.8     4.7E-05     1.1E-05     1       756     13.5     0.5     1.0     145.8     1.4778     1.7E-05     1 <td>383     21     0.890     165     5.5     0.5     10     1517     1539     4.25-05     1.0E-05     1       429     21     0.890     16.0     6.0     0.5     0.5     0.5     1.0     160.7     15.29     4.26-05     1.1E-05     1       431     21     0.980     15.0     6.9     0.5     0.5     1.0     147.8     15.20     4.8E-05     1.1E-05     1       561     21     0.980     14.5     7.4     0.5     0.5     1.0     147.8     1.52.09     4.8E-05     1.1E-05     1       650     21     0.980     14.0     7.9     0.5     0.5     1.0     147.8     1.6E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     147.8     1.6E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     147.8     1.6E-05     1       756     21     0.980     13.5     0.5     0.5     1.0     147.8     4.7E-05     1.1E-05       756     21     0.980     13.5     0.5     0.5     1.0     145.8     4.7E-05     1.1E-05       756     21<!--</td--><td></td><td>293</td><td>21</td><td>0.980</td><td>17.0</td><td>5.0</td><td>0.5</td><td>0.5</td><td>1.0</td><td>152.7</td><td>15.49</td><td>4.5E-05</td><td>1.1E-05</td><td>1.2E-05</td></td>	383     21     0.890     165     5.5     0.5     10     1517     1539     4.25-05     1.0E-05     1       429     21     0.890     16.0     6.0     0.5     0.5     0.5     1.0     160.7     15.29     4.26-05     1.1E-05     1       431     21     0.980     15.0     6.9     0.5     0.5     1.0     147.8     15.20     4.8E-05     1.1E-05     1       561     21     0.980     14.5     7.4     0.5     0.5     1.0     147.8     1.52.09     4.8E-05     1.1E-05     1       650     21     0.980     14.0     7.9     0.5     0.5     1.0     147.8     1.6E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     147.8     1.6E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     147.8     1.6E-05     1       756     21     0.980     13.5     0.5     0.5     1.0     147.8     4.7E-05     1.1E-05       756     21     0.980     13.5     0.5     0.5     1.0     145.8     4.7E-05     1.1E-05       756     21 </td <td></td> <td>293</td> <td>21</td> <td>0.980</td> <td>17.0</td> <td>5.0</td> <td>0.5</td> <td>0.5</td> <td>1.0</td> <td>152.7</td> <td>15.49</td> <td>4.5E-05</td> <td>1.1E-05</td> <td>1.2E-05</td>		293	21	0.980	17.0	5.0	0.5	0.5	1.0	152.7	15.49	4.5E-05	1.1E-05	1.2E-05			
429     21     0.890     160     6.0     0.5     0.0     16.07     15.29     4.86-05     1.16-05     1       491     21     0.990     15.5     6.4     0.4     0.5     0.8     149.8     15.20     4.46-05     1.06-05     1       81     21     0.990     15.5     6.4     0.4     0.5     0.5     1.0     147.8     15.09     4.86-05     1.16-05     1       87     21     0.990     14.5     7.4     0.5     0.5     1.0     147.8     1.803     4.86-05     1.16-05     1       690     21     0.990     14.0     7.9     0.5     0.5     1.0     146.8     1.819     4.96-05     1.16-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.76-05     1.16-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.76-05     1.16-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.76-05     1.16-05       756     14.79     1.479     4.76-05<	429     21     0.800     16.0     6.0     0.5     0.5     10     15.07     15.29     4.56.05     11E-05     1       61     21     0.3900     15.5     6.4     0.5     0.5     10     143.8     15.20     4.45-05     116-05     1       551     21     0.3900     14.5     7.4     0.5     0.5     1.0     147.8     1.62-05     1     1.62-05     1       756     21     0.3900     13.5     8.4     0.5     0.5     1.0     147.8     1.62-05     1     1.62-05     1       756     21     0.3900     13.5     8.4     0.5     0.5     1.0     147.8     1.42-05     1.12E-05     1       756     21     0.3900     13.5     8.4     0.5     0.5     1.0     145.8     1.42-05     1.1E-05     1       756     21     0.3900     13.5     8.4     0.5     0.5     1.0     145.8     1.47-05     1.1E-05     1       756     21     0.3900     13.5     8.4     0.5     0.5     1.0     145.8     1.47-05     1.1E-05     1       7     7     7     7     0.5     0.5     1.0     145.8	429     21     0.890     16.0     6.0     0.5     0.0     15.20     4.85.05     11E-05     1       41     21     0.390     15.5     6.4     0.5     0.5     1.0     143.8     15.20     4.85.05     11E-05     1       551     21     0.390     14.5     7.4     0.5     0.5     1.0     147.8     15.20     4.85.05     1.1E-05     1       756     21     0.390     13.5     8.4     0.5     0.5     1.0     147.8     1.890     4.86.05     1.1E-05     1       756     21     0.390     13.5     8.4     0.5     0.5     1.0     145.8     1.4205     1.1E-05     1       756     21     0.390     13.5     8.4     0.5     0.5     1.0     145.8     1.1E-05     1       756     21     0.390     13.5     8.4     0.5     0.5     1.0     147.8     4.7E-05     1.1E-05       756     21     0.390     13.5     0.5     0.5     1.0     147.79     4.7E-05     1.1E-05       7     4.46     14.68     4.96     4.7E-05     1.1E-05     1       7     4.7     0.5     0.5     0.5     0.5		363	21	0.980	16.5	5.5	0.5	0.5	1.0	151.7	15.39	4.2E-05	1.0E-05	1.1E-05			
