

**Star Valley Ranch  
Test Boring No. 1  
Lithologic Log**

Depth (feet)		Unit	Description (in decreasing order of abundance)	Comments
From	To			
0	20	Quaternary Alluvium	Coarse gravel with clasts consisting of black to medium gray and light gray limestone with veinlets of white calcite, yellow-orange clay	Clasts are broken during drilling so that the degree of sorting and rounding is uncertain.
20	30		Coarse gravel consisting of clasts of black to medium gray crystalline limestone with veinlets of white calcite, yellow-orange clay	
30	40		Coarse gravel with clasts of black to dark gray and gray-orange sandy limestone	
40	60		Coarse gravel consisting of clasts of dark gray limestone with veins of white calcite, dark yellow-orange clay	
60	80		Coarse gravel with clasts of light gray and medium dark gray crystalline limestone	
80	100		Coarse gravel with clasts of light gray and medium dark gray crystalline limestone and brecciated limestone, gray-orange clay	
100	120	Salt Lake Formation	Weakly consolidated conglomerate consisting of clasts of light olive, dark gray to black, and red-brown crystalline brecciated limestone, yellow-orange clay	
120	130		Weakly consolidated conglomerate consisting of clasts of light olive, dark gray to black, and red-brown crystalline brecciated limestone, yellow-gray clay, minor fine to coarse-grain, rounded, calcareous sandstone	
130	140		Weakly consolidated conglomerate with clasts of medium dark gray and light brown-gray fractured, crystalline limestone, yellow-orange clay	
140	160		Weakly consolidated conglomerate with clasts of medium light gray and light brown-gray fractured limestone, yellow-orange clay	
160	170		Weakly consolidated conglomerate with clasts of medium light gray, dark brown-gray, and black crystalline limestone, dark yellow-orange limestone breccia, yellow orange clay	
170	180		Weakly consolidated conglomerate with clasts of medium light gray, dark gray, and dark brown-gray, crystalline, fractured limestone, pale yellow-orange granular limestone	Water encountered at 170 feet; static water level 175 feet below ground level on 5/14/2008
180	210		Weakly consolidated conglomerate with clasts of black, crystalline, fractured limestone, medium olive-gray finely crystalline limestone, and very light gray travertine	Static water level 190 feet below ground level on 5/17/2008
210	240		Weakly consolidated conglomerate containing clasts of black, medium gray, light gray, and dark-olive gray crystalline, fractured limestone and pale yellow-orange granular limestone	

240	260	Salt Lake Formation	Weakly consolidated conglomerate with clasts of olive-gray very finely crystalline limestone, black and medium gray crystalline, fractured limestone, minor moderate red-brown oxidized limestone	
260	270		Weakly consolidated conglomerate with clasts of black and medium gray, crystalline, fractured limestone, moderate red-brown to gray-orange oxidized limestone, dusky yellow clay	
270	290		Weakly consolidated conglomerate with clasts of black, medium gray, and very light gray, crystalline, fractured limestone, moderate olive-brown, finely crystalline limestone, moderate red-brown to gray-orange oxidized limestone	
290	300		Weakly consolidated conglomerate with clasts of black and medium gray, crystalline, fractured limestone, moderate olive-brown, finely crystalline limestone, moderate red-brown to gray-orange oxidized limestone	Bottom of 8 5/8-inch diameter casing at 298 feet
300	320		Cobble conglomerate with clasts of medium light gray, black, light gray crystalline limestone, dark yellow-orange oxidized limestone	6 1/4-inch diameter borehole; air drilling with foam injection
320	340		Cobble conglomerate with clasts of medium light gray, black, light gray crystalline limestone, dark yellow-orange oxidized limestone, white calcite	
340	360		Cobble conglomerate with clasts consisting of black and gray-black, crystalline limestone, light gray and very light gray, finely crystalline limestone, dark yellow-orange to light brown oxidized limestone	
360	370		Cobble conglomerate with clasts consisting of black and gray-black, crystalline limestone, light brown to moderate yellow-brown oxidized, fractured limestone, light gray and very light gray, finely crystalline limestone	Production water sample: T = 10.6°C, pH = 8.5, conductivity = 380 µS
370	390		Cobble conglomerate with clasts consisting of black and gray-black, crystalline limestone, light gray and very light gray, finely crystalline limestone, dark yellow-orange to light brown oxidized limestone	
390	400		Cobble conglomerate with clasts consisting of black, brown-black, medium dark gray crystalline limestone, dark yellow-orange to light brown, oxidized limestone, minor yellow-gray, granular limestone	
400	410		Cobble conglomerate with clasts consisting of black, dark gray to light gray crystalline limestone, with fractured and patchy moderate red-brown, oxidized limestone; some cuttings are rounded	
410	430		Cobble conglomerate with clasts consisting of black, dark gray to light gray, and dark green-gray crystalline limestone, with fractured and patchy moderate red-brown, oxidized limestone	
430	440		Cobble conglomerate with clasts consisting of black, dark gray to light gray crystalline limestone, with fractured and patchy moderate red-brown, oxidized limestone	Air-lift production = 100 gpm
440	450		Cobble conglomerate with clasts consisting of black, dark gray to light gray, and olive-gray finely crystalline limestone, with fractured and patchy moderate red-brown, oxidized limestone	Production water sample: T = 11.3°C, pH = 8.3, conductivity = 290 µS, TDS = 204 ppm

