

Memo

To: Greg Church, North Wind Portage
From: Steve Dwyer, Dwyer Engineering LLC
CC: Chris Pulskamp, DOE MOAB UMTRA Project
Date: January 25, 2022
Re.: Investigation of Dispersive Soils at Crescent Junction, Utah

Crescent Junction Disposal Cell 60% Design Review Comment

A review comment received during the 60% Design Review from the NRC relating to the potential for dispersive soil at the Crescent Junction, Utah site and possible inclusion in the cover system is as follows:

NRC Comment: *The Design Report does not discuss the potential for the presence of dispersive soils within the cover at Crescent Junction. Dispersive soils can be more susceptible to erosion. The presence of dispersive soils in covers can result in removal of soil from the cover and lead to the formation of erosion rills or voids. Therefore, the presence of dispersive soils represents a long-term maintenance concern for DOE-LM. It is not clear if the dispersion characteristics for soils at Crescent Junction have been evaluated. A joint discussion between DOE-EM, DOE-LM, and NRC may be helpful in addressing this issue.*

DOE Reply: *Soil samples from cover soil borrow material have been submitted for testing of soil dispersion. The testing methodology will include a pinhole test (ASTM D4747) and a crumb test (ASTM D6572) for each submitted sample.*

This memo discusses dispersive soils and the results of the testing performed.

Dispersive Clay

Dispersive clays differ from ordinary, erosion resistant clays because they have a higher relative content of dissolved sodium in the pore water. Ordinary clays have a preponderance of calcium and magnesium dissolved in the pore water. Ordinary clays have a flocculated or aggregated structure because of the electrochemical attraction of

the particles to each other and to water. This accounts for these soils' cohesive, less-erosive behavior.

Dispersive clays have an imbalance in the electrochemical forces between particles. This imbalance causes the minute soil particles in a dispersive clay to be repulsed rather than attracted to one another. Consequently, dispersive clay particles tend to react as single-grained particles and not as an aggregated mass of particles.

Testing was performed on six samples extracted from the Crescent Junction site (Figure 1). Crumb test (ASTM D6572) and pinhole tests (ASTM D4747) were performed on each of the soil samples. A 5-gallon bucket of soil from each location was taken to allow for multiple tests from each sample. Initial tests were performed by Dwyer Engineering on November 29, 2021 and repeated on November 30, 2021. The soil samples were then forwarded to the Geo-Logic Associates located in Sparks, Nevada that has engineers with expertise in testing of dispersive soils.



Figure 1. Soil Sample Locations

Crumb test (ASTM D6572)

The crumb test is the simplest of the tests used for detecting dispersive clays. Crumb tests are often performed during an investigation to supplement laboratory information on samples collected. The test is performed by gently placing a clod of soil about 1/4 to 3/8 inch in diameter into a transparent plastic glass partly filled with distilled water. Using demineralized water or other substitutes gives misleading test results. The clod or crumb should be at natural water content unless the soil is very wet. Very wet soils may be air-dried to about their plastic limit before performing the test. The crumb is dropped at the

edge of the glass bottom and left in the glass undisturbed for a minimum of 1 hour. At the end of the waiting period, the clod and water are observed and the presence of any colloidal cloud in the water is evaluated.

A second observation is recommended after leaving the clod in the glass overnight. Some soils have no reaction after 1 hour, but have a significant reaction after the longer waiting time. A grade is assigned to the test result using the following criteria:

1. No colloidal cloud develops. Even though the crumb may slake and particles spread away from the original clod because of this slaking activity, no trace of a colloidal cloud is observed in the water.
2. A colloidal cloud is observable, but only immediately surrounding the original clod. The cloud has not spread any appreciable distance from the crumb.
3. A colloidal cloud emanates an appreciable distance from the crumb. However, the cloud does not cover the bottom of the glass, and it does not meet on the opposite side of the glass bottom from the crumb.
4. The colloidal cloud spreads completely around the circumference of the glass. The cloud may not completely obscure the bottom of the glass, but the cloud does completely cover the circumference of the glass. In extreme cases, the entire bottom of the glass is covered by the colloidal cloud.

