

# IPEC

Inland Pacific Engineering Company  
Geotechnical Engineering and Consulting

October 14, 2014  
Project No. 14-086

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

Re: **Geotechnical Evaluation**  
**Proposed Stormwater Pond**  
**Parcel No. 45343.9052**  
**Spokane Valley, WA**

Dear Mr. Walker:

As you authorized, we have completed a geotechnical evaluation for geotechnical evaluation at the above-referenced site in Spokane Valley, Washington. The purpose of our services is to evaluate the subsurface soil and groundwater conditions relative to use as a stormwater management facility as part of the Painted Hills golf course property stormwater management system. This report summarizes the results of our site investigation, engineering analyses and recommendations.

## 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. To account for stormwater runoff volumes from the unnamed tributary along State Highway 27, you propose to use this parcel as a stormwater pond with drywells for subsurface infiltration.

## AVAILABLE INFORMATION

We were provided a conceptual site plan for the project by Whipple Consulting Engineers, Inc. (WCE). This plan showed the proposed pond limits, proposed and existing ground surface elevation contours, and property lines. This plan was prepared by WCE and was not dated.

## FIELD EVALUATION

### Procedures

A geotechnical engineer from Inland Pacific Engineering Company (IPEC) observed the excavation of four test pits at the site. The test pits were excavated on October 1, 2014 using a rubber-tired backhoe operated by an independent firm working under subcontract to IPEC. The geotechnical engineer from IPEC observed the test pit excavations and logged the surface and subsurface conditions. Ground surface elevations at the test pits were interpolated from the contours shown on the site plan.

The soils encountered in the test pits 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)". The samples were returned to our facility for review of the classification by a geotechnical engineer and laboratory testing.

### Soils Encountered

The test pit encountered glacially deposited silty sand at the surface overlying poorly graded sands to the termination depths of the test pits.

Groundwater was not encountered in the test pits during or after excavation. Well log data in the vicinity of the site indicate that groundwater levels range from approximately 90 to 100 feet.

Geologic maps indicate the soils in this area consist primarily of glacially deposited sands and gravels. According to the Soil Survey of Spokane County, the site soils are classified as Urban land-Springdale, disturbed complex. These soils are described as somewhat excessively drained soils that formed in sandy and gravelly glaciofluvial deposits with minor amounts of volcanic ash and loess in the upper part. The native soils exposed in the test pits were consistent with the NRCS data.

### Laboratory Testing

We performed grain size analysis tests on samples obtained from the test pits. The tests were performed in accordance with ASTM Method of Test D 6913. The results of the tests performed are attached to this report.

## ANALYSIS AND RECOMMENDATIONS

### Stormwater Recommendations

Based on the data obtained from the test pits, field permeability test, and laboratory tests performed, it is our opinion that swales and drywells would be suitable for infiltration of stormwater.

We estimated a design outflow rate for drywells using the results of the laboratory tests and the procedures described in the SRSM manual, Appendix 4A (Spokane 200 Method). The following table summarizes the results of the analysis.

Test Pit	Depth (feet)	USCS Classification	Percent Fines	Normalized Outflow Rate (cfs/ft)	Recommended Design Drywell Outflow Rate (cfs)	
					Type A	Type B
TP-1	10 – 12	SP	1.0	0.5	0.3	1.0
TP-2	10 – 12	SP	1.5	0.5	0.3	1.0
TP-3	10 – 12	SP	1.4	0.5	0.3	1.0
TP-4	10 – 12	SP	1.6	0.5	0.3	1.0

These recommended design outflow rates include a safety factor of 1.3 as required by the SRSM.

## REMARKS

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.

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.

## GENERAL REMARKS

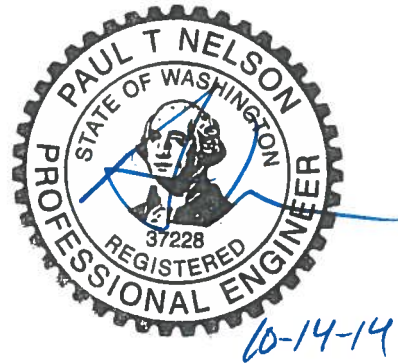
It has been a pleasure being of service to you for this project. If you have any questions or need additional information, please do not hesitate to call me at (509) 209-6262 at your convenience.

