



Lithology Logs
(Direct Push Cores)

Dates: 5/14/19, 5/22/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 1, 2

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/22/19		Site 1
0 - 4	4	Very fine to fine quartz sand, brownish black, minor organics, clean, loose, medium apparent permeability.
4 - 7	3	Very fine silty sand, pale yellowish brown, high density, low apparent permeability.
7 - 16	9	Fine sand, pale yellowish brown, well sorted, low density, medium apparent permeability.
16 - 20	4	Silty fine sand, and shell hash, light gray, wet, loose, high apparent permeability.
20 - 25	5	Coarse sand, light gray, wet, low density, minor phosphatic sand and small shell fragments, high apparent permeability.
25 - 27	2	Coarse sand, minor phosphate, light brownish gray, high apparent permeability.
27 - 40	13	Medium to coarse sand with minor phosphatic sand, light gray, medium apparent permeability.
5/14/19		Site 2
0 - 4	4	Very fine to fine quartz sand, minor organics, pale yellowish brown, medium apparent permeability.
4 - 5	1	Very fine silty sand and minor small shell fragments, grayish orange, medium apparent permeability.
5 - 7	2	Fine sand, dark yellowish brown, medium apparent permeability.
7 - 10	3	Fine sand, very pale orange, wet, loose, well sorted, clean, medium apparent permeability.
10 - 14	4	Fine sand, shell fragments, minor phosphatic coarse sand to small gravel, light olive gray, high apparent permeability.
14 - 16	2	Crumbled limestone, pale yellowish brown, common phosphatic gravel, minor shell fragments, high apparent permeability.
16 - 20	2	No sample, loose fine sand
20 - 22	5	Fine to medium sand with shell fragments, yellowish gray, high apparent permeability.
22 - 23	1	Phosphatic gravel bed
23 - 26	3	Silty limestone gravel, yellowish gray, abundant shells, medium apparent permeability.
26-30	4	Sandy silt with minor fine phosphatic sand, light olive gray, low apparent permeability.



Lithology Logs
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Dates: 6/14/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 3

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Andy McThenia

Depth Interval (feet bls)	Thickness (feet)	Sample Description
6/14/19		Site 3
0 - 4	4	Very fine to fine quartz sand, yellowish gray, minor organics, clean soft, loose, minor organics, good apparent permeability.
4 - 6	2	Very fine silty sand, common organic silt, dark brown to orange, loose, wet, fair apparent permeability.
6 - 8	2	Fine sand, well sorted, clean, light gray, good apparent permeability.
8 - 9	1	Silty sand and shell hash mix, very pale orange, loose, unconsolidated, low apparent permeability.
9 - 10	1	Limestone, light olive gray, fossil packstone, medium hard, good apparent permeability.
10 - 13	3	Sand and shell, loose, greenish gray, good apparent permeability.
13 - 15	2	Sand to gravel with abundant shells, dark gray to dark orange, good apparent permeability.
15 - 20	5	Shell hash with fine sand to gravel, loose, very pale orange, good apparent permeability.
20 - 25	5	Limestone, light yellowish gray, marly, grainstone, soft, grainstone to packstone.
25 - 29	4	Phosphatic and quartz sand to gravel, silty, very pale orange, good apparent permeability.
29 - 30	1	Limestone, yellowish gray to light gray, phosphatic, medium hardness, fossil barnacles abundant, good apparent permeability.
30 - 35	5	Fine to coarse sand to gravel, quartz and phosphatic gravel, pale yellowish brown, good apparent permeability.
35 - 40	5	Sandy silt, pale olive, abundant phosphate sand to granules, sticky, soft to stiff, low apparent permeability.
40 - 44	4	Fine to medium quartz sand, loose, pale olive, minor shells, good apparent permeability.
44 - 45	1	Limestone, moderate hardness, yellowish gray, vitreous calcite filled fossils, fossil packstone, good apparent permeability.
45 - 50	5	Sandy clay, dusky yellow green, soft to moderately stiff, abundant fine phosphatic sand, low apparent permeability.
50 - 55	5	Partial recovery of sample, not collected, soft, silt to granule, quartz and phosphate, dark yellowish green, low apparent permeability.
55 - 69	14	Sand to granules, common shell fragments, dark greenish gray, good apparent permeability.
69 - 80	11	Clay, stiff, cohesive, dusky yellow green, low apparent permeability.