Pinhole test (ASTM D4747)

The pinhole test is performed in the laboratory and is a direct, or performance, test. Comparison of field performance to pinhole test results have indicated an excellent correlation. Another important use of the pinhole test is to determine efficiency of chemical amendments for dispersive clays. Soil samples are prepared with a range of treatment rates of a chemical additive, and the pinhole test is used to determine what rate of treatment is necessary to achieve erodibility reduction.

In the pinhole test, a sample of soil at its natural water content is compacted into a plastic cylinder. A hole is formed in the specimen by inserting a needle through the center of the specimen. Distilled water under specified heads flows through the hole in the specimen. The water is carefully observed for turbidity, and the flow rate is closely monitored to determine if the hole in the sample is enlarging by erosion.

Dispersive clays will rapidly erode as water flows through the 1-millimeter hole under a small water head pressure. Rapid enlargement of the hole is reflected in an increasing flow rate and the turbidity of the collected water. Pinhole tests results are recorded and interpreted using the following system:

A rating of D-1 or D-2 indicates the soils are dispersive enough to require special designs if the soils must be used in the project.

A rating of ND-1 indicates the soil is not dispersive.

A rating of ND-2, ND-3, or ND-4 indicates the soils are slightly to moderately dispersive. Some defensive measures may need to be incorporated into the design.

Testing Results

Initial soil dispersion tests were performed by Steve Dwyer. The six soil samples were each tested for soil dispersive utilizing the Crumb Test as described in ASTM D6572. The crumb tests were performed on November 29, 2021 and repeated with separate soil from each respective 5-gallon soil sample on November 30, 2021. The respective soil samples remained in the water for about 24 hours.

Table 1. Crumb Test 1 (November 29, 2021)

Sample	Results
1	Grade 1 - Nondispersive
2	Grade 1 - Nondispersive
3	Grade 1 - Nondispersive
4	Grade 1 - Nondispersive
5	Grade 1 - Nondispersive
6	Grade 1 - Nondispersive

Table 2. Crumb Test 2 (November 30, 2021)

Sample	Results
1	Grade 1 - Nondispersive
2	Grade 1 - Nondispersive
3	Grade 1 - Nondispersive
4	Grade 1 - Nondispersive
5	Grade 1 - Nondispersive
6	Grade 1 - Nondispersive

Additional soil suspension tests were performed of each soil sample each day by Steve Dwyer. The tests involved placing a small sample of the soil (about 3/8-inch diameter) in a container of about 4 ounces of distilled water. The samples were stirred until all of the soil was suspended in the water. Typically, dispersive soil will remain suspended for lengthy periods (a day or longer). All sediment from each of the six samples settled out of the water within about 15 minutes for both sets of tests. This is indicative of nondispersive soil.

Portions of each of the six 5-gallon bucket soil samples were then forwarded to Geo-Logic to repeat the crumb tests and provide additional testing in the form of pinhole tests (ASTM D4747). The Geo-Logic results are attached to this memo.

The crumb test results were identical to those performed by Dwyer – all samples were Grade 1 – nondispersive. The pinhole tests results varied from ND1 to ND3. ND1 indicates completely nondispersive, while ND2 and ND3 indicate mild soil dispersion.

Observations

General visual observations did not indicate the presence of dispersive soil. Typical indications of dispersive soil in an arid site similar to Crescent Junction, Utah could include "badland" erosion or multiple rills with close spacing. There was no rill or gully such as this observed at the site in either disturbed or undisturbed areas. Furthermore, there was no significant rill or gully formation in on-site steeper borrow piles.