Sincerely,  
**Inland Pacific Engineering Company**



Paul T. Nelson, P.E.  
Principal Engineer

Attachments: Figure 1, Site Location Map  
Figure 2, NRCS Map  
Figure 3, Test Pit Location Map  
Logs of Test Pits TP-1 through TP-4  
Descriptive Terminology  
Laboratory Test Results



**FIGURE 1**



**Site Location Map**

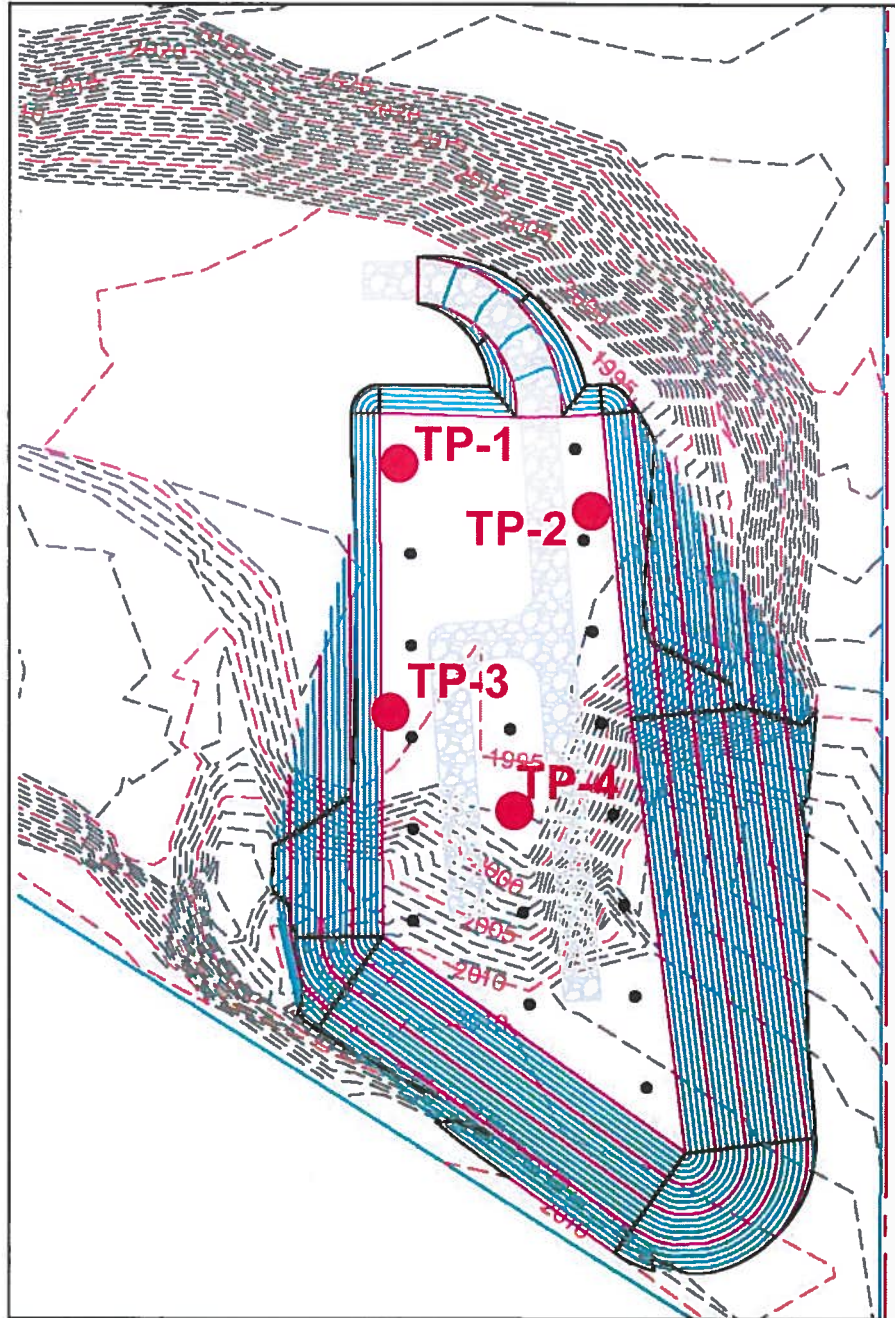
<b>IPEC</b> Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 14-086	October 9, 2014
	Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA	

