

*Office of Environmental Management – Grand Junction*



**Revised Remedial Action Plan and  
Site Design for Stabilization of  
Moab Title I Uranium Mill Tailings  
at the Crescent Junction, Utah,  
Disposal Site**

**Attachment 5: Field and Laboratory Results,  
Volume I**

**June 2007**



**U.S. Department  
of Energy**

**Office of Environmental Management**

**Remedial Action Plan and Site Design  
for Stabilization of Moab Title I Uranium Mill Tailings  
at the Crescent Junction, Utah , Disposal Site**

**Attachment 5: Field and Laboratory Results Volume I**

Work performed under DOE Contract No. DE-AC01-02GJ79491  
for the U.S. Department of Energy Office of Environmental Management.  
Approved for public release; distribution is unlimited.

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U.S. Department of Energy—Grand Junction, Colorado

Calculation Cover Sheet

Calc. No.: MOA-02-03-2006-1-03-00  
Doc. No.: X0156100

Discipline: Geologic and  
Geophysical Properties

No. of Sheets: 6

Location: Attachment 5 Vol. I, Appendix A

Project: Moab UMTRA Project

Site: Crescent Junction, Utah

Feature: Corehole Logs for the Crescent Junction Site

Sources of Data:

Corehole logs

Sources of Formulae and References:

DOE (U.S. Department of Energy), 2005. *Work Plan for Characterization of Crescent Junction Disposal Site*, DOE-EM/GJ912-2005, August 12.

Preliminary Calc.

Final Calc

Supersedes Calc. No.

Author:

R. H. [Signature] 31 May 07  
Name Date

Checked by:

[Signature] 5/30/07  
Name Date

Approved by:

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## **Problem Statement:**

Preliminary site selection performed jointly by the U.S. Department of Energy (DOE) and the Contractor has identified a 2,300-acre withdrawal area in the Crescent Flat area just northeast of Crescent Junction, Utah, as a possible site for a final disposal cell for the Moab uranium mill tailings. The proposed disposal cell would cover approximately 250 acres. Based on the preliminary site-selection process, the suitability of the Crescent Junction Disposal Site is being evaluated from several technical aspects, including geomorphic, geologic, hydrologic, seismic, geochemical, and geotechnical. The objective of this calculation set is to present the corehole logs generated during the drilling program to investigate subsurface geologic conditions at the Crescent Junction Disposal Site.

This calculation will be incorporated into Attachment 2 (Geology) of the Remedial Action Plan and Site Design for Stabilization of Moab Title I Uranium Mill Tailings at the Crescent Junction, Utah, Disposal Site (RAP), and summarized in the appropriate sections of the Remedial Action Selection (RAS) report for the Moab Site.

## **Method of Solution:**

Ten coreholes (0201 through 0210) were drilled to depths of approximately 300 feet (ft) into the Mancos Shale as shown in Figure 1 and Table 1. These were drilled by Layne GeoConstruction using hollow-stem auger (HSA) and rotary coring. The auger bit size was 8.5 inches and core-bit size was HQ. Surface casing was set to selected depths (up to 40 ft) and cemented in each hole. Core samples were logged in the field using visual soil-classification procedures described in the *Work Plan for Characterization of Crescent Junction Disposal Site* (DOE 2005, pp.4-6). Field logs were digitized and standardized using the gINT computer software program (gINT Software USA 2005). Appendix A contains the corehole logs for the Crescent Junction Site. These data are also available in the SEEPro database at the DOE Grand Junction office.

Three additional coreholes (0211 through 0213), also shown in Figure 1 and Table 1, were drilled to depths of approximately 40 ft, offsetting other selected boreholes, for running packer tests (Appendix B).

## **Assumptions:**

N/A

## **Calculation:**

N/A

## **Discussion:**

Results and evaluation of the core drilling activities at the Crescent Junction Disposal Site during 2005 are discussed in detail in Attachment 2 (Geology) of the RAP and summarized in relevant sections of the RAS.

## **Conclusion and Recommendations:**

N/A

## **Computer Source:**

gINT computer software (2005) was used to digitize and standardize the corehole logs.

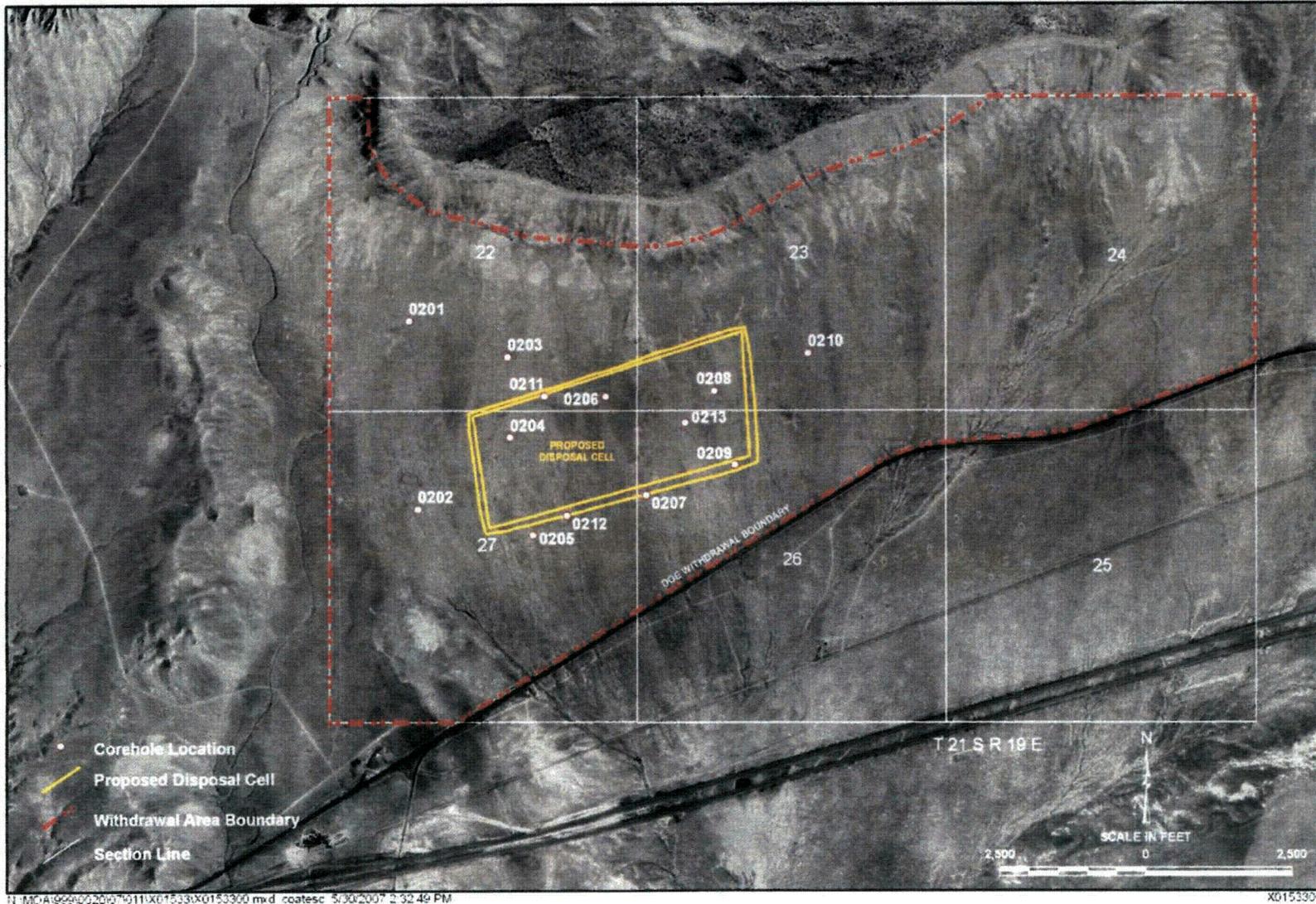


Figure 1. Location of Coreholes at the Crescent Junction Site

Table 1. Corehole Specifications at the Crescent Junction Site

Corehole No.	N Coordinate <sup>a</sup>	E Coordinate <sup>a</sup>	Ground Elevation (ft ngvd) <sup>b</sup>	Total Depth (ft)	Date Completed	Geophysical Logs	Hole Size (in)	Casing (ft)	Sample Type	Drilling Method <sup>c</sup>
CRJ01-0201	6797583.56	2120851.13	5,030.00	301.00	8-Nov-05	some	8.5	0-29	HQ core	HSA/rotary core
CRJ01-0202	6794422.62	2120996.12	4,960.00	300.00	19-Nov-05	yes	8.5	0-29.5	HQ core	HSA/rotary core
CRJ01-0203	6796977.60	2122543.47	5,015.00	301.00	7-Nov-05	yes	8.5	0-30	HQ core	HSA/rotary core
CRJ01-0204	6795633.72	2122583.61	4,983.00	300.00	5-Nov-05	yes	8.5	0-25	HQ core	HSA/rotary core
CRJ01-0205	6793981.28	2122975.63	4,945.90	300.00	2-Nov-05	yes	8.5	0-25	HQ core	HSA/rotary core
CRJ01-0206	6796324.67	2124232.60	4,994.00	302.00	24-Oct-05	yes	8.5	0-26	HQ core	HSA/rotary core
CRJ01-0207	6794658.25	2124919.25	4,950.20	300.00	20-Oct-05	yes	8.5	0-25	HQ core	HSA/rotary core
CRJ01-0208	6796412.91	2126089.65	4,986.10	301.00	8-Oct-05	yes	8.5	0-40	HQ core	HSA/rotary core
CRJ01-0209	6795168.53	2126441.58	4,955.70	300.00	27-Sep-05	yes	8.5	0-35	HQ core	HSA/rotary core
CRJ01-0210	6797035.78	2127690.14	4,998.60	302.00	7-Oct-05	yes	8.5	0-23	HQ core	HSA/rotary core
CRJ01-0211	6796327.81	2123173.42	4,998.00	40.00	22-Nov-05	no	4.0	no	HQ core	Casing advance
CRJ01-0212	6794311.80	2123552.99	4,950.00	42.00	30-Nov-05	no	4.0	no	HQ core	Casing advance
CRJ01-0213	6795880.41	2125591.86	4,975.00	40.50	2-Dec-05	no	4.0	no	HQ core	Casing advance

<sup>a</sup>Local coordinate system based on modified state plane coordinate system NAD 83 Utah Central Zone.

<sup>b</sup>ngvd = National geodetic vertical datum

<sup>c</sup>HSA = Hollow stem auger

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**Appendix A**  
**Corehole Logs**

## BOREHOLE LOG CRJ01-0201

PROJECT <u>MOAB</u>	DATE DRILLED <u>08/24/2005 to 11/08/2005</u>	BIT SIZE(S) (IN) <u>8.5</u>
LOCATION <u>Crescent Junction, UT.</u>	DRILLING COMPANY <u>Layne GeoConstruction</u>	CORE SIZE(S) (IN) _____
SITE <u>Crescent Junction</u>	DRILLING METHOD <u>H.S.A., Rotary Core</u>	LOGGED BY <u>Goodknight, C., Rupp, R.</u>
WELL NUMBER <u>CRJ01-0201</u>	SAMPLING METHOD <u>HQ CORE</u>	WL (FT BGS) _____
NORTH COORD. (FT) <u>6797583.56</u>	DRILL OPERATOR <u>Neaman, J. (CME 750, BB80), Hyleman, B. (BB80)</u>	
EAST COORD. (FT) <u>2120851.13</u>	REMARKS <u>4-inch steel surface casing cemented to depth of 29.0 feet below land surface.</u>	
SURFACE ELEV. (FT NGVD) <u>5030.00</u>		
SOLE DEPTH (FT) <u>301.00</u>		

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT.)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
							0-4.0 ft. SILT (ML); pale brown (10YR 6/3) with up to 10% siltstone and sandstone rock fragments. Mostly alluvial mud derived from sheet wash. Less than 10% very fine grained sand, highly calcareous.
5	5025	5 20 15 24	4.0-5.0 5.0-6.0	X X X X			4.0-4.5 ft. SILTY SAND (SM); moderately calcareous, mottled, very pale brown (10YR 7/4) and yellow (10YR 7/8). 4.5-5.0 ft. SANDSTONE; very fine grained rock fragment, yellowish gray (5Y 8/1), slightly calcareous.
10	5020	13 33 30 37	9.0-10.0 10.0-11.0	X X X X			5.0-14.0 ft. WEATHERED MANCOS SHALE BEDROCK: 5.0-9.0 ft. highly weathered silty shale, soft, mottled, from light gray (N7) to dark yellowish orange (10YR 6/6), with ~5% white gypsum and calcite crystals and masses, moderately calcareous. 9.0-12.0 ft. silty shale moderately weathered, layered, yellowish gray (5Y 7/2), moderately calcareous, several % small white masses of gypsum. 10.5-11.0 ft. thin layer of siltstone that is highly calcareous and dark yellowish orange (10YR 6/6). 12.5-14.0 ft. shale becomes increasingly hard and less weathered.
15	5015	50/3"	14.5-17.0	X X X X			14.0-14.5 ft. Blow refusal @ 14.3 ft. No Recovery. 14.5-301.0 ft. MANCOS SHALE: 14.5-29.0 ft. mostly siltstone, light olive gray (5Y 5/2) wavy bedding, black surfaces on some bedding is framboidal pyrite, slightly weathered, mostly horizontal bedding plane fractures spaced 0.2 to 0.3 ft. apart. Inclined fracture (~45 degrees) @ 16.0 ft. with white gypsum and calcite. Thin clayey zone at ~16.5 ft. 17.9-22.0 ft. layer of abundant burrows filled with limonitic-colored, dark yellowish orange (10YR 6/6) material, trace white calcite and gypsum. Horizontal fracturing more abundant at spacings of 0.1 ft or less.
20	5010		17.0-22.0	X X X X			
25	5005		22.0-27.0	X X X X	14.5-35.0 Very Poor		22.0-27.0 ft. slightly weathered, mostly siltstone, wavy bedded to bioturbated, abundant horizontal fractures spaced approximately 0.2 ft. apart filled with gypsum. Yellowish gray (5Y 7/2) to pale yellowish brown (10YR 6/2), moderately calcareous. Core much more competent, despite the horizontal fracturing.
30	5000		27.0-29.0 29.0-35.0	X X X X			27.0-29.0 ft. slight to nonweathered, less horizontal fracturing filled with gypsum and more dark bedding, which is largely colored by framboidal pyrite. Bedding continues to be bioturbated and wavy. Mostly yellowish gray (5Y 7/2). 29.0-35.0 ft. 4.0 ft. recovery - core loss spread over entire run - core severely parted on bedding with no angular fractures - core is moderately weathered, yellowish gray, some gypsum crystals, core is in fragments and pieces up to 0.05-0.1 ft. thick (long).