Client: Dwyer Engineering LLC
 Project: Crescent Junction
 Project No.: _____
 Tested By: ML

Location: N/A
 Depth: 1'-5'
 Sample Description: Excavated Test Pit Alluvium
 Date: 1/19/2022

PINHOLE DISPERSION TEST RESULTS ASTM D4647

Target Conditions:

Sample Preparation: In-Situ, extruded Remolded Sample
 Density Method: ASTM D698
 Max Wet Density (pcf): 134.5
 Opt. Water Content (%): 13.4
 Max Dry Density (pcf): 118.6
 Procedure Method: A B C

Initial Sample Properties:

Initial Sample Diameter (in): 1.3106
 Initial Sample Height (in): 1.438
 Wet Density (pcf): 132.8
 Water Content (%): 13.4
 Dry Density (pcf): 117.1
 Degree of Compaction (%): 98.7

Final Sample Properties:

Diameter of Hole (mm): 0.73
 Photo Taken: Yes No
 USCS Classification: N/A
 Plasticity Index: N/A
 Liquid Limit: N/A
 Classification: **ND1**

Time	Head (mm)	Flow		Flow Rate mL/s	Turbidity from Side							Notes			
		mL	Sec		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear	Completely Clear from Top				
1628	50	10	22.07	0.45											
		10	28.60	0.35											
		10	28.03	0.36											
		20	56.14	0.36											
		25	72.55	0.34											
		25	74.20	0.34											
		25	56.43	0.44											
		25	72.04	0.35											
		25	75.16	0.33											
		25	74.57	0.34											
	25	76.01	0.33												
	180	25	32.09	0.78											
		25	32.47	0.77											
		25	33.03	0.76											
		25	33.78	0.74											
		50	64.89	0.77											
		50	66.02	0.76											
		50	63.90	0.78											
		380	50	40.12	1.25										
			50	39.66	1.26										
50			39.60	1.26											
50	38.89		1.29												
50	39.57		1.26												
50	40.75		1.23												
50	39.58		1.26												
50	40.17		1.24												
1020	50	20.95	2.39												
	50	21.78	2.30												
	50	21.19	2.36												
	50	22.64	2.21												
	50	21.31	2.35												
	50	22.60	2.21												
	50	21.11	2.37												
	50	22.62	2.21												
	50	21.81	2.29												
	50	21.93	2.28												
	50	21.41	2.34												
	50	22.16	2.26												
	50	21.12	2.37												
	50	22.13	2.26												

**ND1 Determination -
 Flow is less than 3.0 mL/s
 and final size of hole is not
 larger than needle punch**

Client: Dwyer Engineering LLC
 Project: Crescent Junction
 Project No.: _____
 Tested By: ML

Location: N/A
 Depth: N/A
 Sample Description: Interim Cover Mix
 Date: 1/17/2022

PINHOLE DISPERSION TEST RESULTS ASTM D4647

Target Conditions:

Sample Preparation: In-Situ, extruded Remolded Sample
 Density Method: ASTM D698
 Max Wet Density (pcf): 134.4
 Opt. Water Content (%): 13.3
 Max Dry Density (pcf): 118.6
 Procedure Method: A B C

Initial Sample Properties:

Initial Sample Diameter (in): 1.3106
 Initial Sample Height (in): 1.500
 Wet Density (pcf): 126.9
 Water Content (%): 13.3
 Dry Density (pcf): 112.0
 Degree of Compaction (%): 94.4

Final Sample Properties:

Diameter of Hole (mm): 1.59
 Photo Taken: Yes No
 USCS Classification: N/A
 Plasticity Index: N/A
 Liquid Limit: N/A
 Classification: **ND3**