481     21     0.880     155     6.4     0.4     0.5     0.8     149.8     15.20     4.4E-05     1.0E-05     1       581     21     0.980     15.0     6.9     0.5     0.5     1.0     148.8     15.09     4.3E-05     1.0E-05     1       627     21     0.980     14.0     7.4     0.5     0.5     1.0     148.8     14.99     4.3E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.459     4.7E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.7E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.7E-05     1.1E-05       756     1     1.0     145.8     1.479     4.7E-05     1.1E-05     1       756     1     0.5     0.5     0.5     1.0     145.8     1.1E-05     1       756     1     1.458     1.479     4.7E-05     1.1E-05     1     1       8     4.860.5     1.0     145.8 <td< td=""><td>481     21     0.880     15.5     6.4     0.4     0.5     0.8     149.8     15.20     4.4E-05     1.0E-05     1       531     21     0.980     15.0     6.9     0.5     0.5     1.0     143.8     15.09     4.3E-05     1.0E-05     1       527     21     0.980     14.5     7.4     0.5     0.5     1.0     144.8     14.39     4.8E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.47.9     4.7E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     145.8     1.47.9     4.7E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     145.8     1.47.9     4.7E-05     1.1E-05       756     21     0.990     13.5     8.4     0.5     0.5     1.0     1.45.8     1.17.9     4.7E-05     1.1E-05       756     1     1.6     145.8     1.47.9     4.7E-05     1.1E-05     1       standard water</td><td>401     21     0.080     155     6.4     0.4     0.5     0.8     1498     15.20     4.4E-05     10E-05     1       27     21     0.990     145     74     0.5     0.5     10     1478     15.09     4.4E-05     1.1E-05     1       630     21     0.990     14.0     7.9     0.5     0.5     1.0     1478     4.4E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     1458     4.4E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     1458     4.4E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     1458     4.4E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     1.0     14.79     4.7E-05     1.1E-05       7     14.79     4.45.8     14.79     4.7E-05     1.1E-05     1.1E-05       1     1     14.58     1.477     4.770     1.1E-05       1     1     1.45.8     1.479     4.7E-05     1.1E-05  </td><td></td><td>429</td><td>21</td><td>0.980</td><td>16.0</td><td>6.0</td><td>0.5</td><td>0.5</td><td>1.0</td><td>150.7</td><td>15.29</td><td>4.5E-05</td><td>1.1E-05</td><td>1.2E-05</td></td<>	481     21     0.880     15.5     6.4     0.4     0.5     0.8     149.8     15.20     4.4E-05     1.0E-05     1       531     21     0.980     15.0     6.9     0.5     0.5     1.0     143.8     15.09     4.3E-05     1.0E-05     1       527     21     0.980     14.5     7.4     0.5     0.5     1.0     144.8     14.39     4.8E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.47.9     4.7E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     145.8     1.47.9     4.7E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     145.8     1.47.9     4.7E-05     1.1E-05       756     21     0.990     13.5     8.4     0.5     0.5     1.0     1.45.8     1.17.9     4.7E-05     1.1E-05       756     1     1.6     145.8     1.47.9     4.7E-05     1.1E-05     1       standard water	401     21     0.080     155     6.4     0.4     0.5     0.8     1498     15.20     4.4E-05     10E-05     1       27     21     0.990     145     74     0.5     0.5     10     1478     15.09     4.4E-05     1.1E-05     1       630     21     0.990     14.0     7.9     0.5     0.5     1.0     1478     4.4E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     1458     4.4E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     1458     4.4E-05     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     1458     4.4E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     1.0     14.79     4.7E-05     1.1E-05       7     14.79     4.45.8     14.79     4.7E-05     1.1E-05     1.1E-05       1     1     14.58     1.477     4.770     1.1E-05       1     1     1.45.8     1.479     4.7E-05     1.1E-05		429	21	0.980	16.0	6.0	0.5	0.5	1.0	150.7	15.29	4.5E-05	1.1E-05	1.2E-05			
561     21     0.990     15.0     6.3     0.5     0.5     1.0     148.8     15.09     4.3E-05     1.0E-05     1       627     21     0.990     14.5     7.4     0.5     0.5     1.0     147.8     1.429     4.3E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     146.8     1.429     4.7E-05     1     1.E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.7E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.7E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     145.8     1.179     4.7E-05     1.1E-05       1     1     1     1     1     1     1     1.5     6.05     1.16     1.6     1.6       7     21     0.390     13.5     8.4     0.5     0.5     1.10     145.8     1.17     4.7E-05     1.1E-05       1     1     1     1     1     1.6     1.6	561     21     0.990     15.0     6.3     0.5     0.5     1.0     148.8     15.09     4.3E-05     1.1E-05     1       627     21     0.990     14.5     7.4     0.5     0.5     1.0     147.8     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     146.8     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     146.8     1.47.99     4.7E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     146.8     1.47.99     4.7E-05     1.1E-05     1       756     21     0.990     13.5     8.4     0.5     0.5     1.0     146.8     1.47.99     4.7E-05     1.1E-05       7     1     1.0     145.8     1.47.99     4.7E-05     1.1E-05     1       8     1     1.0     145.8     1.47.99     4.7E-05     1       6     1     1.0     145.8     1.47.99     4.7E-05     1       1     1     1.0     145.8     1.47.99     4.7E-05     