**FIGURE 2**



<b>NRCS Map</b>		
<b>IPEC</b> Inland Pacific Engineering Company Geotechnical Engineering and Consulting	Project No. 14-086	October 9, 2014
	Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA	

**FIGURE 3**



**Test Pit Location Map**

**IPEC**  
Inland Pacific Engineering Company  
Geotechnical Engineering and Consulting

Project No. 14-086  
Proposed Stormwater Pond  
Parcel No. 45343.9052  
Spokane County, WA

October 9, 2014

# LOG OF TEST PIT



Inland Pacific Engineering Company  
Geotechnical Engineering and Consulting

PROJECT: 14-086 Geotechnical Evaluation Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA			TEST PIT: <b>TP-1</b>		
			LOCATION: See Test Pit Location Map		
			DATE: 10/1/14   SCALE: 1"=2'		
ELEV.	DEPTH	ASTM D2487 Symbol	DESCRIPTION OF MATERIALS	WL	TESTS OR NOTES
1994.5	0.0				
1993.5	1.0	SM	SILTY SAND WITH GRAVEL, fine to coarse grained, brown, moist. (Glacial Outwash)		
			POORLY GRADED SAND WITH GRAVEL, medium to coarse grained, with Cobbles, brown, moist. (Glacial Outwash)		
		SP			
1979.5	15.0		End of test pit.		
			Groundwater not encountered.		
			Test pit immediately backfilled.		



# LOG OF TEST PIT



Inland Pacific Engineering Company  
Geotechnical Engineering and Consulting

PROJECT: 14-086 Geotechnical Evaluation Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA			TEST PIT: <b>TP-2</b>		
			LOCATION: See Test Pit Location Map		
			DATE: 10/1/14		
			SCALE: 1"=2'		
ELEV.	DEPTH	ASTM D2487 Symbol	DESCRIPTION OF MATERIALS	WL	TESTS OR NOTES
1994.5	0.0				
1993.0	1.5	SM	SILTY SAND WITH GRAVEL, fine to coarse grained, brown, moist. (Glacial Outwash)		
		SP	POORLY GRADED SAND WITH GRAVEL, medium to coarse grained, with Cobbles, brown, moist. (Glacial Outwash)		
1979.5	15.0		End of test pit.		
			Groundwater not encountered.		
			Test pit immediately backfilled.		

# LOG OF TEST PIT



Inland Pacific Engineering Company  
Geotechnical Engineering and Consulting

PROJECT: 14-086 Geotechnical Evaluation Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA			TEST PIT: <b>TP-3</b>		
			LOCATION: See Test Pit Location Map		
			DATE: 10/1/14   SCALE: 1"=2'		
ELEV.	DEPTH	ASTM D2487 Symbol	DESCRIPTION OF MATERIALS	WL	TESTS OR NOTES
1995	0.0				
1994	1.0	SM	SILTY SAND WITH GRAVEL, fine to coarse grained, brown, moist. (Glacial Outwash)		
			POORLY GRADED SAND WITH GRAVEL, medium to coarse grained, with Cobbles, brown, moist. (Glacial Outwash)		
		SP			
1980	15.0		End of test pit.		
			Groundwater not encountered.		
			Test pit immediately backfilled.		

# LOG OF TEST PIT



Inland Pacific Engineering Company  
Geotechnical Engineering and Consulting

PROJECT: 14-086 Geotechnical Evaluation Proposed Stormwater Pond Parcel No. 45343.9052 Spokane County, WA			TEST PIT: <b>TP-4</b>		
			LOCATION: See Test Pit Location Map		
			DATE: 10/1/14		
			SCALE: 1"=2'		
ELEV.	DEPTH	ASTM D2487 Symbol	DESCRIPTION OF MATERIALS	WL	TESTS OR NOTES
1996	0.0				
1995	1.0	SM	SILTY SAND WITH GRAVEL, fine to coarse grained, brown, moist. (Glacial Outwash)		
		SP	POORLY GRADED SAND WITH GRAVEL, medium to coarse grained, with Cobbles, brown, moist. (Glacial Outwash)		
1981	15.0		End of test pit.		
			Groundwater not encountered.		
			Test pit immediately backfilled.		