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## BOREHOLE LOG CRJ01-0201

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0201  
**SITE** Crescent Junction Site **DATES DRILLED** 08/24/2005 to 11/08/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
40	4990		35.0-45.0	X	35.0-45.0 Poor		35.0-45.0 ft. good recovery 9.6 ft. -still fractured and broken to about 42.0 ft. with gypsum infilling and limonitic stain, normal dark gray coloration and the usual +/-5 degree bedding angle - all lost core is at top of the run. No major high angle fractures in the run - broken core is generally on the nearly horizontal bedding planes. Below 42.0 ft., core becomes largely unweathered.
45	4985			X			45.0-55.0 ft. unweathered "fresh" core, moderate parting on bedding; some parting on fissile zones. Good Run.
50	4980		45.0-55.0	X	45.0-55.0 Fair		
55	4975			X			55.0-65.0 ft. very good run - relatively hard, moderately calcic claystone, dry interior of core, horizontal bedding, usual crenulations and hairline gypsum fillings.
60	4970		55.0-65.0	X			
65	4965			X	55.0-75.0 Good		65.0-75.0 ft. very good recovery, breaks and parting on bedding, no fractures, slightly fissile in spots - dry core interior- moderately to strongly calcic.
70	4960		65.0-75.0	X			

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## BOREHOLE LOG CRJ01-0201

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0201  
**SITE** Crescent Junction Site **DATES DRILLED** 08/24/2005 to 11/08/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
75	4955			X			75.0-85.0 ft. very competent run - excellent recovery. Claystone, dry core interior, slightly fissile from 77.0-78.0 ft., hard, moderately calcic, no fractures, no secondary mineralization, no indication of water.
80	4950		75.0-85.0	X			
85	4945			X			85.0-95.0 ft. dark gray, horizontal bedding ( at a 90 degree angle to core axis), thin bedding laminations, hard, dry core interior, minor mechanical breaks on bedding, short splinter from drilling stress at 92.7-93.0 ft.
90	4940		85.0-95.0	X			
95	4935			X	75.0-301.0 Excellent		95.0-105.0 ft. core splintered by mechanical stress from 97.0-98.5 ft., fissile break at 99.2 ft. Hard, calcic, dry core interior, no indication of formation water.
100	4930		95.0-105.0	X			
105	4925			X			105.0-115.0 ft. dark colored silty claystone (medium gray, N5) approximately 90%, and light colored (very light gray, N8), very fine grained sandstone, which represents bioturbated layers ~10%. Bioturbated layers are as much as 0.05 ft. thick. Core hard and competent, dry when broken open. Bioturbated beds are quite contorted in places. Trace fine carbonaceous and framboidal pyrite on bedding. No natural fractures, slightly to moderately calcareous.
110	4920		105.0-115.0	X			

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## BOREHOLE LOG CRJ01-0201

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0201
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 08/24/2005 to 11/08/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
115	4915						115.0-125.0 ft. core hard and competent, no natural fractures, dry when broken open. Bedding along some bioturbated layers is inclined as much as 25 degrees.
120	4910		115.0-125.0				
125	4905						125.0-135.0 ft. core is hard and competent, no natural fractures, dry when broken open. Carbonaceous mats (up to 0.05 ft. long) occur on some bedding surfaces. Trace fossil imprints on some bedding surfaces.
130	4900		125.0-135.0		75.0-301.0 Excellent		
135	4895						135.0-145.0 ft. bioturbated bedding increases to as much as 15-20% of layering. Carbonaceous mats are on some bedding planes and they break easily. Core hard and competent, no natural fractures, dry when broken open. Thin fissile layer at ~140.0 ft.
140	4890		135.0-145.0				
145	4885						145.0-155.0 ft. bioturbated bedding in as much as 30% of layering. Core is hard and competent, but breaks along finer grained, dark layers of silty claystone and carbonaceous material. Thin fissile layer at ~149 ft. and 155.3 ft.
150	4880		145.0-155.0				

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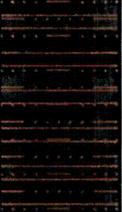
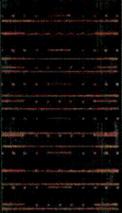
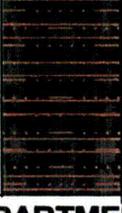
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## BOREHOLE LOG CRJ01-0201

PROJECT MOAB BOREHOLE NUMBER CRJ01-0201  
 SITE Crescent Junction Site DATES DRILLED 08/24/2005 to 11/08/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
155	4875						
160	4870		155.0-165.0				155.0-165.0 ft. bioturbated layering is ~20% from 155.5-157.0 ft., then decreases rapidly to 2-3% at 159.0 ft., and remains so to bottom of interval. Some near vertical stress fractures from 157.0-159.0 ft. No natural fractures. Core hard and competent and dry when broken open. Coiled nautiloid fossil at 159.2 ft. coated in fine pyrite. Below 159.0 ft., core is much finer grained and <u>more competent</u> .
165	4865						
170	4860		165.0-175.0		75.0-301.0 Excellent		165.0-175.0 ft. core placement is jumbled because core was extruded explosively from the barrel and scattered. Core through interval is mostly silty claystone with 2-3% bioturbated layering that is very fine grained sandstone. Several vertical stress fractures caused by drilling. Core from 174.5 to 175.5 ft. is placed correctly.
175	4855						
180	4850		175.0-185.0				175.0-185.0 ft. silty claystone with 2-3% bioturbated (or storm) layering composed of very fine grained sandstone. Vertical stress fractures at top of interval at 175.5-176.0 ft. At 179.5-180.5 ft. and 181.0-181.5 ft. are vertical fractures that may be natural - no evidence of fluid movement along these tight fractures. At 180.5 and 181.8 ft. are thin fissile layers. Large flattened cephalopod at 177.3 ft.
185	4845						
190	4840		185.0-195.0				185.0-195.0 ft. increase in bioturbated layering to ~5%, some of it is chaotic, especially from 186.0-187.0 ft. Vertical fracture at 189.5- 190.5 ft., appears to be drilling related stress. Bioturbated layering decreases below ~190.0 ft., to about 2-3%. Core is hard and competent throughout, dry when broken apart.

## BOREHOLE LOG CRJ01-0201

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0201  
**SITE** Crescent Junction Site **DATES DRILLED** 08/24/2005 to 11/08/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
195	4835						
200	4830		195.0-205.0			[Graphic Log Representation]	195.0-205.0 ft. bioturbated layering increases below ~202.0 ft. to ~5-10%. Some bioturbated layering is inclined as much as 20 degrees from horizontal. Core is hard and competent throughout, dry when broken open. Some fine carbonaceous material along bedding surfaces.
205	4825						
210	4820		205.0-215.0		75.0-301.0 Excellent	[Graphic Log Representation]	205.0-215.0 ft. bioturbated layering composes is nearly 10% of bedding from 206.0-211.0 ft., then decreases quickly to ~1% at 212.0 ft. and below. Core has fissile layers in many locations from 206.0 to 208.5 ft., below which the core is more competent and less broken. A couple of fissile layers from 211.0-212.0 ft. Core is dry when broken open. Fine carbonaceous material along many bedding surfaces.
215	4815						
220	4810		215.0-225.0			[Graphic Log Representation]	215.0-225.0 ft. silty claystone with only ~10% bioturbated (or storm) layering consisting of lighter colored very fine grained sandstone. Some vertical fracturing at 218.0 and ~224.5-225.5 ft. is probably mechanical stress from drilling - no evidence of fluid movement along the tight fractures. Fissile, thin bedded layers at 221.7-221.9 ft., 222.3-222.5 ft., 222.9 and 225.3 ft. Layering looks to dip 5-7 degrees. One or more of the fissile layers may be bentonite.
225	4805						
230	4800		225.0-235.0			[Graphic Log Representation]	225.0-235.0 ft. core splintered by mechanical stress from 225.0-226.3 ft. From 227.0-229.0 ft., core softer and fissile - washed out and rounded. From 229.0-232.0 ft., core generally parted on bedding every 0.3-0.7 ft. From 232.0-235.0 ft., more competent core with only parting on bedding.

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## BOREHOLE LOG CRJ01-0201

<b>PROJECT</b> <u>MOAB</u>	<b>BOREHOLE NUMBER</b> <u>CRJ01-0201</u>
<b>SITE</b> <u>Crescent Junction Site</u>	<b>DATES DRILLED</b> <u>08/24/2005 to 11/08/2005</u>

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
235	4795			X			
240	4790		235.0-245.0	X			235.0-245.0 ft. very dark gray when wet, mostly medium dark gray (4) when dry, minor parting, no fractures, slightly fissile @239.3 ft. No secondary mineralization.
245	4785			X			
250	4780		245.0-255.0	X	75.0-301.0 Excellent		245.0-255.0 ft. very dark gray claystone. Splintered @245.8-246.4 ft., parted on bedding in a few places, otherwise unbroken. Very competent, horizontal bedding, dry core interior, no biocrenulations, no fractures, no formation water.
255	4775			X			
260	4770		255.0-265.0	X			255.0-265.0 ft. splintered by mechanical stress @255.0-257.3 ft., and 259.0-261.0 ft., somewhat fissile @261.0, 261.6, and 262.2 ft., otherwise moderately calcic, relatively hard, competent claystone.
265	4765			X			
265	4760		265.0-275.0	X			265.0-275.0 ft. splintered 265.3-266.0 ft., and 273.0-275.0 ft. Good competent run, no fractures other than stress related, consistent color and hardness, normal bedding and parting, no secondary mineralization.

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## BOREHOLE LOG CRJ01-0201

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0201
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 08/24/2005 to 11/08/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
275	4755			X			<p>275.0-285.0 ft. splintered @ 275.0-276.0 ft., fissile (0.1 ft.) @284.0 ft., otherwise standard claystone with normal bedding, coloration, hardness, very competent and only slight parting on bedding planes, core interior is dry, no bioturbation.</p>
280	4750		275.0-285.0	X			
285	4745			X	75.0-301.0 Excellent		
290	4740		285.0-295.0	X			
295	4735			X			<p>295.0-301.0 ft. fissile and parted @297.4, 297.7, 297.9, 298.1, 298.6, 299.6, 300.0, 300.4, and 300.8 ft. No secondary mineralization, no angular fractures, dry core interior, normal bedding angle.</p>
300	4730		295.0-301.0	X			
Total Depth 301.0 ft.							
305	4725						

## BOREHOLE LOG CRJ01-0202

<b>PROJECT</b> MOAB	<b>DATE DRILLED</b> 08/25/2005 to 11/19/2005	<b>BIT SIZE(S) (IN)</b> 8.5
<b>LOCATION</b> Crescent Junction, UT.	<b>DRILLING COMPANY</b> Layne GeoConstruction	<b>CORE SIZE(S) (IN)</b>
<b>SITE</b> Crescent Junction	<b>DRILLING METHOD</b> H.S.A., Rotary Core	<b>LOGGED BY</b> Goodknight, C., Rupp, R.
<b>WELL NUMBER</b> CRJ01-0202	<b>SAMPLING METHOD</b> HQ CORE	<b>WL (FT BGS)</b>
<b>NORTH COORD. (FT)</b> 6794422.62	<b>DRILL OPERATOR</b> Neaman, J. (CME 750, BB80), Hyleman, B. (BB80)	
<b>EAST COORD. (FT)</b> 2120996.12	<b>REMARKS</b> 4-inch steel surface casing cemented to depth of 29.5 feet below	
<b>SURFACE ELEV. ( FT NGVD)</b> 4960.00	land surface. Water used during intial coring.	
<b>HOLE DEPTH (FT)</b> 300.00		

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT.)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
		4 8 9 9	0-0.5 0.5-1.0 1.0-1.5 1.5-2.0				0-8.0 ft. CLAYEY SILT (ML); abundant roots and worm hole porosity, light brownish gray (10YR 6/2), highly calcareous, trace white mottling.
5	4955	5 8 8 8	4.0-4.5 4.5-5.0 5.0-5.5 5.5-6.0				4.0-8.0 ft. light yellowish brown (10YR 6/4) to yellowish red (5YR 5/6), compacted, mottled with white calcite and gypsum, slightly calcareous.
10	4950	50/5					8.0-9.0 ft. SANDY SILT (ML); light brown (7.5YR 6/4), highly calcareous, appears to be eolian-deposited material. 9.0-15.0 ft. WEATHERED MANCOS SHALE BEDROCK: silty shale, moderately weathered but fairly hard (could not get drive samples), highly calcareous, yellowish gray (5Y 7/2) to dark yellowish orange (10YR 6/6).
15	4945	50/4					15.0-300.0 ft. MANCOS SHALE: 15.0-17.5 ft. moderately to highly weathered, highly calcareous, soft, mostly clayey siltstone, light olive gray (5Y 5/2) to dark yellowish orange (10YR 6/6), with more of the yellowish orange beds from 15.0-16.0 ft. 17.5-19.5 ft. inclined bedding at ~20 degrees, mostly bedding plane fractures about every 0.1 ft., a few vertical fractures. Some black material (framboidal pyrite?) on bedding surfaces and trace white gypsum crystals, trace of yellow orange (10YR 6/6) beds. 20.0-23.0 ft. moderate to slightly weathered.
20	4940		14.5-19.5				
25	4935		19.5-24.5				
30	4930		24.5-29.5		14.5-40.0 Very Poor		23.0-24.0 ft. several bedding plane fractures filled with gypsum (up to 0.03 ft. thick). Several thin layers of limonitic-colored, dark yellowish orange (10YR 6/6) altered material from 24.0 to 24.5 ft. 24.5-29.5 ft. slightly weathered. At 25.8-26.0 ft. is limonitic altered fracture, which is soft; color is dark yellowish brown (10YR 6/6) to light brown (5YR 5/6). A few vertical fractures (with no gypsum or calcite along them) but mostly bedding plane fractures. Highly calcareous. At 28.5 to 29.0 ft. fractures along bedding planes coated with gypsum, black film on bedding surfaces is mostly fine framboidal pyrite.
			29.5-35.0				29.5-35.0 ft. recovery of 4.5 ft. Top 1.0 ft. lost. Weathered, moderately to highly calcareous. Core is fractured mostly along bedding surfaces at spacings generally from 0.1-0.3 ft. Gypsum coats many fractures and one at 34.5 ft. is colored by limonite (dark yellowish orange, 10YR 6/6). Rock is mostly silty claystone and thin bedded with trace bioturbated layering.