1       1     1     1.0     146.8	561     21     0.980     15.0     6.3     0.5     0.5     1.0     148.8     15.06     4.3E-05     1.0E-05     1       627     21     0.980     14.5     7.4     0.5     0.5     1.0     147.8     1.1E-05     1       756     21     0.980     14.0     7.9     0.5     0.5     1.0     146.8     1.1E-05     1       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.47.95     4.7E-05     1       756     21     0.390     13.5     8.4     0.5     0.5     1.0     145.8     1.1E-05     1       766     21     0.390     13.5     8.4     0.5     0.5     1.0     145.8     1.1E-05     1       756     21     0.390     13.5     8.4     0.5     0.5     1.0     145.8     1.1E-05     1       84     0.5     0.5     0.5     0.5     1.0     1.46.8     1.1E-05     1       standard water		491	21	0.980	15.5	6.4	0.4	0.5	0.8	149.8	15.20	4.4E-05	1.0E-05	1.2E-05			
27     21     0.990     14.5     7.4     0.5     0.5     1.0     147.8     14.99     4.6E-05     1.1E-05       690     21     0.990     14.0     7.9     0.5     0.5     0.5     1.0     145.8     1.4.79     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     0.5     1.0     145.8     1.4.79     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     0.5     1.0     145.8     1.4.79     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     0.5     1.0     145.8     1.4.79     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     1.167.05     1.1E-05       1     1     1     1     1     1     1     1     1.1E-05     1.1E-05       1     1     1     1     1     1     1     1.1E-05     1.1E-05       1     1     1     1     1     1     1     1.1E-05     1.1E-05       1     1     1     1     1     1<	27     21     0.900     14.5     7.4     0.5     0.5     1.0     147.8     14.99     4.6E-05     1.1E-05       690     21     0.900     13.5     8.4     0.5     0.5     1.0     146.8     1.489     4.9E-05     1.2E-05       756     21     0.900     13.5     8.4     0.5     0.5     1.0     145.8     1.479     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     0.5     1.0     145.8     1.479     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     0.5     1.0     145.8     1.4779     4.7E-05     1.1E-05       Itandard water	627     21     0.990     14.5     7.4     0.5     0.5     1.0     147.8     14.99     4.6E-05     1.1E-05       756     21     0.990     13.5     8.4     0.5     0.5     1.0     145.8     14.79     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     14.79     4.7E-05     1.1E-05       756     21     0.980     13.5     8.4     0.5     0.5     1.0     145.8     14.79     4.7E-05     1.1E-05       standard water		561	21	0.980	15.0	6.9	0.5	0.5	1.0	148.8	15.09	4.3E-05	1.0E-05	1.2E-05			
500         21         0.900         14.0         7.9         0.5         1.0         146.8         1.4.89         4.9E-05         1.2E-05         1           756         21         0.990         13.5         8.4         0.5         0.5         1.0         145.8         14.79         4.7E-05         1.1E-05         1           756         21         0.990         13.5         8.4         0.5         1.0         145.8         14.79         4.7E-05         1.1E-05         1           standard water	550         21         0.900         140         7.9         0.5         1.0         146.8         14.89         4.9E-05         1.2E-05         1           756         21         0.990         13.5         8.4         0.5         0.5         1.0         145.8         14.89         4.9E-05         1.1E-05         1           756         21         0.990         13.5         8.4         0.5         0.5         1.0         145.8         14.79         4.7E-05         1.1E-05         1           standard water	500         21         0.900         140         7.9         0.5         1.0         146.8         1.489         4.9E-05         1.2E-05         1.2E-05         1.1E-05         1.1E		627	21	0.980	14.5	7.4	0.5	0.5	1.0	147.8	14.99	4.6E-05	1.1E-05	1.2E-05			
756         21         0.800         135         8.4         0.5         0.0         14.79         4.7E-05         1.1E-05           No.well         Image: Standard water         Image: Standard water         Image: Standard water         Image: Standard water         1.1E-05         Image: Standard water         Image: Standard w	756     21     0.880     135     8.4     0.5     0.0     14.79     4.7E-05     1.1E-05       Image: Standard water	756     21     0.890     13.5     8.4     0.5     0.6     1.0     145.8     1.17E-05     1.1E-05       Image: Standard water       Standard water       Run 1 Permeability & Gradient vs Time		690	21	0.980	14.0	7.9	0.5	0.5	1.0	146.8	14.89	4.9E-05	1.2E-05	1.3E-05			
Itendend water	standard water	standard water Run 1 Permeability & Gradient vs Time		756	21	0.980	13.5	8.4	0.5	0.5	1.0	145.8	14.79	4.7E-05	1.1E-05	1.3E-05			
R <sub>ve</sub> ≡ 1.1E-05 last 4. cm/s	Isst 4 cm/s	tendard water standard water Run 1 Permeability & Gradient vs Time					1 · · · · · · · · · · · · · · · · · · ·												
standard water	standard weler	standard water standard water Run 1 Permeability & Gradient vs Time		A									1000						
standard water		standard water Run 1 Permeability & Gradient vs Time												Kava T	1.1E-05				
								-					- (18 ×	1881 4	CINS	cms			
		Run 1 Permeability & Gradient vs Time	Permeant liquit	d:	standard wate	*		the second second			and a second second second		to and the data light the - 1 is not some						
		Run 1 Permeability & Gradient vs Time																	