# IPEC

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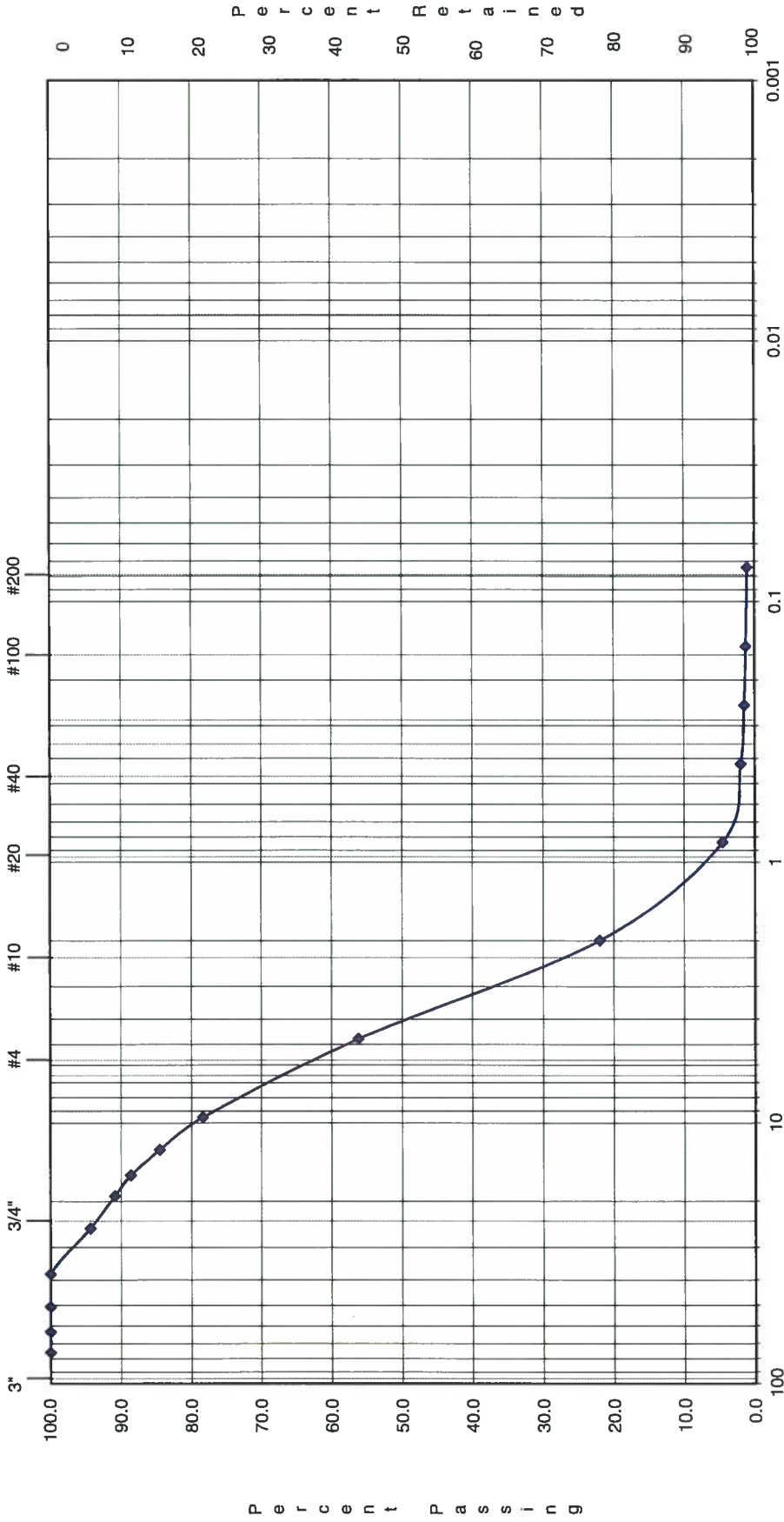
RELATIVE DENSITY OR CONSISTENCY VERSUS SPT N-VALVE			
COARSE-GRAINED SOILS		FINE-GRAINED SOILS	
DENSITY	N(BLOWS/FT)	CONSISTENCY	N(BLOWS/FT)
Very Loose	0 - 4	Very Soft	0 - 1
Loose	4 - 10	Soft	2 - 3
Medium-Dense	11 - 30	Rather Soft	4 - 5
		Medium	6 - 8
Dense	31 - 50	Rather Stiff	9 - 12
		Stiff	13 - 16
Very Dense	> 50	Very Stiff	17 - 30
		Hard	> 30