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## BOREHOLE LOG CRJ01-0202

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0202  
**SITE** Crescent Junction Site **DATES DRILLED** 08/25/2005 to 11/19/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
40	4920		35.0-45.0	X			35.0-45.0 ft. bedding plane fracturing dominates and decreases in spacing frequency from 0.1-0.2 ft. to 0.5-1.0 ft. at 45.0 ft. Gypsum coatings are along many fractures. An inclined (45 degrees) fracture at ~43.5 ft. that is coated with gypsum but it cuts across bedding that contains limonitic coloration (which seems to follow bedding planes in the 3 or 4 occurrences in this core segment). Bedding is inclined at 15 -20 degrees. Bioturbated or storm bedding is trace to 1% of layering and it consists of very fine grained sandstone of very light gray (N8) color. Limonitic colored bands along bedding are as much as 0.07 ft. thick. Core becoming moderately hard and competent below 40.0 ft.
45	4915			X	40.0-50.0 Poor		45.0-55.0 ft. core hard and competent. Weathering effects are nearly absent. At 49.5 ft. is a 40 degree inclined fracture with limonite coloration along it, also a minor bedding plane fracture with limonite coating at 49.3 ft. A bedding plane fracture with limonite coating at 50.0 ft. that broke along a bioturbated/ storm bedding layer. No other natural fractures observed. Fine carbonaceous material along some bedding surfaces and trace of fossil imprints. Rock here is mainly claystone, medium gray (N5).
50	4910		45.0-55.0	X			
55	4905			X			55.0-65.0 ft. core hard and competent - no effects of weathering. Core is dry when broken open. Bedding plane fractures, probably drilling induced occur at thin fissile layers or along partings created by fossil imprints (such as at 56.0, 59.8, and 64.6 ft.). A fossil pelecypod imprint at 57.1 ft. Layering looks to be inclined ~10 degrees. Trace fossil resin at 57.4 ft. Claystone parts easily upon handling.
60	4900		55.0-65.0	X			
65	4895			X	50.0-75.0 Fair		65.0-75.0 ft. core loss from 65.0-66.4 ft. occurred due to driller dropping the core barrel and breaking the bit. Footage lost in clearing the bit fragments from the hole. Competent core run with solid core and few breaks. Parting @73.6 ft. shows iron stain and deposit on bedding, possible fracture with water movement.
70	4890		65.0-75.0	X			

## BOREHOLE LOG CRJ01-0202

<b>PROJECT</b> <u>MOAB</u>	<b>BOREHOLE NUMBER</b> <u>CRJ01-0202</u>
<b>SITE</b> <u>Crescent Junction Site</u>	<b>DATES DRILLED</b> <u>08/25/2005 to 11/19/2005</u>

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
75	4885			X			75.0-85.0 ft. competent core, solid, few parts on bedding, fossiliferous in places (see 80.0 and 84.5 ft.). No secondary mineralization seen, no fissile locations.
80	4880		75.0-85.0	X			
85	4875			X			85.0-95.0 ft. somewhat fissile at 85.0-90.0 ft. and breaking on bedding (particularly 87.0-88.5 ft.). Solid sections are relatively hard and competent. Breaking may be due to mechanical problems as drillers are pulling rods to inspect the bit and lower rods. Inspection shows new bit is wrong style and broken. Bit changed.
90	4870		85.0-95.0	X			
95	4865			X			95.0-105.0 ft. shale broken into knobs and pieces; core loss of 1.5 ft. is spread over run, core appears slightly fissile but is obviously damaged by mechanical forces and how the new bit is cutting. Pieces are all broken on bedding planes. No evidence of angular fractures or secondary minerals.
100	4860		95.0-105.0	X	75.0-125.0 Good		
105	4855			X			105.0-115.0 ft. soft, fissile. No core loss, but overall condition is only fair. No secondary mineralization, core interior is dry, more of a calcic mudstone than claystone, weak rock integrity.
110	4850		105.0-115.0	X			

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## BOREHOLE LOG CRJ01-0202

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0202  
**SITE** Crescent Junction Site **DATES DRILLED** 08/25/2005 to 11/19/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
115	4845			X			115.0-125.0 ft. core loss @ 115.0-116.0 ft. Fissile and broken at 116.0-117.5 ft. More competent @ 117.5-120.5 ft. Broken @ 120.5-121.0 ft. Very soft and fissile @ 122.5-123.4 ft. Generally a mudstone.
120	4840		115.0-125.0	X			
125	4835			X			125.0-135.0 ft. generally fissile as previous run with fewer partings. Core is soft but dry on interior surfaces, no secondary mineralization, no bioturbation, bedding angle +/- 5 degrees.
130	4830		125.0-135.0	X	125.0-300.0 Excellent		
135	4825			X			135.0-145.0 ft. mostly claystone, trace bioturbated or storm bedding layers. Fissile from 135.0-139.0 ft. and generally soft, but competent in rest of interval with several thin fissile layers. Core dry when broken open. No natural fractures seen. Bedding plane fractures common from 135.0-139.0 ft., but they are drilling induced. Core breaks easily along bedding when handled.
140	4820		135.0-145.0	X			
145	4815			X			145.0-155.0 ft. Bedding plane fractures common in 145.0-148.0 ft. interval and core less broken below. These fractures are drilling induced. Rock is fissile and soft throughout except for short interval at 148.3-148.5 ft., which is hard (better cemented). Core dry when broken open, breaks easily when handled.
150	4810		145.0-155.0	X			

## BOREHOLE LOG CRJ01-0202

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0202  
**SITE** Crescent Junction Site **DATES DRILLED** 08/25/2005 to 11/19/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
-155	4805			X			155.0-165.0 ft. bedding plane fractures common in 155.0-157.0 ft. interval and core broken again only at ~161.0 ft. These are drilling induced fractures. Rock is fissile and soft throughout except for several short segments averaging about 0.2 ft. that are harder and more cemented. Bedding is slightly inclined at ~5 degrees. Core is dry when broken open and breaks easily when handled.
-160	4800		155.0-165.0	X			
-165	4795			X			165.0-175.0 ft. generally very fissile with minor core loss (probably top of the run), parting on bedding with some mechanical rounding, no identifiable fractures, no evident secondary mineralization, dry core interior, continued soft, essentially the same as previous 30.0 ft.
-170	4790		165.0-175.0	X	125.0-300.0 Excellent		
-175	4785			X			175.0-185.0 ft. slightly more competent but generally fissile and soft, easily parts on bedding. Bedding angle is ~10 degrees, no fractures evident, much like previous core run.
-180	4780		175.0-185.0	X			
-185	4775			X			185.0-195.0 ft. fissile with only about 2.0 ft. of competent rock, parting on bedding, no fractures, no secondary mineralization, dry core interior.
-190	4770		185.0-195.0	X			

## BOREHOLE LOG CRJ01-0202

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0202  
**SITE** Crescent Junction Site **DATES DRILLED** 08/25/2005 to 11/19/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
195	4765			X			195.0-205.0 ft. soft fissile shale, easily parted on bedding, which is ~90 degrees to core axis. Not significantly different than the last 70.0 ft.
200	4760		195.0-205.0	X			
205	4755			X			205.0-215.0 ft. core loss spread over run, not much improvement in competency, fissile, easily parted.
210	4750		205.0-215.0	X	125.0-300.0 Excellent		
215	4745			X			215.0-225.0 ft. continued soft, fissile, very broken, core loss spread over length of run with no distinct loss location, but likely most loss @215.0-221.0 ft., some fossil imprints.
220	4740		215.0-225.0	X			
225	4735			X			225.0-235.0 ft. core loss from 233.0-234.0 ft. Normal bedding angle~90 degrees to core axis, in general the core is slightly less broken but still easily parted on bedding, no significant difference in competency.
230	4730		225.0-235.0	X			

## BOREHOLE LOG CRJ01-0202

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0202  
**SITE** Crescent Junction Site **DATES DRILLED** 08/25/2005 to 11/19/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
235	4725			X			235.0-245.0 ft. core loss @ start of run. Overall the core is slightly more competent and not as broken as usual, but still very fissile and soft with the last 2.0 ft. (243.0-245.0 ft.) the hardest and most competent, fossil @ 239.7 ft.
240	4720		235.0-245.0	X			
245	4715			X			245.0-255.0 ft. core looking more competent now that the landing ring is back in the rods above the bit, minor core loss @248.0-249.0 ft. due to mechanical problems. Core still looks a little fissile and soft, still parting on bedding, borehole seems to be making water.
250	4710		245.0-255.0	X	125 0-300.0 Excellent		
255	4705			X			255.0-265.0 ft. parting on bedding and soft in places but the most competent run since about 75.0 ft. (far less mechanical damage). Bedding angle approximately 5 degrees, no fractures noted.
260	4700		255.0-265.0	X			
265	4695			X			265.0-275.0 ft. moderately fissile throughout, but best run of the day. Usual bedding parting, broken and crumbled where very fissile, no uncommon features, core interior dry where competent.
265	4690		265.0-275.0	X			

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## BOREHOLE LOG CRJ01-0202

<b>PROJECT</b>	MOAB	<b>BOREHOLE NUMBER</b>	CRJ01-0202
<b>SITE</b>	Crescent Junction Site	<b>DATES DRILLED</b>	08/25/2005 to 11/19/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
275	4685			X			<p>275.0-285.0 ft. very fissile from 277.0-283.0 ft., easily parted on bedding, not crumbly from drilling, bedding angle ~ 5 degrees, some bioturbation crenulations.</p>
280	4680		275.0-285.0	X			
285	4675			X	125.0-300.0 Excellent		
290	4670		285.0-295.0	X			
295	4665			X			<p>295.0-300.0 ft. minor core loss at end of run, probably due to drilling stress or dropped out of core barrel. Last foot of recovered core broken on bedding into 0.2 ft. and 0.1 ft. lengths.</p>
300	4660		295.0-300.0	X			
305	4655						Total Depth 300.0 ft.

## BOREHOLE LOG CRJ01-0203

<b>PROJECT</b> MOAB	<b>DATE DRILLED</b> 08/25/2005 to 11/07/2005	<b>BIT SIZE(S) (IN)</b> 8.5
<b>LOCATION</b> Crescent Junction, UT.	<b>DRILLING COMPANY</b> Layne GeoConstruction	<b>CORE SIZE(S) (IN)</b>
<b>SITE</b> Crescent Junction	<b>DRILLING METHOD</b> H.S.A., Rotary Core	<b>LOGGED BY</b> Goodknight, C., Rupp, R.
<b>WELL NUMBER</b> CRJ01-0203	<b>SAMPLING METHOD</b> HQ CORE	<b>WL (FT BGS)</b>
<b>NORTH COORD. (FT)</b> 6796977.60	<b>DRILL OPERATOR</b> Neaman, J. (CME 750, BB80), Hyleman, B. (BB80)	
<b>EAST COORD. (FT)</b> 2122543.47	<b>REMARKS</b> 4-inch steel surface casing cemented to depth of 30.0 feet below land surface.	
<b>SURFACE ELEV. ( FT NGVD)</b> 5015.00		
<b>HOLE DEPTH (FT)</b> 301.00		

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT.)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
							0-4.0 ft. CLAYEY SILT (ML); moderate root content, some white mottling, highly calcareous, light brownish gray (10YR 6/2), some worm-hole porosity.
5	5010	4 3 5 11	2.0-2.5 2.5-3.0 3.0-3.5 3.5-4.0				4.0-9.5 ft. SANDY SILT (ML); compacted, trace mottling, slightly calcareous, light brownish gray (2.5Y 6/2), ~2% dark shale fragments and trace limonitic siltstone fragments.
10	5005	4 8 14 17	4.5-5.0 5.0-5.5 5.5-6.0 6.0-6.5				8.5-9.5 ft. light brown (7.5YR 6/4), highly calcareous, appears to be eolian transported material.
							9.5-14.5 ft. WEATHERED MANCOS SHALE BEDROCK: highly weathered for first 2-3 ft., then moderately weathered down to 14.5 ft. Generally yellowish gray (5Y 7/2) to grayish orange (10YR 7/4), mostly highly calcareous. From 10.0-11.0 ft. is a thin layer of reddish yellow (7.5YR 6/8) siltstone that is non-slightly calcareous. White gypsum masses are 2-3% of material.
15	5000	504.0"	9.5-10.0 10.0-10.5 10.5-11.0 11.0-11.5				14.5-301.0 ft. MANCOS SHALE: 14.5-22.0 ft. clayey siltstone, moderately weathered, light olive gray (5Y 5/2), wet color), horizontal bedding, gypsum coatings along some fractures, which are spaced about 0.1 ft. apart. Highly calcareous. Some bioturbated bedding and burrowing. 18.0-19.0 ft. numerous horizontal fractures.
20	4995		15.0-17.5 17.5-19.0				@19.9 ft. is a 0.1 ft. thick bentonite bed, yellowish gray (5Y 7/2), moderately calcareous. Horizontal fracturing at least every 0.1 ft. still moderately weathered, some gypsum coatings on fractures. Bedding wavy and bioturbated.
25	4990		19.0-22.0 22.0-27.0				22.0-23.7 ft. moderately weathered, numerous bedding plane fractures spaced less than 0.1 ft. apart. Only trace gypsum along bedding fractures, Dark bedding surfaces are largely fine framboidal pyrite. Some contorted bedding and bioturbation. Mostly yellowish gray (5Y 7/2).
					15.0-35.0 Very Poor		28.0-30.0 ft. numerous horizontal bedding plane fractures. Trace gypsum along fractures.
30	4985		27.0-30.0 30.0-35.0				30.0-35.0 ft. moderately weathered, broken and fractured throughout run due to poor integrity of the rock. Core loss considerable (50%). A couple of fractures inclined 20 degrees to bedding with gypsum coatings.