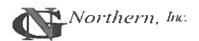


Budinger & Associates, Inc. Geotechnical & Environmental Engineers Construction Materials Testing & Special Inspection

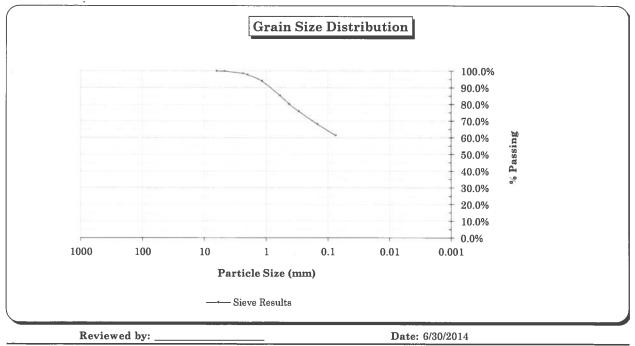
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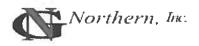


Project:	Painted Hills			Date Received: 5	/15/2014	
Client:	IPEC			Job #: S	14-033	
Material:				W.O. #:		
Source:	B1 @ 5' & 7.5'	(combined)		Lab #: 3	35	
	Percent	Specifi	ications	<u>Sieve Analysis I</u>	Data: ASTI	<u>M D422, D1140</u>
Sieve Size	<u>Passing</u>	<u>Minimum</u>	<u>Maximum</u>			
4"				Fineness Modulus:		
3"				% Gravel:	0.09	
2 1/2"				% Sand:	38.60	
2"				% Silt & Clay:	61.31	
1 1/2"				<b>Moisture Content:</b>	8.8%	
1 1/4"						
1"						
3/4"						
5/8"						
1/2"				Coefficient of U	niformity	Cu, and Curvature Cc
3/8"				$D_{60 (mm)} =$		C <sub>u</sub> =
1/4"	100.0%			$D_{30 (mm)} =$		C <sub>c</sub> =
#4	99.9%			$D_{10 (mm)} =$		
#8	98.5%					
#10	97.8%					
#16	94.0%					
#20						
#30	85.2%					
#40	80.2%					
#50	75.9%					
#60						
#80						
#100	68.2%					
#200	61.3%					