USCS SOIL CLASSIFICATION				
MAJOR DIVISIONS			GROUP DESCRIPTIONS	
<b>Coarse-Grained Soils</b>  <50% passes #200 sieve	Gravel and Gravelly Soils <50% coarse fraction passes #4 sieve	Gravel <small>(with little or no fines)</small>	GW	Well Graded Gravel
			GP	Poorly Graded Gravel
		Gravel <small>(with &gt;12% fines)</small>	GM	Silty Gravel
			GC	Clayey Gravel
	Sandy and Sandy Soils >50% coarse fraction passes #4 sieve	Sand <small>(with little or no fines)</small>	SW	Well Graded Sand
			SP	Poorly Graded Sand
Sand <small>(with &gt;12% fines)</small>		SM	Silty Sand	
		SC	Clayey Sand	
<b>Fine-Grained Soils</b>  >50% passes #200 sieve	Silt and Clay Liquid Limit < 50		ML	Silt
			CL	Lean Clay
			OL	Organic Silt and Clay (low plasticity)
	Salt and Clay Liquid Limit > 50		MH	Inorganic Silt
			CH	Fat Clay
			OH	Organic Clay and Silt (med to high plasticity)
Highly Organic Soils			PT	Peat
				Muck

MODIFIERS	
DESCRIPTION	RANGE
Occasional	<5%
Trace	5% - 12%
With	>12%

MOISTURE 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

MAJOR DIVISIONS WITH GRAIN SIZE							
SIEVE SIZE							
	12"	3"	3/4"	4	10	40	200
GRAIN SIZE (INCHES)							
	12	3	0.75	0.19	0.079	0.0171	0.0029
Boulders	Cobbles	Gravel		Sand			Silt and Clay
		Coarse	Fine	Coarse	Medium	Fine	



UNIFIED SOIL CLASSIFICATION SYSTEM	COARSE GRAVEL	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES
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Lab No. L14-039