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## BOREHOLE LOG CRJ01-0203

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0203  
**SITE** Crescent Junction Site **DATES DRILLED** 08/25/2005 to 11/07/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
40	4975		35.0-45.0	X	35.0-50.0 Poor		35.0-45.0 ft. weathered, pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4), becoming medium gray (N5) at 44.0 ft. A tiger stripe appearance with abundant gypsum-healed fractures ranging from 0 degree to 50 degree angles inclined from bedding and 0.003 to 0.006 ft. thick. Associated iron stain and limonitic deposits especially from 43.0-45.0 ft. on fractures running parallel (vertical) to core axis. Interesting weathered top of bedrock sequence.
45	4970			X			45.0-55.0 ft. multiple fractures along bedding planes (up to 30 degree angles), continued gypsum and limonite mineralization to 50.0 ft., at which point the core becomes largely unaltered or unweathered with normal bedding angles of 5 degrees. Consistent dark gray coloration, becomes moderately calcic and relatively hard.
50	4965		45.0-55.0	X			55.0-65.0 ft. fairly competent with minor breaks on bedding planes, some limonitic alteration.
55	4960			X			
60	4955		55.0-65.0	X	50.0-75.0 Fair		65.0-75.0 ft. @68.0 ft. and 73.0 ft. are large fractures inclined 20 degrees to core axis with heavy limonite stain and mineralization. Possibly open water course on parallel fractures.
65	4950			X			
70	4945		65.0-75.0	X			

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## BOREHOLE LOG CRJ01-0203

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0203  
**SITE** Crescent Junction Site **DATES DRILLED** 08/25/2005 to 11/07/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
75	4940			X			75.0-85.0 ft. very competent, dark gray, dry core interior, calcic, hard.
80	4935		75.0-85.0	X			
85	4930			X			85.0-95.0 ft. very competent, with no parting, core is hard and in one piece, no indication of formation water.
90	4925		85.0-95.0	X			
95	4920			X			95.0-105.0 ft. very competent, normal bedding with few parts, no secondary mineralization.
100	4915		95.0-105.0	X	75.0-125.0 Good		
105	4910			X			105.0-115.0 ft. fissile partings and breaks at 106.2, 107.3, 110.5, 111.5, 111.7, 112.3, 112.5, 113.5 and 114.4 ft. Hard core, no secondary mineralization, no indication of water, dry core interior.
110	4905		105.0-115.0	X			

## BOREHOLE LOG CRJ01-0203

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0203  
**SITE** Crescent Junction Site **DATES DRILLED** 08/25/2005 to 11/07/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
115	4900			X			115.0-125.0 ft. few partings on bedding, good solid core run.
120	4895		115.0-125.0	X			
125	4890			X			125.0-135.0 ft. excellent parting on bedding, no fissile sections, no fractures, no secondary mineralization, no indication of water.
130	4885		125.0-135.0	X	125.0-301.0 Excellent		
135	4880			X			135.0-145.0 ft. good competent shale. Normal bedding angle, nothing abnormal.
140	4875		135.0-145.0	X			
145	4870			X			145.0-155.0 ft. a few partings on bedding, no fractures.
150	4865		145.0-155.0	X			

## BOREHOLE LOG CRJ01-0203

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0203
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 08/25/2005 to 11/07/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
155	4860						155.0-165.0 ft. a few fissile partings @ 157.0, 158.0, 159.9, 160.5, 161.2, and 162.0 ft. No secondary mineralization or indication of formation water, core interior is dry, normal bedding (+/- 5 degrees).
160	4855		155.0-165.0				
165	4850						165.0-175.0 ft. nice competent run, almost no partings, core is relatively hard with normal bedding angles.
170	4845		165.0-175.0		125.0-301.0 Excellent		
175	4840						175.0-185.0 ft. a couple of fissile spots at 176.6, 178.3, 178.6, and 179.6 ft. Good run overall.
180	4835		175.0-185.0				
185	4830						185.0-195.0 ft. fissile @185.7, 190.4, 192.0, 193.5, and 194.0 ft. Splintered from 192.5-193.3 ft. Hard claystone.
190	4825		185.0-195.0				

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## BOREHOLE LOG CRJ01-0203

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0203  
**SITE** Crescent Junction Site **DATES DRILLED** 08/25/2005 to 11/07/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
195	4820			X			195.0-205.0 ft. good run of competent shale, fossiliferous from 201.0-203.0 ft. Splintered by mechanical stress at 195.5-197.0 ft. No fractures, minor partings.
200	4815		195.0-205.0	X			
205	4810			X			205.0-215.0 ft. splintered by mechanical stress from 205.0-207.0 ft. Parted @ 205.7 ft. with rounding by bit. @205.7-215.0 ft., core was solid and unbroken, very nice core, bedding about 90 degrees to core axis (near-horizontal bedding).
210	4805		205.0-215.0	X	125.0-301.0 Excellent		
215	4800			X			215.0-225.0 ft. mostly silty claystone, moderately calcareous, medium gray (N5), trace bioturbated and/or storm bedding that is very fine grained sandstone, light gray (N7). Trace fossil imprints and shell (pelecypods) replacements (aragonite). Rock hard and competent through most of interval, more fissile 216.5-217.5 ft. Steeply inclined fracture (80-90 degrees) at 220.0-222.5 ft. that may be natural - it is tight with no gypsum or limonite coating.
220	4795		215.0-225.0	X			
225	4790			X			225.0-235.0 ft. hard core and competent throughout. A steeply inclined near-vertical fracture (possibly mechanical, drilling induced) at 225.0-227.0 ft. that is tight with no evidence of fluid movement. Core dry inside when broken apart. Bedding appears to be inclined ~5 degrees from horizontal.
230	4785		225.0-235.0	X			

## BOREHOLE LOG CRJ01-0203

<b>PROJECT</b>	MOAB	<b>BOREHOLE NUMBER</b>	CRJ01-0203
<b>SITE</b>	Crescent Junction Site	<b>DATES DRILLED</b>	08/25/2005 to 11/07/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
235	4780			X			235.0-245.0 ft. hard and competent core, near vertical tight fracture, possibly mechanical at 237.0-239.0 ft. Mechanical induced fractures at 244.0-246.0 ft.
240	4775		235.0-245.0	X			
245	4770			X			245.0-254.0 ft. hard competent core throughout. More fissile interval (~0.1 ft.) at 246.0 ft. Possible natural vertical tight fracture at 247.5-249.0 ft. Thin fissile layer at 249.0 ft. and 249.7 ft. Trace pelecypod and cephalopod fossil imprints.
250	4765		245.0-254.0	X	125.0-301.0 Excellent		
255	4760		254.0-255.5	X			255.5-265.5 hard, competent core throughout. Fissile layer ~0.2 ft. thick at 257.5 ft. and one ~0.1 ft thick at 258.5 ft. Other fractures are mechanical and along bedding planes. Core is dry when broken open.
260	4755		255.5-265.5	X			
265	4750			X			265.5-275.5 ft. core hard and competent throughout and dry when broken open. Bioturbated or storm bedding forms increase to ~1-2% from 268.5-272.0 ft. At 271.0 ft., possible natural fracture ~20% from horizontal, tight, no evidence of water movement. Other scant fractures are horizontal and likely drilling induced.
270	4745			X			

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## BOREHOLE LOG CRJ01-0203

<b>PROJECT</b> <u>MOAB</u>	<b>BOREHOLE NUMBER</b> <u>CRJ01-0203</u>
<b>SITE</b> <u>Crescent Junction Site</u>	<b>DATES DRILLED</b> <u>08/25/2005 to 11/07/2005</u>

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
-275	4740		265.5-275.5	X			275.5-285.5 ft. mostly silty claystone. Bioturbated or storm bedding forms are ~1% with some of the layers as much as 0.05 ft. thick. No natural fractures present, bedding plane fractures seen are drilling induced. Core hard and competent. Dry when core was broken open.
-280	4735		275.5-285.5	X			
-285	4730			X	125.0-301.0 Excellent		285.5-295.5 ft. clayey siltstone, bioturbated and/or storm bedding is 1-2% of layering. Core is hard and competent, no natural fractures. Bedding plane fractures (infrequent) are drilling induced. At 290.0 and 295.5 ft., are thin (0.05-0.1 ft.) layers of porcelaneous, yellowish gray (5Y 8/1), very highly calcareous masses that are amorphous and not appearing to be fossils and have white small specks scattered through them. Core is dry when broken open. Trace fine carbonaceous material along bedding planes.
-290	4725		285.5-295.5	X			
-295	4720			X			295.5-301.0 ft. Core hard and competent, no natural fractures, bioturbation or storm bedding at 1-2% continues. Core dry when broken open. At 298.8 ft. is thin porcelaneous layer.
-300	4715		295.5-301	X			
							Total Depth 301.0 ft.
-305	4710						



## BOREHOLE LOG CRJ01-0204

PROJECT <u>MOAB</u>	BOREHOLE NUMBER <u>CRJ01-0204</u>
SITE <u>Crescent Junction Site</u>	DATES DRILLED <u>08/26/2005 to 11/05/2005</u>

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
40	4945		30.0-45.0	X			35.0-45.0 ft. loss of 1.0 ft. over the run but appears to be in the top 5.0 ft. Core is generally parted on bedding @ 0.1-0.3 ft. lengths. Minor fracturing. Bedding appears normal. Some limonitic alteration throughout the run. Gypsum crystallization prevalent throughout. @39.0-40.0 ft. some low angle fracturing (possibility related to bioturbation, alteration markedly decreasing at end of run, @ 44.5 ft. transition to "fresh" rock begins.
45	4940			X	35.0-50.0 Poor		45.0-55.0 ft. largely unweathered core "fresh." Parted on bedding in 0.2 ft. segments in intervals @45-46.4 ft. and 47.0-48.0 ft. Parted surfaces are coated with yellowish brown iron stain. @ 50.5, 51.0, 52.4, 53.8, 54.4 ft. are fractures on bedding that are significant and coated with iron alterations and trace gypsum mineralization. Bedding angle is normal.
50	4935		45.0-55.0	X			
55	4930			X			55.0-65.0 ft. fissile fracture at 55.3 ft and splintered to 57.0 ft. Core @57.0-65.0 ft. is very competent with only a couple of parting breaks @62.0-65.0 ft. Fossil shell @ 65.0 ft. Bedding angle < 3 degrees to almost perpendicular to core axis. Good fresh Mancos Shale, strongly calcic and relatively hard.
60	4925		55.0-65.0	X	50.0-67.0 Fair		
65	4920			X			65.0-75.0 ft. slightly fissile @ 65.0-67.0 ft. with break/fracture @67.0 ft. on bedding plane with limonite staining. Regular bedding. Remainder of core is very competent with few parts on bedding; interior of core is dry.
70	4915		65.0-75.0	X			
	4910			X			

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## BOREHOLE LOG CRJ01-0204

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0204  
**SITE** Crescent Junction Site **DATES DRILLED** 08/26/2005 to 11/05/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
75				X			75.0-85.0 ft. @81.0 ft. parting on bedding with limonite stain. @81.8, 82.8, and 83.6 ft. are fissile breaks.
	4905		75.0-85.0	X			
80				X			
	4900			X			
85				X			85.0-95.0 ft. parted @ 88.2, 88.5, and 89.2 ft. with clean breaks on bedding. No stain, no mineralization. Core generally hard, no fractures and no water.
	4895		85.0-95.0	X			
90				X			
	4890			X			
95				X			95.0-105.0 ft. broken @ 96.3, 97.3, 98.2, 98.6, 100.3, 102.7, and 103.3-103.7 ft., which is fissile and has heavy limonitic coating, also limonite @ 98.2 ft. Breaks are potential water courses, but no indication of water presently exists. All breaks on bedding.
	4885		95.0-105.0	X			
100				X			
	4880			X			
105				X	67.0-145.0 Good		105.0-115.0 ft. broken @ 105.2, 105.5, 108.0, and 110.7 ft. and fissile @ 108.8-109.0 ft. Parted @ 113.8 ft. No iron stain or deposits in breaks or fissile locations, dry core interior, normal bedding.
	4875		105.0-115.0	X			
110				X			
	4870			X			

## BOREHOLE LOG CRJ01-0204

PROJECT	MOAB	BOREHOLE NUMBER	CRJ01-0204
SITE	Crescent Junction Site	DATES DRILLED	08/26/2005 to 11/05/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
115	4865		115.0-125.0	X			115.0-125.0 ft. good run with no unusual characteristics, fissile @120.0, 124.8 and 125.0 ft.
120	4860			X			
125	4855		125.0-135.0	X			125.0-135.0 ft. generally fissile @127.0-129.0 ft. with breaks on bedding, but no secondary mineralization or staining Also fissile @130.0-132.0 ft. with fossil replacement @131.0 ft. Bedding angle ~10 degrees.
130	4850			X	67.0-145.0 Good		
135	4845		135.0-145.0	X			135.0-145.0 ft. broken on bedding 2 to 3 places @2.0 ft. intervals. Normal bedding angle; hard core with no observed secondary mineralization, no indication of formation water, core interior is dry.
140	4840			X			
145	4835		145.0-155.0	X			145.0-155.0 ft. very competent run, no fissile sections, only minor parting on bedding, which dips approximately 5 degrees, minor mechanical breaks, no fractures.
150				X			

## BOREHOLE LOG CRJ01-0204

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0204  
**SITE** Crescent Junction Site **DATES DRILLED** 08/26/2005 to 11/05/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
155	4830			X		[Graphic Log]	155.0-165.0 ft. competent run with minor parting on bedding and mechanical breaks, no fractures, no secondary mineralization, no indication of formation water, dry.
160	4825		155.0-165.0	X		[Graphic Log]	
165	4820			X		[Graphic Log]	165.0-175.0 ft. competent run, minor parting and mechanical damage. Normal bedding angle, moderately calcic.
170	4815		165.0-175.0	X	145.0-300.0 Excellent	[Graphic Log]	
175	4810			X		[Graphic Log]	175.0-185.0 ft. moderately fissile @ 176.0-177.0 ft. and 180.6 ft., moderately broken on bedding. @184.5 ft. is a large bioturbation crenulation, which upsets the normal bedding angles. Slightly fossiliferous @185.0 ft.
180	4805		175.0-185.0	X		[Graphic Log]	
185	4800			X		[Graphic Log]	185.0-195.0 ft. broken at fissile locations @ 187.7 and 188.0 ft. Fissile but unbroken @189.0 ft. Two broken fissile locations in the 194.0-195.0 ft. interval. Consistent bedding, few biocrenulations. Good run.
190	4795		185.0-195.0	X		[Graphic Log]	

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## BOREHOLE LOG CRJ01-0204

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0204  
**SITE** Crescent Junction Site **DATES DRILLED** 08/26/2005 to 11/05/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
195	4790			X			195.0-205.0 ft. mechanical breaks on fissile locations @195.8, 196.4, 196.8, 197.6, 198.0, 202.5, and 203.3 ft. Normal bedding angle, no fractures, no secondary mineralization, no indication of water. Core interior is dry, good competent run.
200	4785		195.0-205.0	X			
205	4780			X			205.0-215.0 ft. core is splintering @205.0-210.0 ft. due to mechanical stress. @206.5, 209.8, 211.7, and 212.0 ft., are breaks on fissile bedding, normal bedding angle, no natural fractures, good competent run.
210	4775		205.0-215.0	X	145.0-300.0 Excellent		
215	4770			X			215.0-225.0 ft. very competent run with only a couple of partings on bedding, no breaks or fractures.
220	4765		215.0-225.0	X			
225	4760			X			225.0-235 ft. very competent run, mechanical breakage @226.0-227.0 ft.
230	4755		225.0-235.0	X			

## BOREHOLE LOG CRJ01-0204

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0204  
**SITE** Crescent Junction Site **DATES DRILLED** 08/26/2005 to 11/05/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
235	4750			X			
240	4745		235.0-245.0	X			235.0-245.0 ft. @236.2-236.3 ft is a fissile section. @240.4 and 241.0 ft. broken on bedding and fissile. @242.0 ft. is a fissile break and ones also @242.6, 244.7, and 245.0 ft. Normal bedding angle is approximately 5 to 10 degrees. Dry core interior, no secondary mineralization.
245	4740			X			
250	4735		245.0-255.0	X	145.0-300.0 Excellent		245.0-255.0 ft. good competent run with few breaks on bedding, core is relatively hard, moderately calcic, and shows no sign of secondary mineralization or formation water.
255	4730			X			
260	4725		255.0-265.0	X			255.0-265.0 ft. good run, moderately fissile, no fractures, parting on bedding @ 256.0, 258.7, 259.5, 260.0, and 263.5 ft. Fossiliferous @~260.0-265.0 ft.
265	4720			X			
265	4715		265.0-275.0	X			265.0-275.0 ft. very competent run with parting and mechanical breaks @ 266.0, 267.5, 271.5, and 272.8 ft. Normal bedding, no secondary mineralization, no indication of formation water.