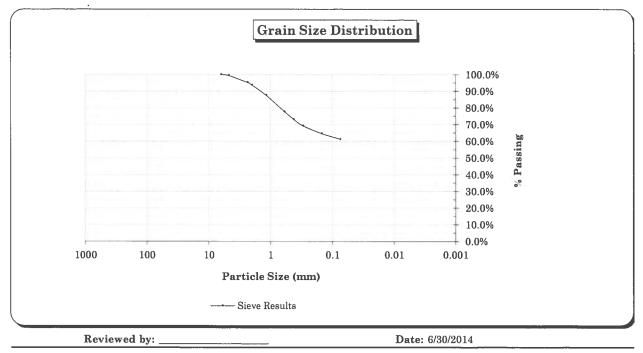


#### LABORATORY SIEVE ANALYSIS

#### GN Northern, Inc. 1 11115 E. Montgomery Ave., Suite C Spokane Valley, WA 99206

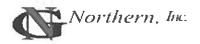


Project:	Painted Hills			Date Received: 5	/15/2014
Client:				Job #: S	
Material:				W.O. #:	
Source:	B2 @ 5'			Lab #: 3	36
	_				
	Percent	Specifi	cations	<u>Sieve Analysis I</u>	<u>Data: ASTM D422, D1140</u>
Sieve Size	Passing	<u>Minimum</u>	<u>Maximum</u>		
4"				Fineness Modulus:	
3"				% Gravel:	0.58
2 1/2"				% Sand:	38.13
2"				% Silt & Clay:	61.29
1 1/2"				Moisture Content:	11.4%
1 1/4"					
1"					
3/4"					
5/8"					
1/2"				<u>Coefficient of U</u>	niformity Cu, and Curvature Cc
3/8"				$D_{60 (mm)} =$	C <sub>u</sub> =
1/4"	100.0%			$D_{30 (mm)} =$	C <sub>c</sub> =
#4	99.4%			$D_{10 (mm)} =$	
#8	95.3%				
#10	93.7%				
#16	87.6%				
#20					
#30	77.8%				
#40	73.1%				
#50	69.3%				
#60					
#80					
#100	64.7%				
#200	61.3%				

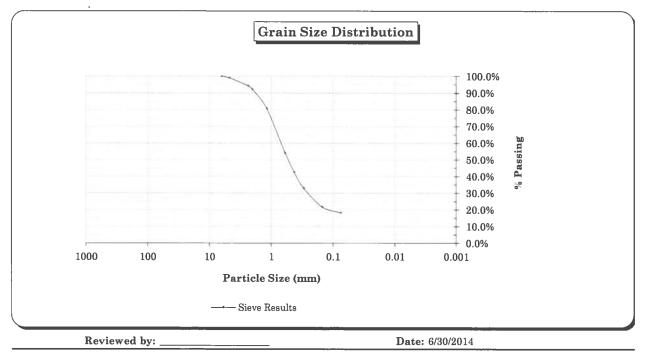


#### LABORATORY SIEVE ANALYSIS

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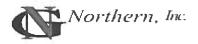


Project:	Painted Hills			Date Received: 5	/15/2014	
Client:	IPEC			Job #: S	14-033	
Material:				W.O. #:		
Source:	B2 @ 15'			Lab #: 3	37	
ę						
	Percent	Specifi	ications	<u>Sieve Analysis I</u>	Data: ASTM	D422, D1140
<u>Sieve Size</u>	<b>Passing</b>	<u>Minimum</u>	<u>Maximum</u>			
4"				Fineness Modulus:		
3"				% Gravel:	0.89	
2 1/2"				% Sand:	80.93	
2"				% Silt & Clay:	18.18	
1 1/2"				Moisture Content:		
1 1/4"						
1"						
3/4"						
5/8"						
1/2"				Coefficient of U	niformity Cu	<u>i, and Curvature Cc</u>
3/8"				D <sub>60 (mm)</sub> =		C <sub>u</sub> =
1/4"	100.0%			D <sub>30 (mm)</sub> =		$C_c =$
#4	99.1%			$D_{10 (mm)} =$		
#8	94.3%					
#10	92.1%					
#16	80.6%					
#20						
#30	54.2%					
#40	42.5%					
#50	33.0%					
#60						
#80						
#100	21.7%					
#200	18.2%					
1400	10.270					

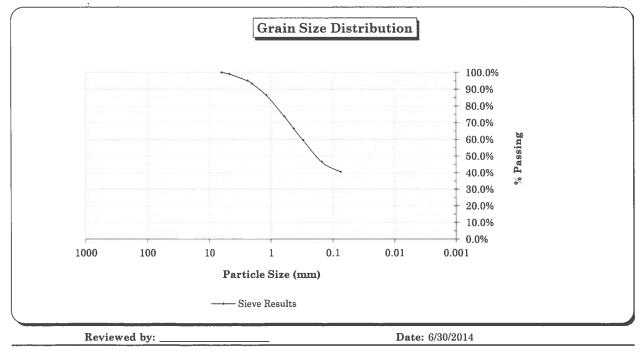


#### LABORATORY SIEVE ANALYSIS

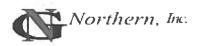
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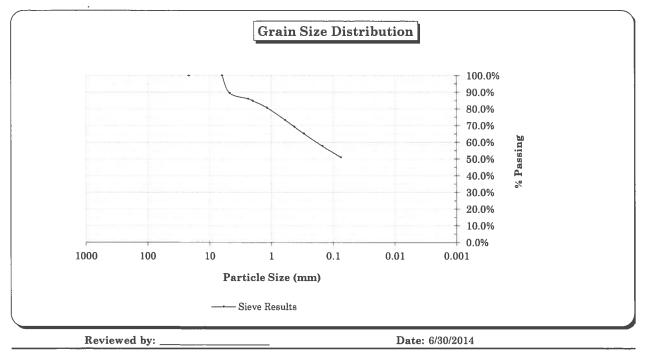
Project:	Painted Hills			Date Received: 5	/15/2014	
Client:	IPEC			Job#: S	14-033	
Material:				W.O. #:		
Source:	B3 @ 15'			Lab #: 3	38	
	· ·					
	Percent	Specifi	ications	<u>Sieve Analysis I</u>	Data: ASTM	<u>D422, D1140</u>
<u>Sieve Size</u>	Passing	<u>Minimum</u>	<u>Maximum</u>			
4"				<b>Fineness Modulus:</b>		
3"				• % Gravel:	0.84	
2 1/2"				% Sand:	58.80	
2"				% Silt & Clay:	40.36	
1 1/2"				Moisture Content:	14.2%	
1 1/4"						
1"						
3/4"						
5/8"						
1/2"				<u>Coefficient of U</u>	niformity C	u, and Curvature Cc
3/8"				$D_{60 (mm)} =$		C <sub>u</sub> =
1/4"	100.0%			D <sub>30 (mm)</sub> =		C <sub>c</sub> =
#4	99.2%			$D_{10 (mm)} =$		
#8	95.0%					
#10	93.3%					
#16	86.4%					
#20						
#30	73.5%					
#40	66.3%					
#50	59.4%					
#60						
#80						
#100	46.4%					
#200	40.4%					