Lithology Logs
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Dates: 5/20/19, 5/21/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 4, 5

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/21/19		Site 4
0 - 4	4	Fine sand, very pale orange, medium apparent permeability.
4 - 7	3	Silty fine sand, light olive gray, low apparent permeability.
7 - 8	1	Fine to very coarse sand, dusky yellow, high apparent permeability.
8 - 10	2	Fine to very coarse sand, yellowish gray, dense/compacted, low apparent permeability.
10 - 15	5	No recovery, sample stuck, hard rock layer, rig chatter.
15 - 20	5	Coarse sand with minor silt, yellowish gray, high apparent permeability.
20 - 22	2	fine to medium sand, very light gray, wet, loose, high apparent permeability.
22 - 25	3	Sandy silt with coarse sand, light olive gray, low apparent permeability.
25 - 30	5	Fine sand, well sorted, pale yellowish brown, medium apparnt permeability.
5/20/19		Site 5
0 - 4	4	Fine sand, very pale orange, well sorted, medium apparent permeability.
4 - 5	1	Silty medium sand, yellowish gray, low apparent permeability.
5 - 7	2	Fine to coarse sand, dark yellowish orange, medium apparent permeability.
7 - 10	3	Very coarse phosphatic sand and marl with minor small shell fragments, light gray, high apparent permeability.
10 - 15	5	Fine to coarse sand and marl, very light gray, medium apparent permeability.
15 - 20	5	Limestone rock, yellowish gray, very dense, hard, boring sample refusal, high apparent permeability. Terminated boring at 20'.



Lithology Logs
(Direct Push Cores)

Dates: 5/16/19, 5/21/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 6, 7

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/21/19		Site 6
0 - 3	3	Fine sand, minor organics, light brownish gray.
3 - 4	1	Fine sand, grayish orange.
4 - 7	3	Fine sand and shell fragments, pinkish gray.
7 - 12	5	Very coarse sand and shell fragments, wet, loose, very light gray.
12 - 13	1	Very coarse sand, gravel and shell fragments.
13 - 17	4	Silty fine to coarse sand, very light gray.
17 - 22	5	Silty fine sand, light olive gray.
22 - 30	8	Very fine sandy silt, light olive gray.
5/16/19		Site 7
0 - 1	1	Fine sand with common organic.
1 - 4	3	Fine sand, grayish orange.
4 - 5	1	Fine silty sand, pale yellowish brown.
5 - 8	3	Fine sand and minor shell fragments, yellowish gray.
8 - 9	1	Fine sand, yellowish gray.
9 - 14	5	Fine sand, loose, pale yellowish brown.
14 - 20	6	Coarse silty sand, gravel with minor rock, pale yellowish brown.
20 - 25	5	Coarse sand, gravel and shell fragments, minor marl, loose, light olive gray.
25 - 30	5	Fine sandy silt, light olive.



Lithology Logs
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Dates: 5/15/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 8, 9

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/15/19		Site 8
0 - 5	5	Very fine to fine sand, minor organics, pale yellowish brown clean, loose, medium apparent permeability.
5 - 10	5	Fine sand, light gray to medium gray, well sorted, medium apparent permeability.
10 - 13	3	Very fine sand and shell hash, light gray, good apparent permeability.
13 - 15	2	Very fine silty sand and small phosphatic gravel, medium light gray, high apparent permeability.
15 - 20	5	Fine to medium sand and minor shell, light brownish gray, high apparent permeability.
20 - 23	3	Very fine sand and shell hash, light brownish gray, medium apparent permeability.
23 - 25	2	Fine silty sand with minor phosphatic sand and small gravel, pale yellowish brown, high apparent permeability.
25 - 26	1	Very fine silty sand with minor phosphatic sand, light olive gray, low apparent permeability.
26 - 29	3	Very fine sandy silt with minor small shell fragments, yellowish gray, low apparent permeability.
29 - 30	1	Sandy silt, olive gray, low apparent permeability.
5/15/19		Site 9
0 - 4	4	Fine sand, minor organics, moderate yellowish brown, medium apparent permeability.
4 - 8	4	Fine sand with minor shell fragments, yellowish gray, medium apparent permeability.
8 - 10	2	Very fine sand, medium light gray, well sorted, low apparent permeability.
10 - 15	5	Very fine sand, shell fragments, small phosphatic gravel, yellowish gray, wet, medium apparent permeability.
15 - 20	5	Very fine sand, yellowish gray, wet, loose, low apparent permeability.
20 - 25	5	Medium sand with minor small shell fragments, light gray, dry, medium apparent permeability.
25 - 30	5	Very fine sandy silt, well sorted, light olive gray, low apparent permeability.