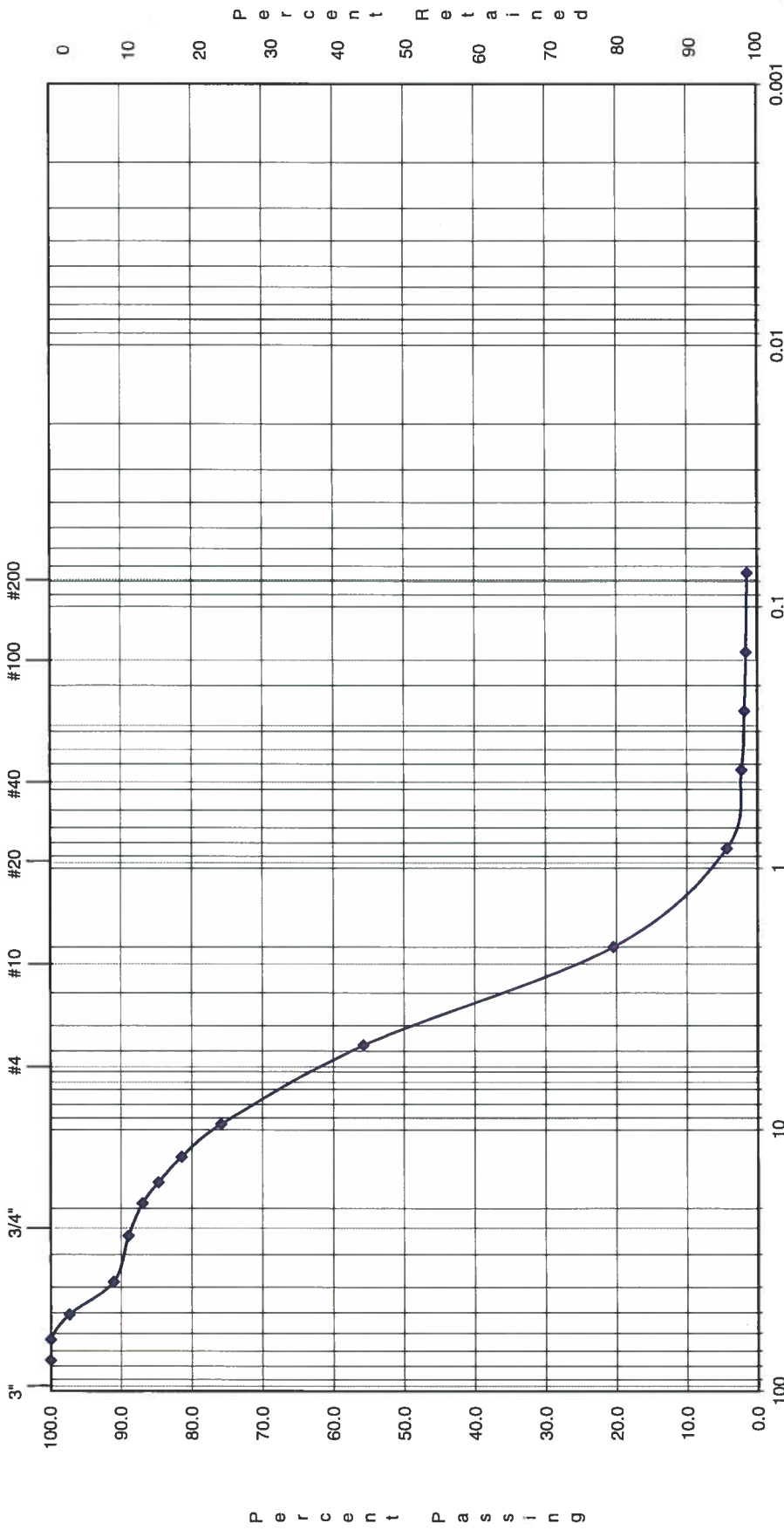
Sample Identification: L14-039

Sample Description: SP Poorly Graded Sand with Gravel

Project: 40th Avenue Stormwater  
 Location: TP-1 @ 10-12'  
 Job No.: 14-086  
 Date: 10/1/2014

# GRAIN SIZE REPORT

**IPEC**  
 Inland Pacific Engineering Company  
 Geotechnical Engineering and Consulting  
 P.O. Box 1566, Veradale, WA 99037 (509) 209-6262