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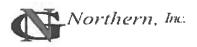


Project:	Painted Hills			Date Received: 5	/15/2014	
Client:	IPEC			Job #: S	14-033	
Material:				W.O. #:		
Source:	B4 @ 5'			Lab #: 3	39	
	Percent	Specifi	ications	<u>Sieve Analysis I</u>	Data: ASTM D4	<u>22, D1140</u>
Sieve Size	Passing	<u>Minimum</u>	<u>Maximum</u>			
4"				<b>Fineness Modulus:</b>		
3"				% Gravel:	10.52	
2 1/2"				% Sand:	38.47	
2"				% Silt & Clay:	51.01	
1 1/2"				Moisture Content:	12.5%	
1 1/4"						
1"						
3/4"						
5/8"						
1/2"				Coefficient of U	niformity Cu, a	<u>nd Curvature Cc</u>
3/8"				$D_{60 (mm)} =$		C <sub>u</sub> =
1/4"	100.0%			D <sub>30 (mm)</sub> =		C <sub>c</sub> =
#4	89.5%			$D_{10 (mm)} =$		
#8	86.1%					
#10	84.9%					
#16	80.8%					
#20						
#30	73.3%					
#40	69.3%					
#50	65.3%					
#60						
#80						
#100	57.8%					
#200	51.0%					

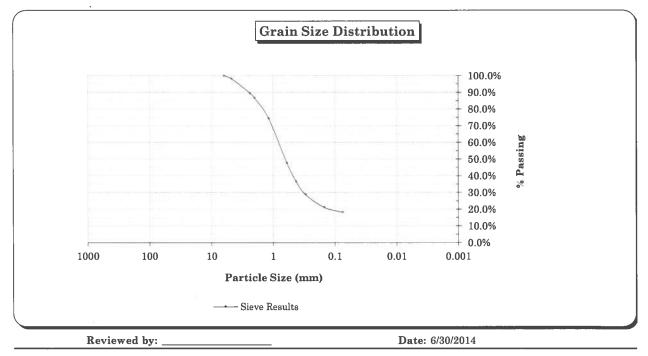


LABORATORY S	IEVE ANALYSIS
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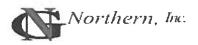
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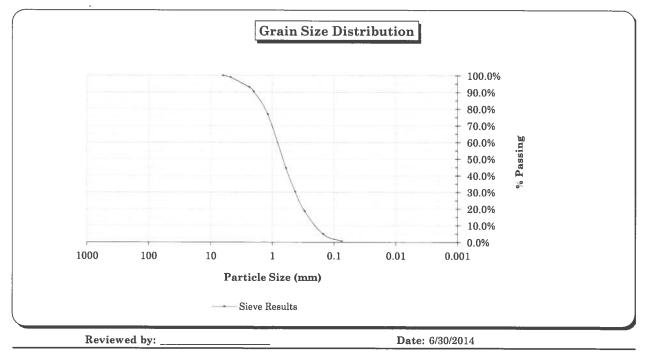
Project:	Painted Hills			Date Received: 5	/15/2014		
Client: IPEC			<b>Job #:</b> S14-033				
Material:				W.O. #:			
Source:	B4 @ 10'		Lab #: 340				
		····		,			
	Percent	Specifications <u>Sieve Analysis Data: ASTM D422, D1140</u>				<u>M D422, D1140</u>	
<u>Sieve Size</u>	<b>Passing</b>	<u>Minimum</u>	<u>Maximum</u>				
4"				Fineness Modulus:			
3"				% Gravel:	1.76		
2 1/2"				% Sand:	80.15		
2"				% Silt & Clay:	18.09		
1 1/2"				Moisture Content:			
1 1/4"							
1"							
3/4"							
5/8"							
1/2"				<b>Coefficient of U</b>	niformity	<u>Cu, and Curvature Cc</u>	
3/8"				$D_{60 (mm)} =$		C <sub>u</sub> =	
1/4"	100.0%			D <sub>30 (mm)</sub> =		C <sub>c</sub> =	
#4	98.2%			$D_{10 (mm)} =$			
#8	89.4%						
#10	86.7%						
#16	74.3%						
#20							
#30	47.6%						
#40	36.6%						
#50	28.8%						
#60							
#80							
#100	21.1%						
#200	18.1%						