Lithology Logs
(Direct Push Cores)

Dates: 5/23/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 10

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Rahul John and Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/23/19		Site 10
0 - 3	3	Fine sand, pale brown, well sorted, medium apparent permeability.
3 - 6	3	Weathered limestone and common fine sand, well indurated, high apparent permeability.
6 - 12	4	Lime mud with silt and limestone rock fragments, minor shell fragments, light gray, high apparent permeability.
12 - 14	2	Silty fine sand, yellowish gray, low apparent permeability.
14 - 16	2	Weathered limestone with minor shell fragments, light gray, well indurated, high apparent permeability.
16 - 20	4	Fine sand and minor phosphatic sand, minor shell fragments, well sorted, low apparent permeability.
20 - 23	3	Silty sand and minor phosphatic sand, thin limestone lense, light gray, low apparent permeability.
23 - 30	7	Very fine sandy silt, light olive gray, sticky, stiff, low apparent permeability.
30 - 35	5	No sample recovery.
35 - 40	3	Very fine sandy silt, pale olive green, smooth and pasty, low apparent permeability.
40 - 43	3	Very fine sandy silt, light olive gray, high plasticity, low apparent permeability.
43 - 45	2	Very fine sandy silt, light olive gray, stiff, low apparent permeability.
45 - 47	2	Fine to medium sand and shell fragments, minor phosphatic modules, poorly sorted, high apparent permeability.
47 - 48	1	Very fine sandy silt, light olive gray, low apparent permeability.
48 - 50	2	Medium carbonite sand and silt, greenish gray, moderately sorted, low apparent permeability.
50 - 52	2	Very fine sandy silt, light olive gray, stiff, low apparent permeability.
52 - 53	1	Fine to medium sandy silt, light olive gray, stiff, low apparent permeability.
53 - 55	2	Very fine sandy silt, olive gray, very stiff, moldable, sticky, relatively low plasticity, low apparent permeability.
55 - 60	5	Very fine sandy silt, greenish gray, low to medium plasticity, low apparent permeability.
60 - 62	2	Silt, yellowish gray, common phosphatic modules and minor shell fragments, low apparent permeability.
62 - 65	3	Very fine sandy silt, olive gray, very stiff, moldable, sticky, relatively low plasticity, low apparent permeability.
65 - 67	2	Very fine sandy silt, greenish gray, minor rock fragments, medium plasticity, low apparent permeability.
67 - 70	3	Very fine sandy silt, olive green, stiff, smooth texture, low to medium plasticity, low apparent permeability.



Lithology Logs
(Direct Push Cores)

Dates: 5/23/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 10

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Rahul John and Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/23/19		Site 10 Continued
70 - 72	2	No recovery.
72 - 75	3	Common fine sand and shell hash, minor phosphatic sand, moderate apparent permeability, probable collapsed hole sample recovery.
75 - 77	2	Very fine sandy silt, pale olive gray, syrupy consistency, high plasticity, low apparent permeability.
77 - 80	3	Silt, olive green, smooth texture, stiff, medium plasticity, low apparent permeability.



Lithology Logs
(Direct Push Cores)

Dates: 6/13/19, 5/16/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 11, 12