Time	Head (mm)	Flow		Flow Rate mL/s	Turbidity from Side							Notes	
		mL	Sec		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear	Completely Clear from Top		
1500	50	10	18.48	0.54									
		10	24.41	0.41									
		10	25.33	0.39									
		20	50.09	0.40									
		25	62.22	0.40									
		25	65.89	0.38									
		25	63.63	0.39									
		25	62.55	0.40									
		25	57.60	0.43									
		25	62.65	0.40									
		25	59.20	0.42									
		25	61.18	0.41									
		25	59.38	0.42									
		25	63.75	0.39									
		180	25	25	25.05	1.00							
25	24.40			1.02									
25	24.60			1.02									
25	25.16			0.99									
25	24.42			1.02									
25	25.14			0.99									
50	49.28			1.01									
50	48.60			1.03									
50	49.74			1.01									
380	100			50	55.53	1.80							
		50	27.41	1.82									
		50	27.04	1.85									
		50	27.41	1.82									
		50	26.86	1.86									
		75	40.37	1.86									
		25	14.08	1.78									
		50	25.74	1.94									
		50	26.82	1.86									
		50	27.20	1.84									
1020	50	50	14.73	3.39									ND3 Determination - Flow increased to 1.8 to 3.2 mL/s
		50	14.76	3.39									
		50	13.63	3.67									
		50	14.90	3.36									
		50	14.21	3.52									
		50	14.20	3.52									
		50	14.34	3.49									
		50	13.74	3.64									
		50	14.04	3.56									
		50	13.69	3.65									
		50	13.45	3.72									
		50	13.68	3.65									
		50	13.19	3.79									
		50	13.89	3.60									
		50	13.64	3.67									
		50	13.61	3.67									
		50	13.31	3.76									
		50	13.59	3.68									
		50	13.31	3.76									
		50	13.36	3.74									
50	13.74	3.64											
50	12.94	3.86											

Client: Dwyer Engineering LLC
 Project: Crescent Junction
 Project No.: _____
 Tested By: ML

Location: N/A
 Depth: 1'-10'
 Sample Description: Open Test Pit Alluvium 1'-10'
 Date: 1/14/2022

PINHOLE DISPERSION TEST RESULTS ASTM D4647

Target Conditions:

Sample Preparation: In-Situ, extruded Remolded Sample
 Density Method: ASTM D698
 Max Wet Density (pcf): 133.0
 Opt. Water Content (%): 13.3
 Max Dry Density (pcf): 117.4
 Procedure Method: A B C

Initial Sample Properties:

Initial Sample Diameter (in): 1.3106
 Initial Sample Height (in): 1.500
 Wet Density (pcf): 125.0
 Water Content (%): 13.3
 Dry Density (pcf): 110.3
 Degree of Compaction (%): 94.0

Final Sample Properties:

Diameter of Hole (mm): 1.04
 Photo Taken: Yes No
 USCS Classification: N/A
 Plasticity Index: N/A
 Liquid Limit: N/A
 Classification: **ND2**

Time	Head (mm)	Flow		Flow Rate mL/s	Turbidity from Side							Notes			
		mL	Sec		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear	Completely Clear from Top				
1628	50	10	21.25	0.47											
		10	22.70	0.44											
		10	23.70	0.42											
		20	44.07	0.45											
		25	53.17	0.47											
		25	55.79	0.45											
		25	64.28	0.39											
		25	62.34	0.40											
		25	63.94	0.39											
		25	57.74	0.43											
		25	60.84	0.41											
		25	61.39	0.41											
		25	58.72	0.43											
			180	25	23.00	1.09									
				25	23.22	1.08									
25	23.56			1.06											
25	23.59			1.06											
25	22.03			1.13											
25	24.22			1.03											
25	22.48			1.11											
25	23.59			1.06											
50	45.42			1.10											
50	46.39			1.08											
	380	50	28.10	1.78											
		50	28.06	1.78											
		50	27.13	1.84											
		50	28.63	1.75											
		50	28.10	1.78											
		50	28.94	1.73											
		50	26.43	1.89											
		50	27.78	1.80											
		50	26.69	1.87											
		50	27.85	1.80											
	1020	50	15.74	3.18											
		50	15.55	3.22											
		50	15.50	3.23											
		50	15.60	3.21											
		50	14.79	3.38											
		50	15.83	3.16											
		50	15.51	3.22											
		50	15.16	3.30											
		50	15.57	3.21											
		50	15.06	3.32											
		50	15.38	3.25											
		50	15.07	3.32											
		50	15.78	3.17											
		50	14.19	3.52											
		50	15.41	3.24											
		50	14.83	3.37											
		50	15.64	3.20											
		50	14.15	3.53											
		50	15.70	3.18											
		50	14.35	3.48											