### GN Northern, Inc. 11115 E. Montgomery Ave., Suite C Spokane Valley, WA 99206

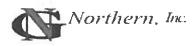


Project:	Painted Hills			Date Received: 5	/15/2014	······
Client: IPEC				<b>Job #:</b> S14-033		
Material:	Material:			W.O. #:		
Source:	B4 @ 15'			Lab #: 3	37	
	Percent	Specifications <u>Sieve Analysis Data: ASTM D422, D114</u>			<u>I D422, D1140</u>	
<u>Sieve Size</u>	<u>Passing</u>	<u>Minimum</u>	<u>Maximum</u>			
4"				Fineness Modulus:		
3"				% Gravel:	1.10	
2 1/2"				% Sand:	98.30	
2"				% Silt & Clay:	0.60	
1 1/2"				Moisture Content:		
1 1/4"						
1"						
3/4"						
5/8"						
1/2"				<u>Coefficient of U</u>	niformity C	Cu, and Curvature Cc
3/8"				$D_{60 (mm)} =$	-	C <sub>u</sub> =
1/4"	100.0%			D <sub>30 (mm)</sub> =		$C_c =$
#4	98.9%			$D_{10 \text{ (mm)}} =$		
#8	93.0%					
#10	90.4%					
#16	76.5%					
#20						
#30	44.3%					
#40	30.1%					
#50	18.7%					
#60						
#80						
#100	4.9%					
#200	0.6%					

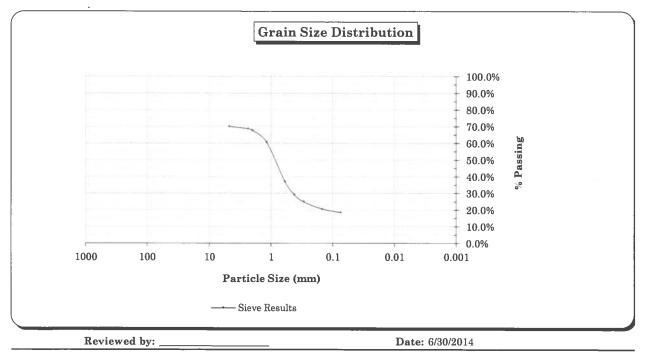


LABORATORY	SIEVE	ANALYSIS
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GN Northern, Inc. L 11115 E. Montgomery Ave., Suite C Spokane Valley, WA 99206



Project:	Painted Hills			Date Received: 5	/15/2014	
Client: IPEC				<b>Job #:</b> S14-033		
Material:				W.O. #:		
Source:	B4 @ 20'			Lab #: 3	41	
	Percent	Specifi	ications	<u>Sieve Analysis I</u>	Data: ASTM	D422, D1140
Sieve Size	Passing	<u>Minimum</u>	<u>Maximum</u>			
4"				<b>Fineness Modulus:</b>		
3"				% Gravel:		
2 1/2"				% Sand:	51.56	
2"				% Silt & Clay:	18.57	
1 1/2"				Moisture Content:	12.1%	
1 1/4"						
1"						
3/4"						
5/8"						
1/2"				Coefficient of U	niformity Cu	<u>i, and Curvature Cc</u>
3/8"				$D_{60 (mm)} =$		C <sub>u</sub> =
1/4"				$D_{30 (mm)} =$		C <sub>c</sub> =
#4	70.1%			$D_{10 (mm)} =$		
#8	68.7%					
#10	67.8%					
#16	60.6%					
#20						
#30	37.1%					
#40	29.3%					
#50	25.0%					
#60						
#80						
#100	20.6%					
#200	18.6%					
	2010/0					





Construction Materials Testing

Project:Painted HillsClient:IPECGN Job #:S14-033IPEC Job #:14-037

#### 200 Wash / ASTM D1140

Sample Location / ID	% Retained	% Passing	
B6@ 15'	56.7%	43.3%	
B4@5'	50.7%	49.3%	
B2@5'	48.4%	61.6%	
B4@10'	85%	14.8%	
B3@15'	70.6%	29.4%	
B6@5'	42.7%	57.3%	

**REMARKS**:

**REVIEWED BY:** 

Kal A.

Karl A. Harmon, LEG, PE

As a mutual protection to clients, the public and ourselves, all reports are submitted as the confidential property of our clients and authorization for publication of statements, conclusions or extracts from or regarding our reports is reserved pending our written approval.