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
6/13/19		Site 11
0 - 3	3	Fine sand with minor organics, grayish orange pink, medium apparent permeability.
3 - 7	4	Fine sand, slightly silty and sticky, pale brown , well sorted, medium apparent permeability.
7 - 10	3	Fine sand and minor shell fragments, dark yellowish brown, medium apparent permeability.
10 - 12	2	Fine sand and common shell fragments, medium apparent permeability.
12 - 14	2	Coarse sand and gravel with minor phosphatic coarse sand, medium gray, high apparent permeability.
14 - 17	3	Fine sand, small gravel and marl. Yellowish gray, wet, loose, high apparent permeability.
17 - 19	2	Fine sand with minor silt, common shell fragments, yellowish gray, wet, loose, medium apparent permeability.
19 - 21	2	Fine to coarse sand and gravel, marl, yellowish gray, high apparent permeability.
21 - 23	2	Coarse sand and gravel with phosphatic gravel and minor shell fragments, yellowish gray, high apparent permeability.
23 - 27	4	Very fine silty sand with common small shell fragments, yellowish gray, low apparent permeability.
27 - 29	2	Sandy silt with minor coarse sand and gravel, light olive gray, low apparent permeability.
29 - 30	1	Medium to coarse sand , dry, dense/compacted, light gray, medium apparent permeability.
5/16/19		Site 12
0 - 4	4	Fine to medium sand, dark yellowish orange.
4 - 5	1	Silty fine sand, compacted, pale yellowish brown.
5 - 9	4	Coarse sand with small shell fragments, light olive gray.
9 - 10	1	Coarse sand and gravel, minor rocks, pale yellowish brown.
10 - 13	3	Fine sand with minor shell fragementes.
13 - 16	3	Coarse sand, gravel, and shell fragementes, yellowish gray.
16 - 19	3	Fine sand and gravel, loose, yellowish gray.
19 - 23	4	Shell and large phosphatic gravel.
23 - 27	4	Fine silty sand and shells with minor fine phosphatic sand, pale yellowish brown, loose.
27 - 30	3	Silt with large shell fragments, dry, compacted, pale yellowish brown.



Lithology Logs
(Direct Push Cores)

Dates: 5/16/19, 5/20/19, 5/23/19

Project Name: Yucca Pens Borings
 Driller Name/No. Preferred D
 Drilling Company Preferred Drilling
 Well No.: 13, 14, 15
 Drilling Method: Geoprobe Direct Push, Hollow Stem Auger
 Bit Size: Direct Push 2", HAS 6"
 Sampling Method: Direct Push Cores
 Described By: Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/20/19		Site 13
0 - 4	4	Fine sand with minor organics, very pale orange.
4 - 5	1	Fine sand, grayish brown.
5 - 10	5	No Return, sample stuck in sampling rod (rock).
10 - 15	5	Silty fine to coarse sand, loose, wet, yellowish gray.
15 - 20	5	Fine sand with minor shell fragments, very pale orange.
20 - 25	5	Fine sand, wet, loose, pale yellowish brown.
25 - 30	5	Silt, light olive gray, low apparent permeability.
5/16/19		Site 14
0 - 4	4	Fine sand with minor organics, light brown, medium apparent permeability.
4 - 5	1	Fine to coarse sand, very slightly silty or sticky, moderate yellowish brown, medium apparent permeability.
5 - 8	3	Fine sand, well sorted, yellowish brown, medium apparent permeability.
8 - 23	15	Fine sand and small gravel, wet, loose, yellowish gray, high apparent permeability.
23 - 26	3	Fine sand and gravel, loose, yellowish gray, high apparent permeability.
26 - 30	4	Very fine sandy silt, light olive gray, well sorted, low apparent permeability.
5/23/19		Site 15
0 - 5	5	Fine sand, pale brown, well sorted, medium apparent permeability.
5 - 8	3	Fine sand, well sorted, olive brown, medium apparent permeability.
8 - 11	3	Silty coarse sand and gravel with coarse phosphatic sand, light gray, medium apparent permeability.
11 - 14	3	Fine sand, well sorted, yellowish gray, medium apparent permeability.
14 - 16	2	Fine to coarse sand, dry, light gray, medium apparent permeability.
16 - 20	4	Silty sand and gravel, light olive gray, low apparent permeability.
20 - 24	4	Fine sand with minor shell fragments, very light gray, medium apparent permeability.
24 - 25	1	Shell hash, high apparent permeability.
25 - 30	5	Fine sandy silt, light olive gray, low apparent permeability.



Dates: 5/18/19, 5/22/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 16, 17

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Andy McThenia and Jared Wilkey

Lithology Logs
(Direct Push Cores)