450	460	Salt Lake Formation	Cobble conglomerate with clasts consisting of black to dark gray crystalline limestone, light gray granular limestone, dark yellow-orange oxidized limestone; some cuttings have rounded edges	
460	470		Cobble conglomerate with clasts consisting of black to dark gray and olive-gray crystalline limestone, light gray granular limestone, dark yellow-orange oxidized limestone; some cuttings have rounded edges	
470	490		Cobble conglomerate with clasts consisting of black to dark gray and olive-gray crystalline limestone, light gray granular limestone, minor dark yellow-orange oxidized limestone; some cuttings have rounded edges	
490	510	Madison Limestone	Black, olive-black, medium gray to medium light gray crystalline limestone, yellow-brown and light olive bedded siltstone, dark yellow-orange oxidized limestone	Air-lift production = 200 gpm; T = 10.3°C, pH = 8.3, conductivity = 290 μS, TDS = 205 ppm
510	550		Black, olive-black, medium gray to medium light gray crystalline limestone, dark yellow-orange oxidized limestone	
550	560		Olive-gray, black, and light gray crystalline limestone, yellow oxidized limestone, white calcite veinlets, black spots of pyrolusite on some clasts	
560	580		Olive-gray, black, and light gray crystalline limestone, yellow oxidized limestone, white calcite veinlets	
580	600		Olive-gray, black, and light gray crystalline limestone, yellow oxidized limestone, minor white calcite	
600	630		Black to light gray crystalline limestone, dark yellow-orange oxidized limestone, white calcite	T = 10.5°C, pH = 8.3, conductivity = 290 μS, TDS = 208 ppm
630	640		Black to light gray and light olive-gray crystalline limestone, dark yellow-orange to pale yellow-orange oxidized limestone, rare light olive bedded siltstone	
640	650		Black to light gray and light olive-gray crystalline limestone, dark yellow-orange to pale yellow-orange oxidized limestone, minor very pale orange welded tuff, rare light olive bedded siltstone	
650	660		Black to light gray and light olive-gray crystalline limestone, dark yellow-orange to pale yellow-orange oxidized limestone, minor very pale orange to light brown porous siltstone, rare light olive bedded siltstone	
660	670		Light gray and black crystalline limestone, yellow oxidized limestone, pale olive, fine grain, well sorted rounded, well cemented quartz sandstone	
670	680		Light gray and black crystalline limestone, yellow oxidized limestone, white, fine grain, well sorted rounded, well cemented quartz sandstone, gray-green siltstone	
680	690		Light gray, black, and brown-gray crystalline limestone, pale yellow-orange to dark yellow-orange limestone, gray-yellow-green mudstone	
690	710		Medium light gray, black, rare light olive-gray crystalline limestone, white to very light gray granular limestone, moderate red-brown to pale yellow-orange oxidized limestone	

710	750	Madison Limestone	Medium gray to black crystalline limestone, moderate red-brown to dark yellow-orange oxidized limestone	T = 12.5°C, pH = 8.2, conductivity = 310 µS, TDS = 220 ppm
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**Total Depth of Boring - 753 Feet**

Note: reported colors were determined using the GSA Rock Color Chart on wet samples, sample interval was 10 feet.