*Average Flow = 1.80 mL/s

**ND2 Determination -
Flow increased to
greater than 3.0 mL/s**

Client: Dwyer Engineering LLC
 Project: Crescent Junction
 Project No.: _____
 Tested By: ML

Location: N/A
 Depth: N/A
 Sample Description: Radon Barrier #1
 Date: 1/20/2022

PINHOLE DISPERSION TEST RESULTS ASTM D4647

Target Conditions:

Sample Preparation: In-Situ, extruded Remolded Sample
 Density Method: ASTM D698
 Max Wet Density (pcf): 130.8
 Opt. Water Content (%): 16.4
 Max Dry Density (pcf): 112.4
 Procedure Method: A B C

Initial Sample Properties:

Initial Sample Diameter (in): 1.3106
 Initial Sample Height (in): 1.500
 Wet Density (pcf): 123.7
 Water Content (%): 16.4
 Dry Density (pcf): 106.3
 Degree of Compaction (%): 94.6

Final Sample Properties:

Note 1: Final diameter taken post 1020mm head
 Diameter of Hole¹ (mm): 3.21
 Photo Taken: Yes No
 USCS Classification: N/A
 Plasticity Index: N/A
 Liquid Limit: N/A
 Classification: **ND3**

Time	Head (mm)	Flow		Flow Rate mL/s	Turbidity from Side						Notes	
		mL	Sec		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear		Completely Clear from Top
1423	50	10	31.22	0.32								Partial Clog
		10	36.61	0.27								
		10	43.55	0.23								
		20	93.58	0.21								
		20	106.52	0.19								
		20	126.20	0.16								
		20	143.92	0.14								
	180	10	66.69	0.15								
		25	67.26	0.37								
		25	68.12	0.37								
		25	68.72	0.36								
	380	25	68.90	0.36								ND3 Determination - Flow under 380mm head is not completely clear
		15	39.39	0.38								
		25	36.83	0.68								
		25	33.54	0.75								
		25	34.86	0.72								
		25	31.72	0.79								
		25	31.82	0.79								
		25	31.10	0.80								
		30	38.32	0.78								
		25	31.24	0.80								
	1020	25	29.89	0.84								
		25	30.62	0.82								
		25	29.48	0.85								
		50	19.96	2.51								
		50	19.52	2.56								
		50	10.31	4.85								
		50	9.36	5.34								
		50	9.05	5.52								
		50	8.20	6.10								
		100	17.64	5.67								
		50	8.67	5.77								
		50	9.45	5.29								
50	8.90	5.62										
100	18.79	5.32										
50	9.41	5.31										
50	9.48	5.27										

Client: Dwyer Engineering LLC
 Project: Crescent Junction
 Project No.: _____
 Tested By: ML

Location: N/A
 Depth: N/A
 Sample Description: Radon Barrier #2
 Date: 1/12/2022

PINHOLE DISPERSION TEST RESULTS ASTM D4647

Target Conditions:

Sample Preparation: In-Situ, extruded Remolded Sample
 Density Method: ASTM D698
 Max Wet Density (pcf): 130.2
 Opt. Water Content (%): 16.5
 Max Dry Density (pcf): 111.7
 Procedure Method: A B C

Initial Sample Properties:

Initial Sample Diameter (in): 1.3106
 Initial Sample Height (in): 1.531
 Wet Density (pcf): 123.3
 Water Content (%): 16.5
 Dry Density (pcf): 104.3
 Degree of Compaction (%): 93.4

Final Sample Properties:

Diameter of Hole (mm): 1.67
 Photo Taken: Yes No
 USCS Classification: N/A
 Plasticity Index: N/A
 Liquid Limit: N/A
 Classification: **ND3**