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## BOREHOLE LOG CRJ01-0204

PROJECT	MOAB	BOREHOLE NUMBER	CRJ01-0204
SITE	Crescent Junction Site	DATES DRILLED	08/26/2005 to 11/05/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
275	4710		275.0-285.0	X			275.0-285.0 ft. competent run with no fractures (only breaks on bedding). No indication of water, fissile breaks @276.5, 280.8, 282.0, and 284.5 ft.
285	4700		285.0-295.0	X	145.0-300.0 Excellent		285.0-295.0 ft. extremely nice run with only very minor fissility @286.7 ft. Dry core interior, no secondary mineralization, almost no parting.
295	4685		295.0-300.0	X			295.0-300.0 ft. mechanical breakage due to drilling @296.6, 297.2, 297.8, 299.0, 299.6, and 299.8 ft. No indication of formation water.
Total Depth 300.0 ft.							

## BOREHOLE LOG CRJ01-0205

PROJECT MOAB	DATE DRILLED 08/28/2005 to 11/02/2005	BIT SIZE(S) (IN) 8.5
LOCATION Crescent Junction, UT.	DRILLING COMPANY Layne GeoConstruction	CORE SIZE(S) (IN)
SITE Crescent Junction	DRILLING METHOD H.S.A., Rotary Core	LOGGED BY Goodknight, C., Rupp, R.
WELL NUMBER CRJ01-0205	SAMPLING METHOD HQ CORE	WL (FT BGS)
NORTH COORD. (FT) 6793981.28	DRILL OPERATOR Neaman, J. (CME 750, BB80), Hyleman, B. (BB80)	
EAST COORD. (FT) 2122975.63	REMARKS 4-inch steel surface casing cemented to depth of 25.0 feet below land surface.	
SURFACE ELEV. ( FT NGVD) 4945.90		
HOLE DEPTH (FT) 300.00		

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT.)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
	4945	6 5 6 7	0-0.5 0.5-1.0 1.0-1.5 1.5-2.0				0-4.0 ft. CLAYEY SILT (ML); light brownish gray (10YR 6/2), highly calcareous, numerous roots, worm hole porosity, some mottling.
5	4940	17 17 23 25	5.5-6.0 6.0-6.5 6.5-7.0				4.0-6.5 ft. SILT (ML); very pale brown (10YR 7/4), ~2% small fragments of shale, highly calcareous, some mottling.
10	4935	38 50/5*	10.0-10.5 10.5-11.0				6.5-10.0 ft. SANDY SILT (ML); light brown (7.5YR 6/4), highly calcareous, some mottling (white), appears to be eolian transported material, ~1% dark mineral grains.
15	4930		11.0-15.0				10.0-11.0 ft. WEATHERED MANCOS SHALE BEDROCK: highly weathered, yellowish gray (5Y 7/2) to dark yellowish orange (10YR 6/6), which reflects limonitic alteration, highly calcareous. Mostly claystone with some silt component.
20	4925		15.0-20.0				11.0-300.0 ft. MANCOS SHALE: 11.66-15.0 ft. yellowish gray (5Y 7/2) to grayish orange (10YR 7/4). Moderate to highly weathered with bedding plane fractures - some segments 0.2-0.3 ft. long are intact. Some dark fossil impressions on bedding (some framboidal pyrite). Highly calcareous. White gypsum masses @ 14.75-15.0 ft. 15.0-20.0 ft. highly calcareous, much less fracturing - bedding plane fractures about every 0.3-0.4 ft. (main fractures @ 15.8, 16.75, 17.25, and 15.4 ft. and a steeply inclined fracture (~80 degrees) @ 18.0-18.5 ft., these fractures all filled with gypsum. Limonitic alteration @ ~17.8 ft., dark yellowish orange (10YR 6/6). Thin bentonite bed (<0.1 ft.) @ ~18.75 ft., pale yellowish brown (10YR 6/2). Several vertical fractures @ ~19.7-20.0 ft.
25	4920		20.0-25.0				20.0-21.5 ft. No Recovery.
30	4915		25.0-35.0		11.0-40.0 Very Poor		21.5-25.0 ft. bedding plane fractures generally ~0.1-0.2 ft. spacing, highly calcareous, slightly weathered, inclined bedding indicates dip ~5 degrees. Gypsum along bedding plane fracture @ 23.8 ft. Thin light brown (5YR 5/6) layer (0.05 ft) @ ~23.25 ft. along with some ~20 degree inclined bedding.
							25.0-35.0 ft. weathered and highly broken to ~32.0 ft., 80% recovery in upper part of run. Some surface slough ~1.0 ft. (hole was tagged @ 24.0 ft. below ground surface prior to drilling). Core is in generally poor condition to 32.0 ft., fragmented and broken by drilling action. Prolific rusty iron staining and evidence of surface water infiltration. Some calcic and gypsum deposition is distinguishable. Core becoming more competent @ 31.0-32.0 ft., but still shows clay interbedded in iron stained shale. @ 32.0-35.0 ft., core is regularly broken into 0.2-0.3 ft. long pieces showing the usual +/- 5 degree dip of bedding with gypsum crystallization along faces of breaks. @ 34.5 ft, thin iron stained band followed by gypsum filled fracture on bedding plane.

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## BOREHOLE LOG CRJ01-0205

<b>PROJECT</b>	MOAB	<b>BOREHOLE NUMBER</b>	CRJ01-0205
<b>SITE</b>	Crescent Junction Site	<b>DATES DRILLED</b>	08/28/2005 to 11/02/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
40	4910		35.0-45.0	X			35.0-45.0 ft. mildly weathered and moderately broken. 90% recovery, core loss in interval from 35.0-40.0 ft. Secondary gypsum deposits in fractures prevalent to 40.0 ft. and sporadically to 44.0 ft. Iron alteration considered characteristic of the run to 44.0 ft. @44.0 ft., the core becomes "fresh" in appearance, is largely unweathered, competent claystone, dark gray to medium gray with white turbidity crenulations along bedding planes, bedding angle throughout run is approximately 5 degrees. @38.2 ft., rather wide (0.05 ft) gypsum filled fracture with ~20 degree angle to core axis.
45	4905			X	40.0-50.0 Poor		45.0-55.0 ft. good core run, some breakage to 49.7 ft. due to mechanical action. Breaks @46.2, 46.6, 47.1, 47.5-47.8, 48.6, and 49.7 ft. @48.0-48.2 ft., core is fissile with moderate iron stain. @51.5 and 52.3 ft., core has parted on bedding. @44.4 ft is a 0.1 ft. "storm" - sequence, which is light gray to tan and well cemented. Bedding throughout run is normal, approximately 5 degrees. Core coloration is normal dark to medium gray, and no high angle fracture or secondary mineralization observed.
50	4900		45.0-55.0	X			
55	4895			X			55.0-65.0 ft. unweathered with minor mechanical breaks and partings on bedding surfaces, no fractures of high angle or secondary mineralization noted. No indication of formation water, dry core interior.
60	4890		55.0-65.0	X			
65	4885			X	50.0-75.0 Fair		65.0-75.0 ft. minimal mechanical breaks. Fissile @66.7, 66.9, 69.4, and 69.9 ft. @75.0 ft., is rusty iron coating on a definite fracture surface along bedding.
70	4880		65.0-75.0	X			
	4875			X			

## BOREHOLE LOG CRJ01-0205

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0205  
**SITE** Crescent Junction Site **DATES DRILLED** 08/28/2005 to 11/02/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
75	4870			X			75.0-85.0 ft. no fractures or breaks, only parting of core on bedding surfaces. Bedding at about a 5 degree angle. Competent unbroken core, no significant abnormalities. @81.0 ft. is a fossil crenulation.
80	4865		75.0-85.0	X			
85	4860			X	75.0-95.0 Good		85.0-95.0 ft. drilling breaks @85.4, 87.1-87.5 ft. Fissile @ 89.6 ft. Splintered along core axis @90.5 and 91.0 ft. Fissile @ 84.6 ft. No secondary mineralization evident. Core breakage probably due to driller down pressure. Core interior is dry - no evidence of formation water.
90	4855		85.0-95.0	X			
95	4850			X			95.0-105.0 ft. core splintered by drilling pressure @95.0-95.5 ft. Core broken across fissile bedding @100.0 ft. Good run, some parting on bedding, bedding angle ~0 degrees (horizontal) or perpendicular to core axis.
100	4845		95.0-105.0	X			
105	4840			X	95.0-300.0 Excellent		105.0-115.0 ft. drill breaks across bedding @107.7-108.7 ft., moderately fissile. 30 degree fractures, which appear mechanically induced @111.0-113.0 ft. Couple of parts on bedding planes @114.0-115.0 ft. No indication of water.
110	4835		105.0-115.0	X			

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## BOREHOLE LOG CRJ01-0205

PROJECT	MOAB	BOREHOLE NUMBER	CRJ01-0205
SITE	Crescent Junction Site	DATES DRILLED	08/28/2005 to 11/02/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
115	4830			X			115.0-125.0 ft. Several fissile intervals (~0.1-0.2 ft.) with breakage on bedding planes from 119.0-121.0 ft. @123.0-125.0 ft., a few sections parted on bedding. No secondary mineralizations seen, no high angle fractures, no indication of formation water.
120	4825		115.0-125.0	X			
125	4820			X			125.0-135.0 ft. bedding angle 0 to 5 degrees, no fractures, some breakage along bedding @ 125.9-126.5, 127.8, 128.3, 128.7, 129.9, and 133.6 ft. Generally, fissile on breaks, but good competent core. No secondary mineralization, dry core interior.
130	4815		125.0-135.0	X	95.0-300.0 Excellent		
135	4810			X			135.0-145.0 ft. mechanical breaks @ 135.3, 135.5, 141.7, and 142.6 ft. Fissile also at these breaks @ 143.2-143.4 ft. is a calcic incrustation on core, with white to tan coloration. Usual approximately 5 degree bedding, no secondary mineralization.
140	4805		135.0-145.0	X			
145	4800			X			145.0-155.0 ft. fissile and broken on bedding @ 145.5, 151.0, and 151.6 ft. Excellent condition, normal bedding @ approximately 5 degrees, some parting on bedding planes, no high angle fractures, no indication of water, dry core interior.
150	4795		145.0-155.0	X			

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## BOREHOLE LOG CRJ01-0205

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0205  
**SITE** Crescent Junction Site **DATES DRILLED** 08/28/2005 to 11/02/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG		
-155	4790			X			<p>155.0-165.0 ft. fissile breaks @ 155.4, 158.5-158.8, 159.1, 159.5, 159.8, 160.6, 160.9-161.2, 160.6, 162.9, 163.4-163.7, and 164.2 ft. All breaks along bedding planes. Approximately 5 degree bedding angles. No unusual characteristics, no evidence of formation water, dry core interiors.</p>	
-160	4785		155.0-165.0	X				
-165	4780			X				<p>165.0-175.0 ft. fissile @ 168.2, 170.5, and 172.4 ft. No fractures, no breaks; only parting on bedding planes. Excellent run.</p>
-170	4775		165.0-175.0	X	95.0-300.0 Excellent			
-175	4770			X			<p>175.0-185.0 ft. fissile breaks @ 176.4-176.8, 177.1, 178.2-178.35, 179.4, 180.5-180.7, and 184.3-184.6 ft. All breaks on bedding which is @ 5 degree angle. No fractures, no secondary mineralizations, no indications of formation water. Core interior is dry, good consistent run.</p>	
-180	4765		175.0-185.0	X				
-185	4760			X			<p>185.0-195.0 ft. In general the run is more fissile than usual, all breaks are on bedding planes @ 185.0, 185.6, 186-187.2, 188.2, 188.8-189.5, 190.1, 190.7-191.1, 192.2, 192.9, 193.5-193.7, and 194.2-194.4 ft. No secondary mineralization or staining in breaks. No water identified.</p>	
-190	4755		185.0-195.0	X				

## BOREHOLE LOG CRJ01-0205

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0205
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 08/28/2005 to 11/02/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
195	4750		195.0-205.0	X			195.0-205.0 ft. fissile breaks and splintered core from drill pressure throughout run @ 195.0-195.5, 197.6-197.8, 198.4-198.5, and 198.5-199.0 ft. @ 199.0 ft. is a 0.15 ft. break, generally washed out. No noticeable mineralization in partings or breaks, no iron staining. Most of these separations and breaks are mechanical.
200	4745			X			
205	4740		205.0-215.0	X	95.0-300.0 Excellent		205.0-215.0 ft. good run. Very minor fissile sections and no fractures. Parting and mechanical breakage only on bedding at fissile intervals. Parted @ 205.2, 210.2, and 212.4 ft. Normal approximately 5 degree angle bedding. No more formation water.
210	4735			X			
215	4730		215.0-225.0	X			215.0-225.0 ft. good competent run with minimal breakage on bedding @ 217.9, 222.4, 223.8, and 224.8-225.0 ft. Breakage @ fissile locations. No fractures, no indication of formation water. Bedding angle about 90 degrees to core axis (horizontal)..
220	4725			X			
225	4720		225.0-235.0	X			225.0-235.0 ft. 1.0 ft dropped on core retrieval but it was recovered next run. Characteristic run with a little more breakage than last run due to driller pushing to get 140.0 ft. for the day. Breaks along bedding in fissile areas @ 225.6, 226.3, 226.7, 229.0, 229.3, 230.2, 230.9, 231.1, 232.4, and 233.6 ft.
230				X			