**Star Valley Ranch  
Test Boring No. 2  
Lithologic Log**

Depth (feet)		Unit	Description (in decreasing order of abundance)	Comments
From	To			
0	10	Quaternary Alluvium	Coarse gravel consisting of crystalline black limestone clasts coated with brown clay	8 5/8-inch diameter borehole; air drilling
10	20		Coarse gravel consisting of crystalline black limestone clasts with abundant brown clay	
20	40		Brown clay, black crystalline limestone pebbles and cobbles	
40	70		Coarse gravel consisting of clasts of black crystalline limestone with veins of white calcite, brown clay	
70	80		Coarse gravel consisting of rounded cobbles of crystalline black limestone, brown clay	
80	90		Coarse gravel with clasts of black to light gray crystalline limestone and dark yellow-orange oxidized limestone; sample is ground up	
90	100		Coarse gravel with rounded clasts of black to light gray crystalline limestone and dark yellow-orange oxidized limestone	
100	110		Coarse gravel with rounded clasts of black to light gray crystalline limestone and dark yellow-orange oxidized limestone; sample is ground up	Bottom of 8 5/8-inch diameter casing at 110 feet
110	130		Coarse gravel with clasts consisting of black to dark gray, and very light gray crystalline limestone, clasts contain veins and vugs filled with white calcite and patches and streaks of dark yellow-orange oxidized limestone	6 1/4-inch diameter borehole; air drilling with foam injection
130	140		Coarse weakly consolidated conglomerate with clasts consisting of black to dark gray, and very light gray crystalline limestone, clasts contain veins and vugs filled with white calcite and patches and streaks of dark yellow-orange oxidized limestone, abundant gray-orange clay	
140	150	Salt Lake Formation	Coarse grain, weakly consolidated conglomerate with clasts consisting of black to dark gray, and very light gray crystalline limestone, clasts contain veins and vugs filled with white calcite and patches and streaks of dark yellow-orange oxidized limestone, abundant gray-orange and yellow-brown clay	
150	160		Coarse weakly consolidated limestone conglomerate with rounded clasts	
160	180		Coarse grain, weakly consolidated limestone conglomerate with dark yellow-orange clay	
180	190		Coarse conglomerate with clasts of black and medium gray crystalline limestone containing veins of white calcite	
190	200		Coarse conglomerate with clasts of black and medium gray crystalline limestone containing veins of white calcite, minor gray-orange clay	
200	230		Coarse grain conglomerate with clasts consisting of light gray, medium gray, black, and very light gray crystalline limestone, black limestone clasts have abundant white calcite	Water encountered at 220 feet