Time	Head (mm)	Flow		Flow Rate mL/s	Turbidity from Side							Notes	
		mL	Sec		Very Dark	Dark	Moderately Dark	Slightly Dark	Barely Visible	Completely Clear	Completely Clear from Top		
1447	50	10	32.06	0.31									Partial Clog
		10	41.25	0.24									
		10	39.94	0.25									
		20	127.16	0.16									
		15	166.44	0.09									
	180	6	301.82	0.02									Partial Clog
		25	62.31	0.40									
		25	64.02	0.39									
		25	64.59	0.39									
		25	62.58	0.40									
		25	57.32	0.44									
		25	59.81	0.42									
		25	59.86	0.42									
		25	58.85	0.42									
		25	59.84	0.42									
	380	25	28.88	0.87									Partial Clog
		25	28.93	0.86									
		25	25.82	0.97									
		25	24.38	1.03									
		50	38.46	1.30									
		50	31.29	1.60									
		50	27.41	1.82									
		50	25.09	1.99									
	50	23.88	2.09									ND3 Determination - Effluent Increased in Darkness and Flow Rate increased	
		21.46	2.33										

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

ASTM D 6572



56 Coney Island Drive
Sparks, Nevada 89431
Tel. (775) 284-5500
Fax. (775) 284-5504
www.appliedsoilwater.com

Client: Dwyer Engineering LLC
Project Name: Crescent Junction
Project Number: _____

Sample Name: Excavated Test Pit Alluvium 1'-5'
Performed By: ML
Date: 1/21/2022

Procedure Method: A B
Test Lab Location: Disturbed Undisturbed
Specimen Type: Natural irregularly shaped crumb Remolded crumb cube
Moisture Content: Natural moisture Air-dried Distilled water added
Water Type: Distilled Distilled and demineralized
Photo Taken: Yes No

Initial Sample Properties

Wet Density (pcf): 127.8
Water Content (%) 13.4
Dry Density (pcf): 112.7
Degree of Compaction (%): 95

Final Grade: **Grade 1 - Nondispersive**

Specimen Number	Time of Reading						Comments:
	2 Minutes		1 Hour		6 Hours		
	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	
Speciment #1	1	17.9	1	16.5	1	15.9	

*Note 1: Water temperature taken at time of reading

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

ASTM D 6572



56 Coney Island Drive
Sparks, Nevada 89431
Tel. (775) 284-5500
Fax. (775) 284-5504
www.appliedsoilwater.com

Client: Dwyer Engineering LLC
Project Name: Crescent Junction
Project Number: _____

Sample Name: Interim Cover Mix
Performed By: ML
Date: 1/13/2022

Procedure Method: A B
Test Lab Location: Disturbed Undisturbed
Specimen Type: Natural irregularly shaped crumb Remolded crumb cube
Moisture Content: Natural moisture Air-dried Distilled water added
Water Type: Distilled Distilled and demineralized
Photo Taken: Yes No

Initial Sample Properties

Wet Density (pcf): 114.8
Water Content (%) 16.4
Dry Density (pcf): 98.6
Degree of Compaction (%): 88.3

Final Grade: **Grade 1 - Nondispersive**

Specimen Number	Time of Reading						Comments:
	2 Minutes		1 Hour		6 Hours		
	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	
Speciment #1	1	19.7	1	19.0	1	18.1	
Speciment #2	1	19.7	1	19.0	1	18.1	
Speciment #3	1	19.7	1	18.5	1	18.1	
Speciment #4	1	19.7	1	18.5	1	18.1	

*Note 1: Water temperature taken at time of reading

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

ASTM D 6572



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Sparks, Nevada 89431
Tel. (775) 284-5500
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www.appliedsoilwater.com

Client: Dwyer Engineering LLC
Project Name: Crescent Junction
Project Number: _____

Sample Name: Mix Borrow Face Phase 3C
Performed By: ML
Date: 1/14/2022

Procedure Method: A B
Test Lab Location: Disturbed Undisturbed
Specimen Type: Natural irregularly shaped crumb Remolded crumb cube
Moisture Content: Natural moisture Air-dried Distilled water added
Water Type: Distilled Distilled and demineralized
Photo Taken: Yes No