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## BOREHOLE LOG CRJ01-0205

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0205  
**SITE** Crescent Junction Site **DATES DRILLED** 08/28/2005 to 11/02/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
235	4710		235.0-245.0	X			235.0-245.0 ft. run is generally fissile and broken in multiple places; splintered @240.0-241.0 ft. Becoming less fissile near bottom of run.
240	4705			X			
245	4700			X			245.0-255.0 ft. generally broken by mechanical action and splintered along core axis from 245.5-248.0, 250.0-251.0, and 253.5-255.0 ft. Remaining breaks on bedding, which is approximately 5 degrees, with no secondary mineralization or indication of water. Core interior is dry, no large bioturbation zones.
250	4695		245.0-255.0	X	95.0-300.0 Excellent		
255	4690			X			255.0-265.0 ft. continued breakage to 258.5 ft., then becoming fossiliferous and more calcic, more competent, and generally unbroken with minor separations on bedding surfaces.
260	4685		255.0-265.0	X			
265	4680			X			265.0-275.0 ft. another largely broken run of claystone. Bedding is normal angle (approximately 5 degrees), no fractures. Breakage is along bedding in fissile rock. Most prominent breaks @ 265.0-267.0, 269.0-271.0 and 272.5 ft.
			265.0-275.0	X			

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## BOREHOLE LOG CRJ01-0205

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0205
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 08/28/2005 to 11/02/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
275	4675			X			275.0-285.0 ft. moderately fissile and broken, normal bedding, no fractures. Parting only on bedding. @276.0-278.0 ft. ~50 % fissile breaks with some mechanical. @279.7 to 281.0 ft., fissile zone.
280	4665		275.0-285.0	X			
285	4660			X	95.0-300.0 Excellent		
290	4655		285.0-295.0	X			285.0-295.0 ft. white banding or bedding @284.0-290.0 ft. is strongly pronounced and closely spaced. Somewhat fissile @289.0-290.0 ft.
295	4650		295.0-300.0	X			
300	4645						Total Depth 300.0 ft.
305	4640						

## BOREHOLE LOG CRJ01-0206

<b>PROJECT</b> MOAB	<b>DATE DRILLED</b> 08/29/2005 to 10/24/2005	<b>BIT SIZE(S) (IN)</b> 8.5
<b>LOCATION</b> Crescent Junction, UT.	<b>DRILLING COMPANY</b> Layne GeoConstruction	<b>CORE SIZE(S) (IN)</b>
<b>SITE</b> Crescent Junction	<b>DRILLING METHOD</b> H.S.A., Rotary Core	<b>LOGGED BY</b> Goodknight, C., Rupp, R.
<b>WELL NUMBER</b> CRJ01-0206	<b>SAMPLING METHOD</b> HQ CORE	<b>WL (FT BGS)</b>
<b>NORTH COORD. (FT)</b> 6796324.67	<b>DRILL OPERATOR</b> Neaman, J. (CME 750, BB80), Hyleman, B. (BB80)	
<b>EAST COORD. (FT)</b> 2124232.60	<b>REMARKS</b> 4-inch steel surface casing cemented to depth of 26.0 feet below land surface.	
<b>SURFACE ELEV. ( FT NGVD)</b> 4994.00		
<b>HOLE DEPTH (FT)</b> 302.00		

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT.)	EXTENT	RCD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
		3 6 7 9	0-0.5 0.5-1.0 1.0-1.5 1.5-2.0				0-1.5 ft. SILT (ML); light brown (7.5YR 6/3), highly calcareous, abundant roots, wormhole porosity.
	4990						1.5-4.0 ft. SANDY SILT (ML); light brownish gray (10YR 6/2), ~2% small pebbles, some mottling, highly calcareous.
5		8 12 16 18	5.0-5.5 5.5-6.0 6.0-6.5 6.5-7.0				4.0-6.5 ft. SILTY SAND (SM); light brownish gray (10YR 6/2), slightly calcareous, ~2% small rock fragments and some coarse sand particles.
	4985						6.5-9.0 ft. SILT (ML); ~10% very fine grained sand, mottled, slightly calcareous, very pale brown (10YR 7/3).
10		22 36 50/4*	10.0-10.5 10.5-11.0				9.0-11.0 ft. WEATHERED MANCOS SHALE BEDROCK: highly weathered, slightly calcareous, soft to moderately hard, yellowish gray (5Y 7/2), some white gypsum crystals and masses along fracture/bedding surfaces.
			11.0-13.0				11.0-12.6 ft. No Recovery.
	4980						12.6-302.0 ft. MANCOS SHALE: 12.6-13.0 ft. moderately weathered, pale yellowish brown (10YR 6/2), mostly siltstone, wavy bedding with some fracturing along them.
15			13.0-18.0				13.0-13.5 ft. No Recovery. 13.5-18.0 ft. highly weathered down to 15.0 ft. (numerous bedding plane fractures) and moderate to slightly weathered down to 18.0 ft. with bedding plane fractures spaced 0.2-0.3 ft. apart. At 15.0-15.3 ft. is a 60 degree fracture. Thin coating of gypsum crystals along about half of the fractures. Yellowish gray (5Y 7/2) to light olive gray (5Y 6/1), highly calcareous, bedding is wavy and bioturbated in places. Trace fine (framboidal) pyrite along bedding surfaces.
	4975						18.0-18.8 ft. No Recovery.
20			18.0-23.0				18.8-23.0 ft. abundant bedding plane fractures down to ~20.0 ft. Bedding plane fractures about 0.2-0.3 ft. apart down to 23.0 ft. Moderate to slightly weathered. Gypsum crystal coatings along many fractures. Some wavy and bioturbated bedding, pale yellowish brown (10YR 6/2) to olive gray (5Y 4/1) on some bedding surfaces, highly calcareous, no vertical or high angle fractures.
	4970						23.0-23.3 ft. No Recovery.
25			23.0-26.0		13.0-34.0 Very Poor		23.3-26.0 ft. abundant bedding plane fractures with spacing 0.1 ft. or less. Gypsum crystals along bedding plane fractures ~25.5 to 25.7 ft. Abundant worm burrows and bioturbated bedding, moderately calcareous.
	4965						26.0-35.0 ft. moderately weathered, prevalent fractures for length of run, but decreasing @34.0 ft. Core loss obvious at beginning of run (@26.0 ft.). Moderately calcic with prominent gypsum crystallization on faces of most fractures. Bedding angle approximately 5 degrees; ~90% of fractures are on bedding, no high angle fractures, some fractures are fissile, wavy bioturbation throughout, no evidence of formation water.
30			26.0-35.0				
	4960						

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## BOREHOLE LOG CRJ01-0206

<b>PROJECT</b>	MOAB	<b>BOREHOLE NUMBER</b>	CRJ01-0206
<b>SITE</b>	Crescent Junction Site	<b>DATES DRILLED</b>	08/29/2005 to 10/24/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
40	4955		35.0-45.0	X	34.0-45.0 Poor		35.0-45.0 ft. weathering decreases to unweathered "fresh" bedrock @39.5 ft. Moderately calcic. @36.0-37.7 ft., moderately fractured along bedding, moderately pyritized, with gypsum crystallization and minor iron staining on fractures to 39.4 ft.
45	4950			X			45.0-55.0 ft. "fresh" appearance to shale, clean mechanical fractures along bedding planes in several locations, no gypsum crystallization or iron staining along fracture faces. No evidence of formation water, core interior dry. Nice claystone.
50	4945		45.0-55.0	X			
55	4940			X	45.0-65.0 Fair		55.0-65.0 ft. fissile along fractures @56.0-58.0 ft. @57.0 ft. fractures occur @80 degree angle to core axis (~twice the bedding plane angle). No secondary mineralization on fractures faces.
60	4935		55.0-65.0	X			
65	4930			X			65.0-75.0 ft. bedding angle and bioturbation crenulations @80% to core axis. Core is solid overall with no fractures from 66.0-70.0 ft. and only minor mechanical fractures from 70.0-75.0 ft.
70	4925		65.0-75.0	X			
	4920			X			

## BOREHOLE LOG CRJ01-0206

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0206  
**SITE** Crescent Junction Site **DATES DRILLED** 08/29/2005 to 10/24/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
75				X	65.0-85.0 Good		75.0-85.0 ft. @79.8-80.0 ft. fossiliferous deposit, calcic, heavy encrustations on core, preceded by short splintery fractures along core axis for 0.5 ft.
80	4915		75.0-85.0	X			
85	4910			X			85.0-95.0 ft. good competent core, mechanical fractures on bedding planes with bioturbation crenulations, no secondary mineralization observed, no indication of formation water, interior of core dry.
90	4905		85.0-95.0	X			
95	4900			X			95.0-105.0 ft. @103.8 ft. approximately 0.2 ft. bioturbations and silt size cemented zone. Good claystone run with minor mechanical fractures and dry core interior, normal 5 degree angle of bedding, moderately calcic.
100	4895		95.0-105.0	X	85.0-302.0 Excellent		
105	4890			X			105.0-115.0 ft. excellent recovery with only 2 locations of mechanical fracturing on bedding, standard overall appearance.
110	4885		105.0-115.0	X			

## BOREHOLE LOG CRJ01-0206

PROJECT	MOAB	BOREHOLE NUMBER	CRJ01-0206
SITE	Crescent Junction Site	DATES DRILLED	08/29/2005 to 10/24/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
115	4880			X			115.0-125.0 ft. core generally hard and moderately calcic. @116.0-117.0 ft. core is splintered along axis (mechanically induced). No secondary mineral deposits noted.
120	4875		115.0-125.0	X			
125	4870			X			125.0-135.0 ft. minor mechanical fracturing along bedding planes.
130	4865		125.0-135.0	X	85.0-302.0 Excellent		
135	4860			X			135.0-145.0 ft. penetration rate slows, shale harder @140.0 ft. @140.0-140.6 ft. core fissile, biocrenulations, no secondary minerals. @141.0-143.0 ft. core fractured along axis. Drill pipe screened with LEL meter at end of run(0.0 ppm).
140	4855		135.0-145.0	X			
145	4850			X			145.0-155.0 ft. formation very hard. @151.0-153.0 ft. abundant fossils, large bivalves.
150	4845		145.0-155.0	X			

## BOREHOLE LOG CRJ01-0206

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0206  
**SITE** Crescent Junction Site **DATES DRILLED** 08/29/2005 to 10/24/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
155	4840			X			155.0-165.0 ft. core loss related to drilling, minor loss (~0.5 ft.). Continued hard core, causing mechanical fractures parallel with axis @ 157.0-158.0 ft. and 162.0-164.0 ft.
160	4835		155.0-165.0	X			
165	4830			X			165.0-175.0 ft. fissile along bedding @167.0-168.0 ft. Bedding plane angle =90 degrees to core axis. Core continues to drill slow, but formation doesn't appear any different.
170	4825		165.0-175.0	X	85.0-302.0 Excellent		
175	4820			X			175.0-185.0 ft. fissile @184.0-185.0 ft. No gas detected.
180	4815		175.0-185.0	X			
185	4810			X			185.0-195.0 ft. @185.0-186.0 ft. core is fissile. @189.5 ft. drilling compressor overheats; stopped drilling.
190	4805		185.0-195.0	X			

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## BOREHOLE LOG CRJ01-0206

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0206  
**SITE** Crescent Junction Site **DATES DRILLED** 08/29/2005 to 10/24/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
195	4800			X			
200	4795		195.0-205.0	X			195.0-205.0 ft. @200.0-202.0 ft. heavy fracture zone, core is partly fissile and relatively weak, possible natural fracture zone, doesn't appear completely mechanically induced although the current compressor has minimal PSI to drill and clear cuttings. @200.0 ft. pyrite deposit.
205	4790			X			
210	4785		205.0-215.0	X	85.0-302.0 Excellent		205.0-215.0 ft. good run, bedding angle is <5 degrees and is almost perpendicular to core axis, minimal bioturbidity crenulations. @214.8-215.0 ft. fissile break.
215	4780			X			
220	4775		215.0-225.0	X			215.0-225.0 ft. @217.8 ft. is a 0.2 ft. fissile break, very broken. @220.7 and 220.9 ft. mechanical breaks. @223.5, and 223.7 ft. fissile with mechanical breaks. @ 224.2 ft mechanical break.
225	4770			X			
230	4765		225.0-235.0	X			225.0-235.0 ft. bedding +/- 5 degree angle, no formation water. @225.5, 225.8, 226.3, and 226.4 ft. mechanical breaks. @ 226.75 fractures on bedding. @227.35 mechanical breaks. @228.9, 229.6, 230.35, 230.55, and 230.75 ft. mechanical breaks, slightly fissile. @232.35, 232.95, 233.2, 233.6, and 234.2 ft. fissile fractures on bedding.

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## BOREHOLE LOG CRJ01-0206

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0206  
**SITE** Crescent Junction Site **DATES DRILLED** 08/29/2005 to 10/24/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
235	4760			X			<p>235.0-245.0 ft. mechanical breaks @236.5, 238.2, 241.2, 242.0, 242.9, and 243.7 ft. Fissile fractures @ 238.65, 240.85-240.95, and 242.55 ft. Bedding angle +/- 5 degrees with bioturbidity crenulations, color, hardness, and general condition normal, no secondary mineralization, no indications of formation water.</p>
240	4755		235.0-245.0	X			
245	4750			X			<p>245.0-255.0 ft. mechanical breaks @246.3, 248.9, 250.3, 251.2, 252.5, 253.0, 253.9, 254.2, 254.5, and 255.0 ft. Core is generally hard, with dry interior, no indication of formation water.</p>
250	4745		245.0-255.0	X	85.0-302.0 Excellent		
255	4740			X			<p>255.0-265.0 ft. mechanical breaks @256.0, 256.5, 257.2, 257.9, 259.4, 259.9, 260.1, 260.5, 261.1, 261.8, and 264.2 ft. Slightly fissile @260.0-260.5 ft. on breaks. 5 degree angle bedding with bioturbation crenulations, moderately calcic.</p>
260	4735		255.0-265.0	X			
265	4730			X			<p>265.0-275.0 ft. no indication of formation water, no secondary mineralization identified on break faces. Mechanical breaks @ 266.3, 266.5, 269.9, 270.0, 270.4, 271.0, and 271.2 ft. @271.7 ft. on the face of bedding are several drops of resin (about 0.003 ft. diameter) or petroleum hydrocarbon deposits? Another is seen @ 268.3 on similar face of a break on bedding plane.</p>
270	4725		265.0-275.0	X			

## BOREHOLE LOG CRJ01-0206

<b>PROJECT</b>	MOAB	<b>BOREHOLE NUMBER</b>	CRJ01-0206
<b>SITE</b>	Crescent Junction Site	<b>DATES DRILLED</b>	08/29/2005 to 10/24/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
275	4720			X			<p>275.0-285.0 ft. mechanical breaks @275.5, 276.0-276.7, 277.7, 278.2, 278.4, 279.0, 279.5, 283.3, 283.6, and 284.0 ft. Wavy biocrenulations (0.2 ft. thick) @ 281.0 ft. Normal bedding angle is 0-5 degrees. Moderately calcic.</p>
280	4715		275.0-285.0	X			
285	4710			X	85.0-302.0 Excellent		
290	4705		285.0-295.0	X			<p>285.0-295.0 ft. mechanical breaks @ 285.7-286.0 ft. 286.0-287.0 ft., 291.6, and 291.8 ft. @ 292.3 ft. "large" storm turbidity? section is light gray. This 10.0 ft. run doesn't appear to be as hard as the penetration rate would indicate.</p>
295	4700			X			
300	4695		295.0-302.0	X			<p>295.0-302.0 ft. mechanical breaks @ 396.0-396.6, 397.2, and 398.2 ft. Random bedding plane breaks, no fractures, core not extremely hard. Bedding angle normal, few scattered bioturbidity crenulations, no indication of formation water, core interior is dry.</p>
305	4690			X			
4685				X			
Total Depth 302.0 ft.							