230	240	Salt Lake Formation	Coarse grain conglomerate with clasts consisting of light gray, medium gray, black, and very light gray crystalline limestone, black limestone clasts have abundant white calcite, dark yellow-orange oxidized limestone clasts	
240	250		Moderate red-orange clay, coarse grain conglomerate with clasts consisting of light gray, medium gray, black, and very light gray crystalline limestone, black limestone clasts have abundant white calcite, dark yellow-orange oxidized limestone clasts	
250	280		Coarse grain conglomerate containing flat, rounded cobbles and pebbles of black, dark gray, and light gray crystalline limestone, black limestone clasts have abundant white calcite	
280	290		Moderate red-brown clay, cobble conglomerate with clasts consisting of black and gray-black, crystalline limestone, light gray and very light gray, finely crystalline limestone, dark yellow-orange to light brown oxidized limestone	
290	300		Cobble conglomerate with clasts consisting of black and gray-black, crystalline limestone, light gray and very light gray, finely crystalline limestone, dark yellow-orange to light brown oxidized limestone, moderate red-brown clay	
300	320		Coarse grain conglomerate containing flat, rounded cobbles and pebbles of dark gray to black (with white calcite), gray, and light gray crystalline limestone, pale yellow-orange and minor moderate red-brown oxidized limestone	
320	360		Coarse grain conglomerate containing flat, rounded cobbles and pebbles of dark gray to black (with white calcite), gray, and light gray crystalline limestone, yellow-orange clay, pale yellow-orange and minor moderate red-brown oxidized limestone	
360	370		Cobble conglomerate with rounded clasts consisting of dark gray to black, gray and very light gray crystalline limestone, light brown and yellow-orange clay	Production water sample: T = 11.5°C, pH = 8.0, conductivity = 320 µS, TDS = 225 ppm
370	380	Madison Limestone	Dark gray to black, gray and very light gray crystalline limestone, dark yellow-orange oxidized limestone; sample is ground up	
380	390		Dark gray to black, gray and very light gray crystalline limestone, dark yellow-orange oxidized limestone, minor yellow-orange clay	
390	400		Black to dark gray, gray and very light gray crystalline limestone, dark yellow-orange oxidized limestone	
400	410		Black to dark gray, gray and very light gray crystalline limestone, dark yellow-orange oxidized limestone, dark yellow-orange clay	
410	420		Black to dark gray, gray and very light gray crystalline limestone, dark yellow-orange oxidized limestone	
420	430		Black to dark gray, gray and very light gray crystalline limestone, dark yellow-orange oxidized limestone, light brown clay	

430	460	Madison Limestone	Very dark gray to black, light gray, and very light gray crystalline limestone, yellow-orange oxidized limestone, white calcite	Air-lift production = 200 gpm
460	490		Very dark gray to black, light gray, and very light gray crystalline limestone, yellow-orange oxidized limestone, white calcite, dark yellow-orange clay	Production water sample: T = 8.2°C, pH = 8.3, conductivity = 320 µS, TDS = 227 ppm
490	500		Very dark gray to black, yellow-orange, and light gray crystalline limestone, white calcite	
500	510		Very dark gray to black, yellow-orange, and light gray crystalline limestone, white calcite, minor light brown clay	
510	520		Very dark gray to black, yellow-orange, and light gray crystalline limestone, white calcite, minor dark yellow-orange clay	
520	530		Very dark gray to black, yellow-orange, and light gray crystalline limestone, white calcite, dark yellow-orange clay	
530	550		Very dark gray to black, yellow-orange, and light gray crystalline limestone, dark yellow-orange, fine grain, well cemented (with calcite) sandstone, white calcite	Production water sample: T = 10.5°C, pH = 8.3, conductivity = 320 µS, TDS = 224 ppm
550	570		Black to brown-black and medium light gray crystalline limestone, light brown clay, dark yellow-orange, fine grain, calcareous sandstone	Drill using mud/rotary methods
570	590		Black to brown-black and medium light gray crystalline limestone, dark yellow-orange, fine grain, calcareous sandstone	
590	610		Black to brown-black and medium to light gray crystalline limestone, pale yellow-orange to dark yellow-orange oxidized limestone, light brown clay	
610	630		Black to brown-black and light gray crystalline limestone, pale yellow-orange oxidized limestone, minor light brown clay	
630	660		Black to brown-black and light gray crystalline limestone, pale yellow-orange oxidized limestone, white calcite	
660	670		Black to brown-black and light gray crystalline limestone, pale yellow-orange oxidized limestone, white calcite, light brown clay	
670	690		Black, brown-black, and light gray crystalline limestone, dark yellow-orange and yellow oxidized limestone, white calcite	
690	700		Black, brown-black, and light gray crystalline limestone, dark yellow-orange and yellow oxidized limestone, white calcite, light brown clay	
700	730		Black, brown-black, and light gray crystalline limestone, dark yellow-orange and yellow oxidized limestone, white calcite	
730	750	Black, brown-black, and light gray crystalline limestone, dark yellow-orange and yellow oxidized limestone, white calcite, light brown clay		

**Total Depth of Boring - 753 Feet**

Note: reported colors were determined using the GSA Rock Color Chart on wet samples, the sample interval was 10 feet.