Initial Sample Properties

Wet Density (pcf): 117
Water Content (%) 13.6
Dry Density (pcf): 103
Degree of Compaction (%): 86.8

Final Grade: **Grade 1 - Nondispersive**

Specimen Number	Time of Reading						Comments:
	2 Minutes		1 Hour		6 Hours		
	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	
Speciment #1	1	17.8	1	15.1	1	14.9	
Speciment #2	1	18.4	1	15.5	1	15.8	

*Note 1: Water temperature taken at time of reading

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

ASTM D 6572



56 Coney Island Drive
Sparks, Nevada 89431
Tel. (775) 284-5500
Fax. (775) 284-5504
www.appliedsoilwater.com

Client: Dwyer Engineering LLC
Project Name: Crescent Junction
Project Number: _____

Sample Name: Open Test Pit Alluvium 1'-10'
Performed By: ML
Date: 1/21/2022

Procedure Method: A B
Test Lab Location: Disturbed Undisturbed
Specimen Type: Natural irregularly shaped crumb Remolded crumb cube
Moisture Content: Natural moisture Air-dried Distilled water added
Water Type: Distilled Distilled and demineralized
Photo Taken: Yes No

Initial Sample Properties

Wet Density (pcf): 109.9
Water Content (%) 13.3
Dry Density (pcf): 97
Degree of Compaction (%): 82.6

Final Grade: **Grade 1 - Nondispersive**

Specimen Number	Time of Reading						Comments:
	2 Minutes		1 Hour		6 Hours		
	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	
Speciment #1	1	15.8	1	14.7	1	14.8	

*Note 1: Water temperature taken at time of reading

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Sparks, Nevada 89431
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Client: Dwyer Engineering LLC
Project Name: Crescent Junction
Project Number: _____

Sample Name: Radon Barrier #1
Performed By: ML
Date: 1/12/2022

Procedure Method: A B
Test Lab Location: Disturbed Undisturbed
Specimen Type: Natural irregularly shaped crumb Remolded crumb cube
Moisture Content: Natural moisture Air-dried Distilled water added
Water Type: Distilled Distilled and demineralized
Photo Taken: Yes No

Initial Sample Properties

Wet Density (pcf): 114.8
Water Content (%) 16.4
Dry Density (pcf): 98.6
Degree of Compaction (%): 87.8

Final Grade: **Grade 1 - Nondispersive**

Specimen Number	Time of Reading						Comments:
	2 Minutes		1 Hour		6 Hours		
	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	
Speciment #1	1	18.0	1	16.4	1	15.9	
Speciment #2	1	18.0	1	16.4	1	15.9	
Speciment #3	1	17.8	1	15.1	1	15.1	

*Note 1: Water temperature taken at time of reading

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

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Client: Dwyer Engineering LLC
Project Name: Crescent Junction
Project Number: _____

Sample Name: Radon Barrier #2
Performed By: ML
Date: 1/13/2022

Procedure Method: A B
Test Lab Location: Disturbed Undisturbed
Specimen Type: Natural irregularly shaped crumb Remolded crumb cube
Moisture Content: Natural moisture Air-dried Distilled water added
Water Type: Distilled Distilled and demineralized
Photo Taken: Yes No

Initial Sample Properties

Wet Density (pcf): 115.7
Water Content (%) 16.5
Dry Density (pcf): 99.3
Degree of Compaction (%): 88.8

Final Grade: **Grade 1 - Nondispersive**

Specimen Number	Time of Reading						Comments:
	2 Minutes		1 Hour		6 Hours		
	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	Grade	Temp. ¹ °C	
Speciment #1	1	17.9	1	15.3	1	15.2	
Speciment #2	1	17.9	1	15.3	1	15.2	
Speciment #3	1	17.8	1	15.2	1	15.1	

*Note 1: Water temperature taken at time of reading