## BOREHOLE LOG CRJ01-0207

PROJECT <u>MOAB</u>	DATE DRILLED <u>09/10/2005 to 10/20/2005</u>	BIT SIZE(S) (IN) <u>8.5</u>
LOCATION <u>Crescent Junction, UT.</u>	DRILLING COMPANY <u>Layne GeoConstruction</u>	CORE SIZE(S) (IN)
SITE <u>Crescent Junction</u>	DRILLING METHOD <u>H.S.A., Rotary Core</u>	LOGGED BY <u>Goodknight, C., Rupp, R.</u>
WELL NUMBER <u>CRJ01-0207</u>	SAMPLING METHOD <u>HQ CORE</u>	WL (FT BGS)
NORTH COORD. (FT) <u>6794658.25</u>	DRILL OPERATOR <u>Neaman, J. (Terramec 1000.), Hyleman, B. (BB80)</u>	
EAST COORD. (FT) <u>2124919.25</u>	REMARKS <u>4-inch steel surface casing cemented to depth of 25.0 feet below land surface.</u>	
SURFACE ELEV. ( FT NGVD) <u>4950.20</u>		
HOLE DEPTH (FT) <u>300.00</u>		

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT.)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
5	4950	2	0-0.5	X			0-1.25 ft. CLAYEY SILT (ML); grayish brown (10YR 5/2), highly calcareous, numerous roots, worm hole porosity.
		5	0.5-1.0	X			1.25-3.5 ft. SANDY SILT (ML); ~90% silt, 10% very fine grained sand, light yellowish brown (10YR 6/4), trace roots, some mottling, highly calcareous, trace small rock fragments, trace gypsum crystals.
		10	1.0-1.5	X			3.5-5.0 ft. SILT (ML); very pale brown (10YR 7/4), highly calcareous, mottled, trace roots, trace gypsum crystals.
		15	1.5-2.0	X			5.0-5.75 ft. CLAYEY SILT (ML); ~5% small rock fragments, light brownish gray (10YR 6/2), highly calcareous.
		17	2.5-3.0	X			5.75-10.5 ft. WEATHERED MANCOS SHALE BEDROCK; yellowish gray (5Y 7/2) to dark yellowish orange (10YR 6/6), highly calcareous, mostly silty mudstone, soft, numerous bedding plane fractures (highly weathered). Trace gypsum along fractures and bedding surfaces, trace fine pyrite. Color becomes mostly pale yellowish brown (10YR 6/2) by 10.0 ft. depth, and rock becomes harder.
10	4945	3	5.0-5.5	X			10.5-14.75 ft. No Recovery.
		21	5.5-6.0	X			
		27	6.0-6.5	X			
15		31	6.5-7.0	X			14.75-300.0 ft. MANCOS SHALE: bedding plane fractures, mostly silty mudstone, pale yellowish brown (10YR 6/2) to yellowish gray (5Y 7/2), gypsum crystals along fractures.
	4940	50/5	10.0-10.4	X			15-21.75 ft. No Recovery.
20			10.4-15.0	X			
	4935		15.0-20.0	X			
			20.0-22.0	X			
25	4930		22.0-25.0	X			21.75-22.0 ft. bedding plane fractures, mostly silty mudstone, gypsum crystals along fractures, trace fish plates and dark framboidal pyrite on bedding surfaces, medium gray (N5) to olive gray (5Y 4/1), moderately calcareous.
			22.0-25.0	X			22.0-25.0 ft. rock seems to be more competent with horizontal bedding plane fractures spaced 0.1-0.2 ft. apart, medium light gray (N6) to medium gray (N5), fairly even bedded, moderately calcareous, hard, trace framboidal pyrite, vertical fracture with gypsum crystal fill at 23.0 ft.
30	4925		25.0-35.0	X	10.5-40.0 Very Poor		25.0-35.0 ft. bedding plane fractures spaced 0.1 to 0.2 ft. apart or less. Rock is silty claystone overall, medium gray (N5), moderately calcareous. Mostly even bedding with only 5% or less bioturbated or storm bedding, which is coarser grained (up to very fine grained sandstone). Thin gypsum crystal coatings of bedding plane fractures. Inclined (45 degree) gypsum coated fractures at ~28.5, 30.0 and 31.5 ft. Bedding appears to be inclined 5-7 degrees. Several bedding surfaces had limonitic-colored, moderate yellowish brown (10YR 5/4) on them, indicating some water movement.
	4920		25.0-35.0	X			

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## BOREHOLE LOG CRJ01-0207

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0207  
**SITE** Crescent Junction Site **DATES DRILLED** 09/10/2005 to 10/20/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
40	4910		35.0-38.0	X		[Graphic Log]	<p>35.0-38.0 ft. could not determine where 1.0 ft. core loss occurred. Bedding plane fractures as above, 30 degree fracture with thin gypsum coating at ~36.0 ft. Numerous horizontal bedding plane fractures 37.0-38.0 ft. and limonitic-coloration. Trace fine carbonaceous material on some bedding.</p> <p>38.0-45.0 ft bedding plane fractures decrease in number with depth from ~0.1-0.2 ft. spacing to 0.2-1.0 ft. spacing at 45 ft. Gypsum crystal coatings along some fractures. A 45 degree inclined fracture with gypsum coating at 42.2 ft. and a 30 degree inclined fracture with gypsum coating at 42.9 ft. Shale is even bedded with only trace of lighter-colored very fine grained sandstone layers representing storm layers or bioturbation. Core very fissile and fractures easily when handled.</p>
45	4905		45.0-46.0	X	40.0-55.0 Poor	[Graphic Log]	<p>45.0-55.0 ft. Limonite and gypsum coated bedding plane fracture. at 45.5 ft. @ 46.0-55.0 ft. bedding plane fracturing generally decreases downward through interval. Thin gypsum crystal coatings on fracture surfaces along with limonitic coloration. A limonitic coating of vertical fracture at ~ 47.0 ft., and a 45 degree fracture with gypsum and limonite coating at 54.3-54.7 ft. Fissile, well fractured zone at ~51.0-51.5 ft. Rock is generally silty claystone and mostly even bedded. Trace bioturbation and storm layers, both of which are represented by very light gray (N8) very fine grained sandstone layers.</p>
55	4895		55.0-65.0	X		[Graphic Log]	<p>55.0-65.0 ft. bedding plane fracturing frequency decreases to generally less than one per foot. Only trace of gypsum coatings on fractures. Core becoming more competent. Amount of bioturbated bedding and storm layers increases below ~60.0 ft to ~5%. Limonite colored material coats most fractures. A high angle (~60 degrees) fracture coated with limonite at 61.3-62.2 ft. and a fissile fractured layer at 62.5 ft. Trace pyritized fossil material.</p>
65	4885		65.0-75.0	X	55.0-75.0 Fair	[Graphic Log]	<p>65.0-75.0 ft. ~65.0-65.5 ft. for a short core run. Bedding plane fracturing nearly absent, only 2 or 3 in this run. Possible 30 degree inclined fracture at ~73.5 ft. Trace limonitic coatings noted at 65.5 ft., and no limonitic or gypsum coatings on fractures noted for rest of run. Light-colored, storm or bioturbated beds are about 3% of layering. Core becoming more competent, most breaks are drilling-induced. Trace fine carbonaceous material and pyrite along some bedding.</p>

## BOREHOLE LOG CRJ01-0207

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0207  
**SITE** Crescent Junction Site **DATES DRILLED** 09/10/2005 to 10/20/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
75	4875			X			
80	4870		75.0-85.0	X			75.0-85.0 ft. fossil @ 80.6 ft., 0.1 x 0.05 ft. Continued low angle bedding (5 degrees), core interior is dry, no indication of water from formation.
85	4865			X	75.0-95.0 Good		85.0-95.0 ft. dark gray (N3-N4) when wet, medium gray (N5) when dry, uniform, thin bedded, calcic, some gypsum, silty claystone. Bedding +/-5 degrees. Sporadic very fine grained sand to thinly bedded siltstone partings.
90	4860		85.0-95.0	X			
95	4855			X			95.0-105.0 ft. mechanical fracturing along bedding planes most common, no fracturing noted except partings along bedding planes, no significant iron alteration zones or infillings, calcite and gypsum predominantly along hairline bedding planes.
100	4850		95.0-105.0	X	95.0-300.0 Excellent		
105	4845			X			105.0-115.0 ft. no indication of formation water noted between 75.0-175.0 ft.
110	4840		105.0-115.0	X			

## BOREHOLE LOG CRJ01-0207

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0207  
**SITE** Crescent Junction Site **DATES DRILLED** 09/10/2005 to 10/20/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
115	4835			X			115.0-165.0 ft. shale or claystone, medium dark gray (N4), as above.
120	4830		115.0-125.0	X			
125	4825			X			
130	4820		125.0-135.0	X	95.0-300.0 Excellent		
135	4815			X			
140	4810		135.0-145.0	X			
145	4805			X			
150	4800		145.0-155.0	X			

## BOREHOLE LOG CRJ01-0207

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0207  
**SITE** Crescent Junction Site **DATES DRILLED** 09/10/2005 to 10/20/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG
155	4795			X		
160	4790		155.0-165.0	X		
165	4785			X		
170	4780		165.0-175.0	X	95.0-300.0 Excellent	<p>165.0-175.0 ft. @167.5 ft. is a weak thinly bedded, silty layer about 0.4 ft. thick. @168.0-169.0 ft. couple of hard microcrystalline sand lenses (porcelaneous-appearing) up to 0.1 ft. thick. Sporadic silt and sand beds up to 0.05 ft. thick.</p>
175	4775			X		
180	4770		175.0-185.0	X		<p>175.0-185.0 ft. @175.2-175.4, 175.7-176.3 ft., core is broken into 0.05 ft. pieces. @176.7-177.4 ft. core breaks to 3 pieces 0.2-0.3 ft. long. @179.5-180.5 core in 3 pieces. @182.0-182.5 several broken pieces.</p>
185	4765			X		
190	4760		185.0-195.0	X		<p>185.0-195.0 ft. competent with only bedding planes and hairline gaps, calcite filling. No breakage other than mechanical @ 185.0, 187.5, 191.0, and 193.5 ft. Bedding plane &lt;~5 degrees, sporadic bioturbation zones about 0.1 ft. thick.</p>

## BOREHOLE LOG CRJ01-0207

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0207  
**SITE** Crescent Junction Site **DATES DRILLED** 09/10/2005 to 10/20/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
195	4755			X			195.0-205.0 ft. mechanical breakage along bedding planes @ 198.0, 201.3, and 204.0-205.0 ft.
200	4750		195.0-205.0	X			
205	4745			X			205.0-215.0 ft. clystone. @205.0-207.5 ft. three 0.3 ft. sections showing strong mechanical fractures, no apparent lithologic cause, could be caused by vibration in drill string. Inner core is dry, no indication of water in the formation.
210	4740		205.0-215.0	X	95.0-300.0 Excellent		
215	4735			X			215.0-225.0 ft. three fractures @ 20 degrees to core axis from 216.5-217.0 ft. Clean hairline fractures, no secondary coatings or evidence of water, fractures spacing is approximately 0.1 ft.
220	4730		215.0-225.0	X			
225	4725			X			225.0-235.0 ft. From 226.0-226.5 ft. strong mechanical damage. Core is generally very consistent in appearance, random, thin (<0.025 ft.) storm and bioturbation layers.
230	4720		225.0-235.0	X			

## BOREHOLE LOG CRJ01-0207

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0207  
**SITE** Crescent Junction Site **DATES DRILLED** 09/10/2005 to 10/20/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
235	4715			X			235.0-245.0 ft. @240.2-240.8 ft. zone of silt size, coarser sediment interbedded with dark gray claystone, zone is mechanically fractured, otherwise the run is consistent with previous runs, no significant change in bedding, lithology, amount of mechanical fractures, no indication of formation water.
240	4710		235.0-245.0	X			
245	4705			X			245.0-255.0 ft. @ 251.5 ft. hairline clean fracture about 20 degrees to core axis is mechanical in origin. Run is competent with no other remarkable characteristics, usual bedding, coloration, fracturing, recovery, no indication of water in the formation.
250	4700		245.0-255.0	X	95.0-300.0 Excellent		
255	4695			X			255.0-265.0 ft. @256.0-259.0 ft. majority of mechanical fractures occur 0.15-0.4 ft. apart. Medium dark gray (N4) claystone with some bedding planes and no indication of water in the formation.
260	4690		255.0-265.0	X			
265	4685			X			265.0-275.0 ft. @266.0 ft. is a mechanical fracture that is filled with a lot of clay. This could be from cuttings or (unlikely but possible?) a large clay filled fracture? @268.7- 269.4 ft. zone of fractures along bedding, some bioturbation-associated breakage, friable. Remainder of run is typical shale.
			265.0-275.0	X			

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## BOREHOLE LOG CRJ01-0207

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0207
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 09/10/2005 to 10/20/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
275	4675			X			
280	4670		275.0-285.0	X			275.0-285.0 ft. competent, unremarkable. Mechanical fractures prevalent @275.0-277.0 ft. with breaks every 0.2-0.4 ft. Only other break @279.5 ft. Nice consistent run, even bedding, minor bioturbation, no indication of water in the formation.
285	4665			X	95.0-300.0 Excellent		285.0-295.0 ft. @ 291.15-291.4, core is fractured and platy - this fracturing is mechanical, but a result of lower calcic content of core.
290	4660		285.0-295.0	X			
295	4655			X			295.0-300.0 ft. no evidence of water.
300	4650		295.0-300.0	X			
							Total Depth 300.0 ft.
305	4645			X			