UNIFIED SOIL CLASSIFICATION SYSTEM

COARSE GRAVEL FINE GRAVEL COARSE SAND MEDIUM SAND FINE SAND FINES

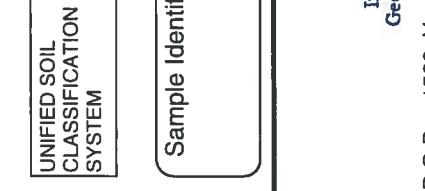
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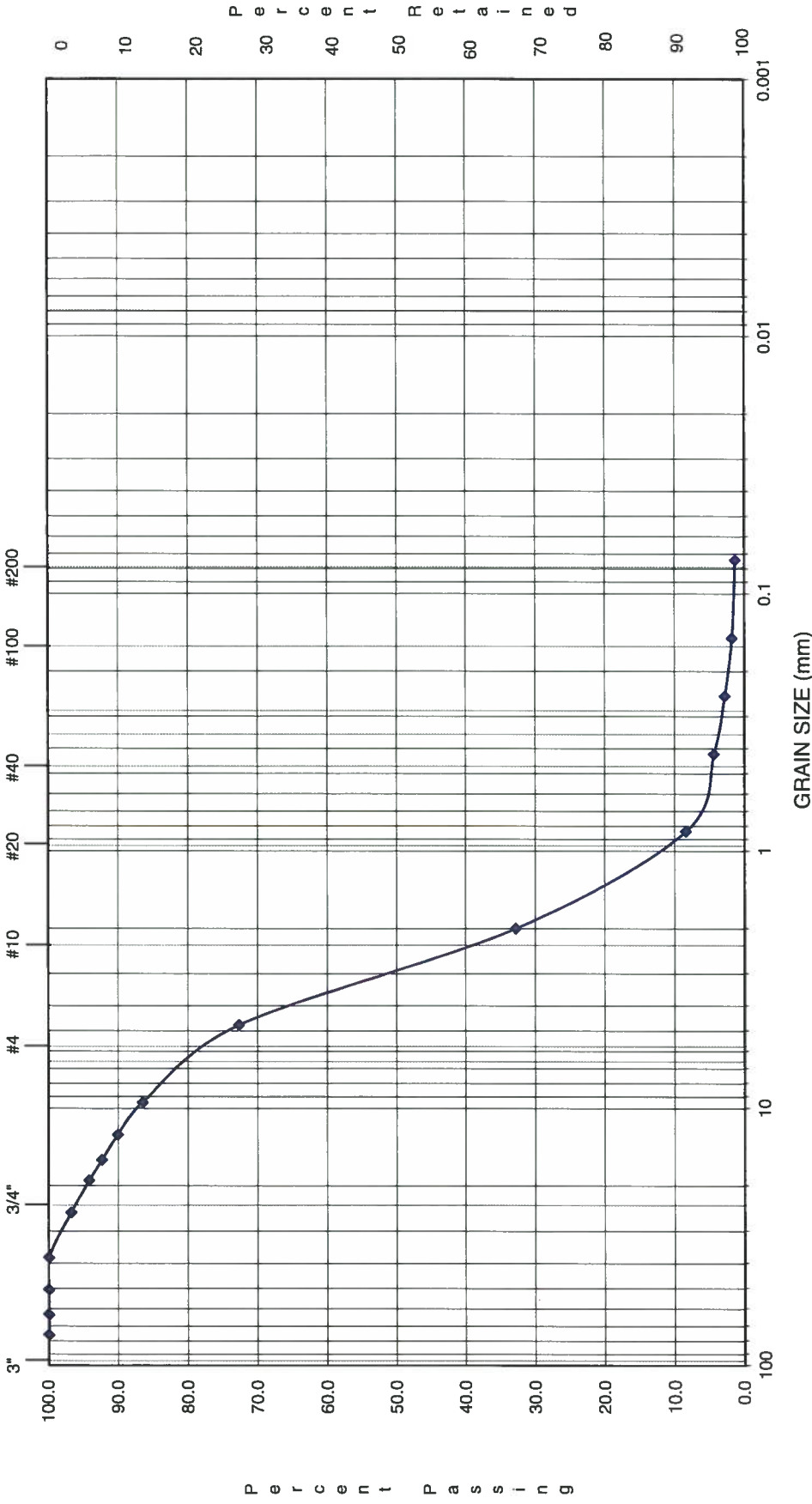
Sample Description: SP Poorly Graded Sand with Gravel

Lab No. L14-040

# GRAIN SIZE REPORT

Project: 40th Avenue Stormwater  
 Location: TP-2 @ 10-12'  
 Job No.: 14-086  
 Date: 10/1/2014





UNIFIED SOIL CLASSIFICATION SYSTEM	COARSE GRAVEL	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES
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Lab No. L14-041