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/18/19		Site 16
0 - 4	4	Very fine to fine quartz sand, yellowish gray to light orange, minor organics, good apparent permeability.
4 - 5	1	Silty sand, silt to very fine quartz sand, dark yellowish brown, low apparent permeability.
5 - 8	4	Silty sand, fine quartz sand, clean, loose, good apparent permeability, minor shell, yellowish gray.
8 - 9	1	Clay, stiff, cohesive, dusky yellow green, low apparent permeability.
9 - 15	4	Limestone gravel, moderate induration, marly, medium gray, abundant phosphatic sand, low apparent permeability.
15 - 20	5	Weathered marly limestone, yellowish gray, abundant shells and marl, abundant fine quartz sand.
20 - 28	5	Loose phosphatic sand to gravel, abundant shells, pale yellowish brown. Good apparent permeability.
28 - 30	2	Phosphatic and quartz sand to gravel, dark greenish grey, loose, good apparent permeability
30 - 32	2	Shell hash, loose, clean pale orange, good apparent permeability.
32 - 35	3	Sand to phosphatic gravel, dark greenish gray, good apparent permeability.
35 - 40	4	Sandy silt, phosphatic silt to sand abundant, sticky, cohesive, low apparent permeability.
5/22/19		Site 17
0 - 3	3	Fine sand, minor organics, very pale orange, well sorted, medium apparent permeability.
3 - 4	1	Silty sand, light greenish gray, dry, compacted/dense, low apparent permeability.
4 - 10	6	Very fine silty sand, light gray, low apparent permeability.
10 - 24	14	Fine to coarse sand with shell fragments, very light gray, high apparent permeability.
24 - 28	4	Silty sand and very coarse sand, pale olive, low apparent permeability.
28 - 30	2	medium sand and phosphate gravel, medium gray, medium apparent permeability.



Lithology Logs
(Direct Push Cores)

Dates: 5/14/19, 5/22/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 18, 19

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Andy McThenia and Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/22/19		Site 18
0 - 3	3	Fine sand, well sorted, very pale orange, medium apparent permeability.
3 - 4	1	Fine sand and very coarse sand, yellowish orange, high apparent permeability.
4 - 7	3	Silty sand, compacted/dense, light gray, low apparent permeability.
7 - 14	7	Medium to coarse sand, wet, loose, very light gray, high apparent permeability.
14 - 15	1	Medium to coarse sand, compacted/dense, crumbly, light gray, low apparent permeability.
15 - 20	5	Hard rock, high apparent permeability.
20 - 21	1	Very fine silty sand and coarse sand, dense/compacted, dry, light olive gray, low apparent permeability.
21 - 23	2	Coarse sand, crumbly, light brownish gray, high apparent permeability.
23 - 28	2	Very fine to medium sand, loose, yellowish brown, medium apparent permeability.
28 - 30	3	Fine sand and coarse phosphatic sand, dark gray, medium apparent permeability.
30 - 35	5	No sample return.
35 - 40	5	Very fine sandy silt, light olive gray, well sorted, low apparent permeability.
5/14/19		Site 19
0 - 2	2	Fine sand, light yellow.
2 - 3	1	Fine to medium sand, dark yellowish orange, wet.
3 - 8	5	Very fine to fine sand, pale yellowish brown.
8 - 9	1	Shell hash, yellowish gray.
9 - 12	1	Silty phosphatic gravel, medium gray.
12 - 20	8	Marly shell bed with silty gravel, limestone gravel, loose, uncemented, low apparent permeability.
20 - 22	2	Limestone, shell and phosphatic gravel. Medium dark gray and orange.
22 - 28	6	Silty sand and gravel, abundant phosphatic sand, yellowish gray, low apparent permeability.
28 - 30	2	Silt with phosphatic sand, stiff, sticky, dusky yellow green.



Lithology Logs
(Direct Push Cores)

Dates: 5/14/19, 5/18/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 20, 21, 22

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Andy McThenia

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/14/19		Site 20
0 - 2	2	Very fine to fine sand, yellowish gray.
2 - 4	2	Silty sand, very pale orange.
4 - 5	1	Silty sand and limestone, wet at 5'.
5 - 10	5	Silty sand with abundant shell.
10 - 15	5	Little Recover, fine silt, dark green, stiff.
15 - 20	5	Limestone sand and shell hash, marl mixture, yellowish gray.
20 - 21	1	Phosphatic gravel and sand, light gray.
21 - 23	2	Fine sand to gravel, yellowish gray.
23 - 25	2	Fine sand, abundant fine phosphatic sand.
25 - 26	1	Shell and gravel mix, grayish orange.
26 - 30	4	Silt and phosphatic sand, dusky yellow green.
5/18/19		Site 21
0 - 7	7	Very fine to fine quartz sand, minor organics, clean soft, loose, yellowish gray, wet at 4' bls, good apparent permeability.
7 - 9	2	Weathered limestone, yellowish gray, packstone, low apparent permeability.
9 - 13	4	Gravel and shell hash, silt to gravel, abundant shells, loose, good apparent permeability.
13 - 15	2	Weathered marly limestone, yellowish gray, mudstone to grainstone, moderate induration, low apparent permeability.
15 - 17	2	Weathered yellow sandy limestone, light orange, moderate hardness, moderate apparent permeability.
17 - 18	1	Shell hash, soft loose, very fine sand to gravel sized quartz sand and shells, yellowish gray, poor induration.
18 - 20	2	Weathered marly limestone with phosphatic sand, moderate induration, light gray, low apparent permeability.
20 - 26	5	Fine sand to gravel, fine quartz sand to gravel limestone, grainstone, abundant phosphatic gravel, medium gray.
26 - 30	4	Sandy clay, olive green, abundant phosphatic sand, low apparent permeability.