**Star Valley Ranch  
Test Boring No. 3  
Lithologic Log**

Depth (feet)		Unit	Description (in decreasing order of abundance)	Comments
From	To			
0	4	Quaternary Alluvium	Brown sandy loam	8 5/8-inch diameter borehole; air drilling
4	10		Coarse gravel with clasts of medium dark gray crystalline limestone with veinlets of white calcite, dark yellow-orange clay	
10	30		Coarse gravel with clasts of medium dark gray crystalline limestone with veinlets of white calcite, light gray finely crystalline limestone, dusky yellow clay	
30	40		Coarse gravel with clasts of gray-black and light olive-gray crystalline fractured limestone, dusky yellow clay	
40	50		Coarse gravel with clasts of gray-black and light olive-gray crystalline fractured limestone, light gray to white finely granular limestone, dusky yellow clay	
50	60		Coarse gravel with clasts of gray-black and light olive-gray crystalline fractured limestone, light gray to white finely granular limestone, moderate red-brown oxidized limestone, dusky yellow clay	
60	70		Coarse gravel with clasts of gray-black and light olive-gray crystalline fractured limestone, dusky yellow clay, light gray to white finely granular limestone	
70	80		Coarse gravel consisting of clasts of black and medium gray crystalline limestone, light olive-gray granular limestone, dark yellow-orange oxidized limestone, dusky yellow clay	
80	100		Coarse gravel with clasts of gray-black crystalline limestone with white calcite veinlets, dark yellow-orange clay and silt	
100	120	Salt Lake Formation	Weakly consolidated conglomerate with clasts of gray-black, light olive-gray, dark yellow-gray, and very pale orange crystalline limestone with white calcite veinlets, moderate red-brown oxidized limestone in fractures, dark yellow-orange clay and silt	
120	140		Dark yellow-orange silty clay, weakly consolidated conglomerate with clasts of gray-black, olive-gray, dark yellow-gray, and very pale orange crystalline limestone with white calcite veinlets, moderate red-brown oxidized limestone	Bottom of 8 5/8-inch diameter casing at 138 feet
140	150		Moderate yellow-brown clay and coarse grain conglomerate	
150	180		Coarse grain, weakly consolidated limestone conglomerate with rounded clasts, pebble and cobbles are generally flat, moderate yellow-brown clay	
180	230		Coarse grain, weakly consolidated limestone conglomerate with black, brown-gray and very light gray rounded clasts, pebble and cobbles are typically flat, moderate yellow-brown clay	
230	270		Weakly consolidated, rounded pebble and cobble conglomerate with clasts consisting of black, brown-gray, and very light gray crystalline limestone, moderate yellow-brown clay	