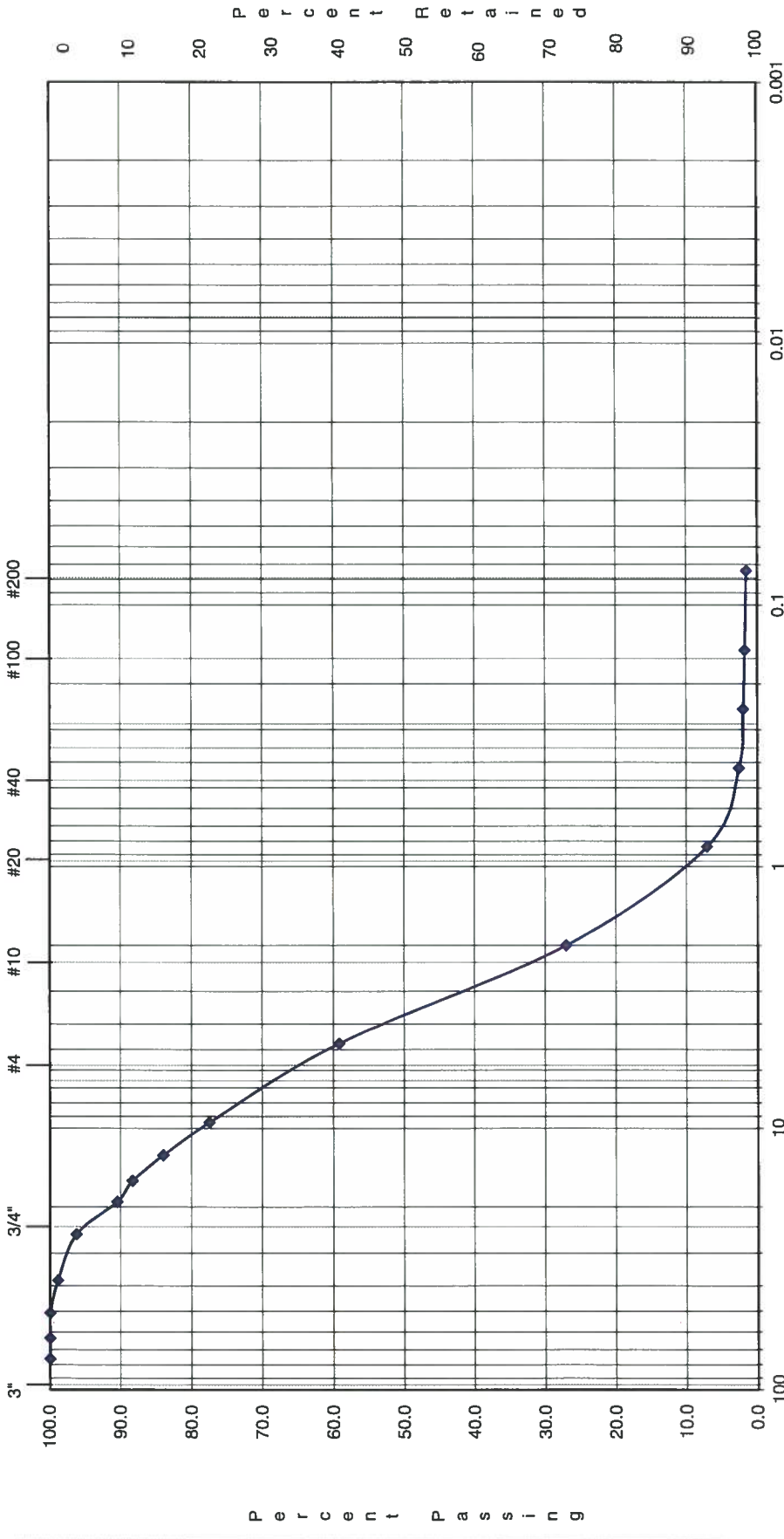
Sample Identification: L14-041

Sample Description: SP Poorly Graded Sand with Gravel

Project: 40th Avenue Stormwater  
 Location: TP-3 @ 10-12'  
 Job No.: 14-086 Date: 10/1/2014

# GRAIN SIZE REPORT

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GRAIN SIZE (mm)

UNIFIED SOIL CLASSIFICATION SYSTEM	COARSE GRAVEL	FINE GRAVEL	COARSE SAND	MEDIUM SAND	FINE SAND	FINES

Lab No. L14-042

Sample Identification: L14-042  
 Sample Description: SP Poorly Graded Sand with Gravel

Project: 40th Avenue Stormwater  
 Location: TP-4 @ 10-12'  
 Job No.: 14-086 Date: 10/1/2014

# GRAIN SIZE REPORT

**IPEC**  
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