Lithology Logs
(Direct Push Cores)

Dates: 5/17/19, 5/22/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 22, 23

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/22/19		Site 22
0 - 5	5	Fine sand, very pale orange, well sorted, medium apparent permeability.
5 - 6	1	Fine sand, moderate yellowish brown, medium apparent permeability.
6 - 12	6	Silty fine sand, light gray, wet, loose, low apparent permeability.
12 - 19	7	Fine to coarse sand and gravel, yellowish gray, wet, loose, medium apparent permeability.
19 - 25	6	Fine to coarse sand and dry silt, very light gray, medium apparent permeability.
25 - 29	4	Fine to very coarse sand and gravel, dry, compacted/dense, high apparent permeability.
29 - 30	1	Refusal, rock, hard, dense, high apparent permeability.
5/17/19		Site 23
0 - 2	2	Fine sand, very pale orange.
2 - 5	3	Fine sand, wet, greyish orange.
5 - 8	3	Fine sand, slightly silty, shell fragments, wet, light olive gray.
8 - 10	2	Coarse sand and gravel, slightly silty, dense, dry, yellowish gray.
10 - 12	2	Fine silty sand with large shell fragments, dense, pale yellowish gray.
12 - 15	3	Coarse sand, slightly silty, dry, crumbly, yellowish gray.
15 - 20	5	Very coarse sand and gravel, slightly silty, dry, crumbly, yellowish gray.
20 - 23	3	Fine sand and shell fragments, slightly silty, loose, wet, yellowish gray.
23 - 25	2	Fine to medium sand with minor phosphatic sand, loose, wet.
25 - 30	5	No return, sample stuck in hollow stem auger.
30 - 34	4	Fine sand and phosphatic sand, slightly silty, light olive gray.
34 - 35	1	Coarse sand, medium dark gray.
35 - 38	3	Silt, dry, dense, crumbly, light olive.
38 - 40	2	Silt, wet, yellowish gray, low apparent permeability.



Lithology Logs
(Direct Push Cores)

Dates: 5/16/19, 5/17/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 24, 25

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/17/19		Site 24
0 - 4	4	Very fine sand, minor organics, grayish orange pink, medium apparent permeability.
4 - 5	1	Fine sand and small gravel, very pale orange, crumble, dry, low apparent permeability.
5 - 6	1	Fine to medium sand, moderate yellowish brown, wet, loose, medium apparent permeability.
6 - 11	5	Fine to coarse sand and marl, yellowish gray, wet, loose, medium apparent permeability.
11 - 13	2	Fine to very coarse sand and marl, yellowish gray, dry, dense, crumble, medium apparent permeability.
13 - 17	4	Sandy silt and minor small shell fragments, yellowish gray, loose, wet, low apparent permeability.
17 - 20	3	Sandy silt, moderate yellowish gray, loose, wet, low apparent permeability.
20 - 22	2	Coarse sand with minor small gravel and shell fragments, yellowish gray, high apparent permeability.
22 - 25	3	Fine to coarse sand and marl, shell fragments, yellowish gray, wet, medium apparent permeability.
25 - 28	3	Coarse sand with minor shell fragments, pale yellowish brown, loose, wet, high apparent permeability.
28 - 30	2	Sandy silt, minor shell fragments, light olive gray, wet, loose, low apparent permeability.
5/16/19		Site 25
0 - 3	3	Fine sand, pinkish gray minor organics.
3 - 5	2	Fine sand, slightly silty, dense/compacted, dusky brown.
5 - 7	2	No Return
7 - 10	3	Coarse sand and gravel, dry crumble, dense/compacted, yellowish gray.
10 - 15	5	Little return, fine sand to coarse sand, loose, olive gray.
15 - 17	2	Medium sand and shell fragments, loose, very pale orange.
17 - 20	3	Fine silty sand, loose, very pale orange.
20 - 23	3	Medium sand and small shell fragments, marly, loose, light olive gray.
23 - 27	2	Fine sand and silt, light olive gray.
27 - 30	3	Fine sandy silt with coarse sand and minor shell fragments, light olive gray.