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# APPENDIX D

# OPERATION AND MAINTENANCE MANUAL

# CHESTER CREEK LEVEE

# OPERATION & MAINTENANCE MANUAL

# FOR

# **LEVEE OPERATION AND MAINTENANCE**

**Chester Creek Homeowners Association** 

IPEC Project No. 14-037

### **FEBRUARY 2015**

By

Inland Pacific Engineering Company 3012 North Sullivan Road Building S-5, Suite C Spokane Valley, WA 99216

# 1.00 PURPOSE

This Operations and Maintenance manual is intended to provide general operations and maintenance guidelines for the Chester Creek levee located at 4403 South Dishman-Mica Road in Spokane County, Washington. The Homeowners Association will maintain the drainage facilities. This includes general maintenance for the levee whether in or out of Spokane County public road rights-of-ways. Implementation of these guidelines will ensure that the levee will function as required by 44 CFR 65.10 of the Code of Federal Regulations for certification by the Federal Emergency Management Agency (FEMA).

# 2.00 INTRODUCTION

The Chester Creek levee is on the east side of Chester Creek between Thorpe Road and Dishman-Mica Road. The creek side of the levee is typically at a 2.3:1 to 3:1 (H:V) slope. The land side of the levee is also at a 3:1 slope from the Dishman-Mica Road bridge to approximately 300 feet southeast. Between this point and Thorpe Road, the land side slope is much less and, in some areas, relatively level with the crest. The levee was constructed by the previous landowner for the development of the golf course on the property. We believe the levee was constructed in the early 1990's by the property owner.

The operation and maintenance of the levee is required to ensure that the levee certification obtained and future or on-going FEMA requirements are met.

# 3.00 GENERAL OPERATION AND MAINTENANCE

3.10 <u>Operation</u> – During flood periods, the levee should be patrolled to locate possible sand boils, unusual wetness of the landward slope, or levee breaches. The inspector may look for indications of sliding or sloughing, that scouring action is not occurring, that no reaches might be overtopped, and that no other conditions exist that might adversely affect the integrity of the levee.

- <u>Boils</u> A boil is a condition where enough pressure is produced by high water levels so that water is piped through or under the levee with sufficient velocity to carry earthen materials to the landward side of the levee. If not controlled, these particles of earthen materials will be eroded from within the levee, causing subsidence to the levee section. The continuation of this process may result in a break in the levee, allowing flood waters to flow over the crest or through the levee.
- <u>Scour</u> Careful observation should be made of the creek-side slope of the levee to detect potential erosion due to current action. Careful observation at the locations of bridge structures should be made. In general, current velocities in Chester Creek are not expected to cause significant scouring.
- <u>Levee Topping</u> If the anticipated high water level will exceeds the top elevation of

# CHESTER CREEK LEVEE OPERATION & MAINTENANCE MANUAL

the levee, steps should be taken to provide emergency topping to raise the levee grade above forecasted water levels. These steps could include sandbagging or hauling additional fill to raise the levee height.

A post-flood assessment of the levee should be completed within 24 hours of the event. The assessment should document any damage to the levee caused by flood waters. Any repairs necessary should then be completed after review and evaluation of options.

3.20 <u>Maintenance</u> – Maintenance activities for the levee are described in this section. Below is a maintenance description for each of the elements affecting levee performance.

- <u>Inspections</u> Levee inspection should include a visual inspection of the levee at a minimum of every 12 months for signs of erosion or settlement. Preferably, the inspection should be completed in the fall prior to the rainy season. The inspections should include the following:
  - Unusual settlement, sloughing, or material loss of grade.
  - Caving on both the creekside and landside of the levee which might affect stability of the levee section.
  - Seepage or saturated areas that may be occurring.
  - Drainage in the creek is in good working condition, facilities are not being clogged.
  - Crown of levee is shaped to drain properly.
  - Unauthorized vehicles on the levee.
  - Rodent damage along the levee.
- <u>Erosion Protection</u> The levee vegetation is a grass cover. The grass should be mowed to a minimum height no shorter than 3 inches. The last mowing should occur to allow for the grass to grow to 8-10 inches for winter protection and extend out 15 feet from the toe of the levee.

No trees should be growing on the levee or in the creek channel. No excavations, structures, or other obstructions should be on the levee or levee easement.

Remove accumulation of drift, grass clippings, or other objectionable materials from the levee side slopes and/or crest.

Attached is a checklist for the annual or post-flood inspection.

# CHESTER CREEK LEVEE OPERATION & MAINTENANCE MANUAL

### CHESTER CREEK LEVEE 4403 SOUTH DISHMAN-MICA ROAD SPOKANE COUNTY, WA

# LEVEE CHECKLIST

Date: \_\_\_\_\_

Item	Location and Description	Action
Has levee settled or lost cross section?		
Has stream action caused any levee slope washing or scouring?		
Has there been any seepage or saturated areas?		
Has vegetation been maintained?		
Have weeds been removed? Dates?		
Condition of any riprap?		
Have there been any authorized or unauthorized encroachments?		
Have burrowing animals been exterminated/removed and the levee repaired?		
Is the creek channel free of obstructions and/or debris?		
Are there any areas where the creek is affecting the levee slopes?		
Has there been any recent high water events?		
Miscellaneous conditions:		

Note: Use additional sheets as necessary.

Signed:_	 	
Title:		