270	280	Salt Lake Formation	Weakly consolidated, rounded pebble and cobble conglomerate with clasts consisting of black, brown-gray, and very light gray crystalline limestone, moderate yellow-brown clay,	Water encountered at 270 feet
280	300		Weakly consolidated, rounded, coarse grain, limestone conglomerate with clasts of brown-gray, black, and dark yellow-gray crystalline limestone, dark yellow-orange graywacke with angular limestone and rock fragments in a tuffaceous matrix	
300	310		Weakly consolidated, rounded, coarse grain limestone conglomerate with clasts of brown-gray, black, dark olive-brown, and dark yellow-gray, crystalline limestone clasts, dark yellow-orange graywacke with angular limestone and rock fragments in a tuffaceous matrix	
310	320		Yellow-orange, fine grain, calcite cemented, porous sandstone, cobble conglomerate with clasts of black crystalline limestone with veinlets of white calcite and light brown-gray and brown-gray crystalline limestone	
320	340		Cobble conglomerate with clasts of black crystalline limestone with veinlets of white calcite and light brown-gray and brown-gray crystalline limestone, yellow-orange, fine grain, bedded, calcite cemented sandstone,	
340	360		Cobble conglomerate with clasts consisting of brown-black, black (with white calcite veinlets) crystalline limestone, dark yellow-orange oxidized limestone	
360	370		Dark yellow-orange, calcareous, silty, moderately cemented, fine grain sandstone, conglomerate with clasts of black, brown-gray, and light gray crystalline limestone	
370	380		Dark yellow-orange, calcareous, silty, moderately cemented fine grain sandstone, conglomerate with clasts of black, brown-gray, and light gray crystalline limestone, moderate yellow-orange clay	
380	390		Cobble conglomerate with rounded clasts consisting of black to dark gray crystalline limestone with veinlets of white calcite, moderate yellow-orange clay, yellow-orange oxidized limestone	
390	400		Cobble conglomerate with rounded clasts consisting of black to dark gray, and very light gray crystalline limestone with veinlets of white calcite, moderate yellow-orange clay, yellow-orange oxidized limestone	
400	420	Madison Limestone	Brown-black, black, very light gray, and light red crystalline limestone with abundant white calcite, minor moderate yellow-orange clay	
420	430		Brown-gray, very light gray, and black crystalline limestone, minor brown-gray, porous, medium grain, porous, moderately cemented calcareous sandstone	Conventional mud/rotary drilling; increased loss of drilling fluid below 420 feet
430	450		Black, brown-gray, and light gray crystalline limestone, dark yellow-orange to yellow-orange, fine grain, moderately cemented, calcareous sandstone, yellow-orange clay	
450	460		Black, brown-gray, and light gray crystalline limestone, dark yellow-orange to yellow-orange, and olive-brown, fine grain, moderately cemented, calcareous sandstone, yellow-orange clay	

460	470	Madison Limestone	Black to dark gray and light gray crystalline limestone, minor light olive-gray granular limestone, minor dark yellow-orange clay	
470	480		Dark gray to black, olive-gray, and light gray crystalline limestone, white calcite fills veins and vugs in limestone clasts, minor yellow-orange clay	
480	500		Dark gray to black, olive-gray, and light gray crystalline limestone, white calcite fills veins and vugs in limestone clasts, minor yellow-orange to olive-gray calcareous siltstone	
500	510		Dark gray to black, olive-gray, and light gray crystalline limestone, white calcite fills veins and vugs in limestone clasts, yellow-orange to olive-gray calcareous siltstone, dark yellow-orange clay	
510	520		Dark gray to black, olive-gray, and light gray crystalline limestone, white calcite fills veins and vugs in limestone clasts, yellow-orange to olive-gray calcareous siltstone, dark yellow-orange clay	
520	540		Dark gray to black, olive-gray, and light gray crystalline limestone with white calcite, yellow-orange to olive-gray calcareous siltstone	
540	550		Dark gray to black crystalline limestone with white calcite, dark yellow-orange to yellow-orange, poorly sorted, fine to coarse grain, moderately cemented, calcareous sandstone, coarse grains consist of rounded quartz, finer grains consist of angular limestone and rock fragments	Loss of drilling fluid at 545 feet
550	600		Dark gray to black, medium light gray, and yellow-gray crystalline limestone, yellow-orange, granular, oxidized limestone, white calcite	
600	610		Dark gray to black, dark brown-gray, and very light brown-gray crystalline limestone, dark yellow-orange to yellow oxidized limestone, white calcite	
610	650		Dark gray to black, dark brown-gray, and very light brown-gray crystalline limestone, dark yellow-orange clay increases downward, white calcite	
650	670		Dark gray to black, dark brown-gray, and very light brown-gray crystalline limestone, yellow-orange to dark yellow-orange calcareous siltstone, minor dark yellow-orange clay, minor white calcite	
670	690		Dark gray to black crystalline limestone, dark yellow-orange and moderate red-brown (rare) oxidized limestone	
690	740		Very dark gray to black, brown-black, and very light gray, crystalline limestone, pale yellow-orange oxidized limestone, white calcite	
740	750		Very dark gray to black, brown-black, and very light gray, crystalline limestone, pale yellow-orange oxidized limestone, dark yellow-orange clay, white calcite	

**Total Depth of Boring - 755 Feet**

Note: reported colors were determined using the GSA Rock Color Chart on wet samples, sample interval was 10 feet.