Lithology Logs
(Direct Push Cores)

Dates: 5/14/2019, 5/21/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 26, 27

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Andy McThenia and Jared Wilkey

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/21/2019		Site 26
0 - 4	4	Fine sand with minor organics, very pale orange.
4 - 7	3	Fine sand, slightly silty, dry, compact, light olive gray.
7 - 8	1	Fine to very coarse sand, wet, loose, yellowish gray.
8 - 11	3	Very coarse sand and gravel, dense, compacted, yellowish gray.
11 - 15	4	Very coarse sand, slightly silty, crumbly, yellowish gray.
15 - 20	5	No return.
20 - 30	10	Silt with very fine sand, light olive gray, low apparent permeability.
5/14/19		Site 27
0 - 2	2	Fine sand, light gray.
2 - 3	1	Organic fine to medium sand, light gray.
3 - 4	1	Sand and organics, light gray.
4 - 5	1	Shell hash, very pale orange.
5 - 7	2	Fine sand and shell hash, very pale orange.
7 - 8	1	Organic silty sand, dark brown, low apparent permeability.
8 - 10	2	Fine to medium silty sand, pale yellowish brown, good apparent permeability.
10 - 15	5	Fine sand , slightly silty, pale yellowish brown to yellowish gray, loose.
15 - 19	4	Fine sand, compacted, yellowish brown.
19 - 20	1	Very silty very fine sand, olive gray.
20 - 25	5	No Recovery.
25 - 30	5	1 foot of recovery, sand and shell, loose.
30 - 35	5	Sandy silt, pale olive, low apparent permeability.



Dates: 5/15/19, 5/17/19, 5/20/19

Project Name: Yucca Pens Borings

Driller Name/No. Preferred D

Drilling Company Preferred Drilling

Well No.: 28, 29, 30

Drilling Method: Geoprobe Direct Push, Hollow Stem Auger

Bit Size: Direct Push 2", HAS 6"

Sampling Method: Direct Push Cores

Described By: Jared Wilkey

Lithology Logs
(Direct Push Cores)

Depth Interval (feet bls)	Thickness (feet)	Sample Description
5/15/19		Site 28
0 - 5	5	Fine sand, common organics, greyish brown.
5 - 7	2	Fine sand, light olive gray.
7 - 10	3	Fine sand and shell fragments, olive gray.
10 - 12	2	Fine sand and shell fragments, dark yellowish gray.
12 - 13	1	Find sand with minor silt clumps.
13 - 15	2	Gravel with phosphatic coarse sand, pale yellowish brown.
15 - 19	4	Very fine sand with minor shell, pale yellowish brown.
19 - 20	1	Shell and phosphatic gravel and marl, yellowish gray.
20 - 23	3	Fine sand and shell fragments, yellowish gray.
23 - 24	1	Large shell and phosphatic gravel.
24 - 25	1	Fine sand, minor shell and fine phosphatic sand, very pale orange.
25 - 26	1	Fine sand and marl, yellowish gray.
26 - 30	4	Silt, light olive gray, low apparent permeability.
5/17/19		Site 29 - Shallow Monitoring Well
0 - 6	6	Fine sand, very pale orange.
5/20/19		Site 30
0 - 5	5	Fine sand, very pale orange.
5 - 8	3	Fine sand with minor shell, wet, loose, yellowish gray.
8 - 12	4	Fine to coarse sand and gravel, wet, yellowish gray.
12 - 15	3	Silty coarse sand, compacted/dense, dry, crumble.
15 - 16	1	Corase sand and gravel.
16 - 22	6	Fine to coarse sand, loose, wet, pale yellowish brown.
22 - 25	3	Silty sand, light olive gray.
25 - 30	5	No Return.
30 - 35	5	Silt, light olive gray, low apparent permeability.