## BOREHOLE LOG CRJ01-0208

PROJECT <u>MOAB</u>	DATE DRILLED <u>09/09/2005 to 10/08/2005</u>	BIT SIZE(S) (IN) <u>8.5</u>
LOCATION <u>Crescent Junction, UT.</u>	DRILLING COMPANY <u>Layne GeoConstruction</u>	CORE SIZE(S) (IN) _____
SITE <u>Crescent Junction</u>	DRILLING METHOD <u>H.S.A., Rotary Core</u>	LOGGED BY <u>Goodknight, C., Reed, J.</u>
WELL NUMBER <u>CRJ01-0208</u>	SAMPLING METHOD <u>HQ CORE</u>	WL (FT BGS) _____
NORTH COORD. (FT) <u>6796412.91</u>	DRILL OPERATOR <u>Neaman, J. (Terra. 1000, BB80), Hyleman, B. (BB80)</u>	
EAST COORD. (FT) <u>2126089.65</u>	REMARKS <u>4-inch steel surface casing cemented to depth of 40.0 feet below land surface.</u>	
SURFACE ELEV. ( FT NGVD) <u>4986.10</u>	_____	
HOLE DEPTH (FT) <u>301.00</u>	_____	

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT.)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
	4985	3 4 6 6 10 9 16 11	0-0.5 0.5-1.0 1.0-1.5 1.5-2.0 2.0-2.5 2.5-3.0 3.0-3.5 3.5-4.0				0-1.5 ft. CLAYEY SILT (ML); gray (2.5Y 5/1), highly calcareous, moderate roots, worm hole porosity. 1.5-3.5 ft. SANDY SILT (ML); light brownish gray (2.5Y 6/2), highly calcareous, mottled, compacted, some roots, trace rock fragments to 0.1 ft. in diameter. 3.5-4.5 ft. greater amount (~5%) of rock fragments to .05 ft. in diameter.
5	4980	8 9 12 11	5.0-5.5 5.5-6.0 6.0-6.5 6.5-7.0				4.5-6.0 ft. GRAVELLY SILT (ML); some very fine grained sand and ~20% rock fragments to 0.1 ft. in diameter, highly calcareous, light brownish gray (2.5Y 6/2). 6.0-9.0 ft. GRAVELLY SAND (SW); sand is very fine to coarse grain and ~70%; gravel consists of rock fragments up to 0.1 ft. in diameter; sand matrix is highly calcareous, light brownish gray (10YR 6/2), some mottling.
10	4975	22 19 16 25	10.0-10.5 10.5-11.0 11.0-11.5 11.5-12.0				9.0-15.75 ft. SILT (ML); trace of very fine grained sand, pale brown (10YR 6/3), highly calcareous, some mottling, compacted in some places, trace rock fragments.
15	4970	11 11 18 21	15.0-15.5 15.5-16.0 16.0-16.5 16.5-17.0				15.75-19.0 ft. GRAVELLY SAND (SP); sand is mostly fine to very fine grained and ~75%; gravel consists of rock fragments up to 0.2 ft. in diameter, trace gypsum crystals, highly calcareous, mottled.
20	4965	40 42 50/5*	20.0-25.5 20.5-21.0 21.0-21.5				19-20.5 ft. SILT (ML); light yellowish brown (10YR 6/4), highly calcareous, compacted. 20.5-22.0 ft. SILTY SAND (SM); silt 40%, very fine grained sand ~60%, light yellowish brown (2.5Y 6/3), trace mottling, highly calcareous, trace rusty colored siltstone fragments.
25	4960	50/4*	25.0-30.0				22.0-30.0 ft. WEATHERED MANCOS SHALE BEDROCK; Contact estimated at 22.0 ft. 25.0-30.0 ft. mostly silty mudstone, light olive gray (5Y 6/1) to medium gray (N5), highly calcareous, bedding plane fractures spaced mostly 0.1 ft. or less apart, wavy, contorted (bioturbated) bedding. Moderately weathered.
30	4955		30.0-35.0		25.0-35.0 Very Poor		30.0-31.5 ft. No Recovery. 31.5-301.0 ft. MANCOS SHALE: 31.5-35.0 ft. bedding plane fractures about 0.1 ft. apart down to ~33.0 ft., then about 0.2 ft. apart to 35.0 ft. Light olive gray (5Y 6/1) to medium gray (N5). @32.7 ft., a thin silty clay bed that is dark yellowish orange (10YR 6/6) with trace pyrite. Mostly clayey siltstone. Highly calcareous throughout, trace pyrite

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## BOREHOLE LOG CRJ01-0208

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0208  
**SITE** Crescent Junction Site **DATES DRILLED** 09/09/2005 to 10/08/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
4950			35.0-40.0	X	35.0-40.0 Poor	[Graphic Log]	<p>crystals and fine framboidal pyrite along bedding surfaces along with trace carbonaceous material. Gypsum crystals along bedding plane fracture @34.5 ft. Bioturbated bedding in many places. -----                      35.0-36.5 ft. No Recovery.</p> <p>36.5-40.0 ft. moderately calcareous, mostly siltstone and ~20% very fine grained sandstone (mainly in lighter gray areas -very light gray, N8). Siltstone is mostly medium gray (N5). Bedding plane fractures are rare - only 0.4-0.5 ft. apart, indicating rock is very competent and only slight to non-weathered. Trace pyrite and carbonaceous material along bedding, which is wavy and bioturbated in most places. Some large burrows.</p>
4945			40.0-45.0	X			<p>40.0-45.0 ft. ~20% very fine grained sandstone, very light gray (N8) in wavy to bioturbated layers up to 0.03 ft. thick; remainder of rock is siltstone to clayey siltstone, medium gray (N5), weak to moderately calcareous. Trace fine pyrite and carbonaceous material along bedding. Core easily broken along bedding when handled. No natural fractures and limonitic coloration and no gypsum/calcite along bedding. Core dry when broken open.</p>
4940			45.0-55.0	X	40.0-55.0 Fair		<p>45.0-55.0 ft. 20-25% of rock that is very fine to fine grained sandstone occurs in layers up to 0.1 ft. thick. Most layers are wavy and bioturbated. More drilling-induced bedding plane fractures - no natural fractures present or indication of water movement (limonite, calcite, gypsum).</p>
4935			55.0-65.0	X			<p>55.0-65.0 ft. ~20% of rock that is very fine to fine grained sandstone occurs in layers up to ~0.07 ft. thick. No natural fractures present or indications of water movement. Trace pelecypod fossil imprints on some bedding surfaces.</p>
4930			65.0-75.0	X	55.0-85.0 Good		<p>65.0-75.0 ft. very fine to fine grained sandstone layers that compose ~20% of rock from 65.0 to 70.0 ft. decreases gradually through 70.0-75.0 ft to about 10%. Bedding plane fractures more frequent from 65.0-68.0 ft. than from 68.0-75.0 ft., but no evidence that they are anything more than drilling induced. Increase in carbonaceous material and associated framboidal pyrite (and trace amber-like material) along bedding planes in the medium gray (N5) silty claystone layers that comprise most of the rock.</p>
4925							
4920							
4915							

## BOREHOLE LOG CRJ01-0208

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0208
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 09/09/2005 to 10/08/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
75	4910		75.0-85.0	X		[Graphic Log Representation]	75.0-85.0 ft. most of the rock is medium gray (N5) and silty claystone to clayey siltstone (~90%). ~10% is very light gray (N8) very fine to fine grained sandstone in thin (<0.01 ft.) layers or as burrows and bioturbation segregations and irregular layers. Trace pelecypod and cephalopod fossil imprints on a few bedding surfaces. High angle (~80 degree) fractures at top and bottom of interval - top fracture at 75.0-75.8 ft. is smooth and may be natural and it is tight. Bottom fracture at 84.2-84.6 ft. is hackly and is probably drilling-induced.
80	4905			X			
85	4900		85.0-95.0	X			85.0-95.0 ft. most rock is silty claystone to clayey siltstone (95%). Only ~5% is very light gray (N8) very fine grained sandstone in a few thin layers (storm layers?) but mostly in round elongated forms that occur along bedding or cut down through bedding at various angles - these are likely burrows. Trace of various fossil imprints and less fine carbonaceous material along bedding. No natural fractures seen.
90	4895			X			
95	4890		95.0-105.0	X			95.0-105.0 ft. amount of very light gray (N8), very fine grained sandstone in wavy layers and as bioturbation (burrows) gradually increases from 5% to ~15% @105.0 ft. Increased amount of fine carbonaceous material along bedding surfaces of the main rock type - clayey siltstone. No natural fractures seen.
100	4885			X	85.0-301.0 Excellent		
105	4880			X			105.0-115.0 ft. amount of very light gray (N8), very fine grained sandstone in wavy layers and as bioturbation gradually decreases from ~15% at 108.0 ft. to 1-2% at 112.0 ft. At 115.0 ft., rock is mostly (~98%) medium gray (N5) silty claystone, weak-moderately calcareous. No natural fractures seen. Core dry when broken open.
110	4875		105.0-115.0	X			

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## BOREHOLE LOG CRJ01-0208

<b>PROJECT</b> <u>MOAB</u>	<b>BOREHOLE NUMBER</b> <u>CRJ01-0208</u>
<b>SITE</b> <u>Crescent Junction Site</u>	<b>DATES DRILLED</b> <u>09/09/2005 to 10/08/2005</u>

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
115	4870			X			<p>115.0-125.0 ft. slight increase in amount of bioturbated layers (and very fine grained sandstone) from ~2% to ~5% from 117.0-122.0 ft. A hackly, near vertical fracture at 115.2-115.8 ft., probably drilling induced; a similar fracture at 124.6-125.0 ft. At 119.5 ft. is a pelecypod fossil imprint with fine pyrite. No natural fractures seen. Decrease in amount of bioturbated layers from 122.0-125.0 ft. down to ~2% or less.</p>
120	4865		115.0-125.0	X			
125	4860			X			
130	4855		125.0-135.0	X	85.0-301.0 Excellent		
135	4850			X			<p>135.0-145.0 ft. Note: drilled to 145.0 ft. on 10/5/2005 but did not open core barrel till 10/6/2005. Although core appears intact and competent, it parts easily upon handling, revealing fossil imprints with fine pyrite coatings on many of them. Rock is homogeneous silty claystone, medium dark gray (N4), slightly calcareous, and only trace of bioturbated bedding. No natural fractures seen.</p>
140	4845		135.0-145.0	X			
145	4840			X			<p>145.0-155.0 ft. amount of bioturbated spots and layers increases slightly to 1-2%. Vertical fractures at ~148.5 and 152.5-153.4 ft. have smooth surfaces and are probably drilling induced - no evidence of water movement or natural fracturing on the surfaces. Thin, fissile bedding at ~145.0-145.5, 150.5-151.0, and 151.5-152.0 ft. are weaker and easily parted (softer).</p>
150	4835		145.0-155.0	X			

## BOREHOLE LOG CRJ01-0208

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0208
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 09/09/2005 to 10/08/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
155	4830		155.0-165.0				155.0-165.0 ft. amount of bioturbation decreases slightly to ~1%. High angle (~80 degrees) fractures at ~158.0-158.8 ft. and 159.0-159.7 ft. - no limonitic or other coatings along these tight fractures, therefore, they are probably drilling induced. Core hard and competent throughout. Trace fine carbonaceous material and fossil imprints.
160	4825						
165	4820						165.0-175.0 ft. bioturbated or storm layering (very fine grained sandstone) is only a trace. No fractures seen. From 165.5-169.4 ft., rock is fissile, softer, and parts easily. From 169.4-173.0 ft., core is more competent and breaks into 0.1-0.2 ft. segments. Core hard and competent from 173.0-175.0 ft.
170	4815		165.0-175.0		85.0-301.0 Excellent		
175	4810						175.0-185.0 ft. core hard and competent - no natural fractures seen. Drilling-induced fractures ~0.5 ft. long occur at top and bottom of core run. Trace fine carbonaceous material and fossil imprints. Lithology continues as silty claystone. Dry when core broken open.
180	4805		175.0-185.0				
185	4800						185.0-195.0 ft. possible natural fractures at 188.0-188.3 ft. - three fractures in this interval are inclined ~45 degrees and separated by ~0.1 ft. - no evidence of fluid movement along these tight fractures. From 189.0-191.0 ft., amount of bioturbation increases to 2-3%. Below 192.0 ft., bioturbated bedding amounts to only a trace. Core hard and competent throughout, and is generally a claystone, medium dark gray (N4).
190	4795		185.0-195.0				

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## BOREHOLE LOG CRJ01-0208

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0208
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 09/09/2005 to 10/08/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
195	4790		195.0-205.0	X			195.0-205.0 ft. hard and competent core throughout. Trace to ~1% bioturbated or storm bedding through interval. Inclined bedding is 5-7 degrees from horizontal, reflecting regional dip. No fractures present. Large pelecypod imprint at 204.5 ft.
200	4785			X			
205	4780		205.0-215.0	X			205.0-215.0 ft. rock is softer and more fissile from 207.5-208.5 ft. Fine carbonaceous material on some bedding planes. Trace to ~1% bioturbated or storm bedding up to 0.01 ft. thick, very light gray (N8), very fine grained sandstone. No fractures present. Dry when core broken open.
210	4775			X	85.0-301.0 Excellent		
215	4770		215.0-225.0	X			215.0-225.0 ft. core breaks into 0.05-0.3 ft. segments from 215.0-218.0 ft. - appears to be drilling induced. From 218.0-219.6 ft., core easily parts and appears to be somewhat more fissile (softer). From 219.6-225.0 ft., core is hard and competent. No natural fractures seen. Only trace of bioturbated bedding.
220	4765			X			
225	4760		225.0-235.0	X			225.0-235.0 ft. soft core, thinly bedded.
230				X			

## BOREHOLE LOG CRJ01-0208

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0208
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 09/09/2005 to 10/08/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
235	4750			X			235.0-245.0 ft. competent core - no soft spots.
240	4745		235.0-245.0	X			
245	4740			X			245.0-255.0 ft. soft, thin bedded, easily parted @250.8-251.6 ft.; rest of core competent.
250	4735		245.0-255.0	X	85.0-301.0 Excellent		
255	4730			X			255.0-265.0 ft. light gray (N7) from 259.1-259.25 and 259.8-259.95 ft. - strong HCL, fine grained, dense, scattered small white fragments with strong HCL (calcite?). These are porcelaneous-appearing masses along bedding.
260	4725		255.0-265.0	X			
265	4720			X			265.0-275.0 ft. strong HCL, fine grained, dense, scattered small white fragments with strong HCL (calcite?) from 266.35-266.5 ft. - light gray (N7). These are additional porcelaneous masses.
			265.0-275.0	X			

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## BOREHOLE LOG CRJ01-0208

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0208
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 09/09/2005 to 10/08/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG
275	4715			X		275.0-285.0 ft. softer core, thin bedded, parts easily from 276.1-276.5, 278.3-279.5, and 280.1-280.7 ft.
280	4710		275.0-285.0	X		
285	4705			X		
290	4700			X	85.0-301.0 Excellent	
295	4695		285.0-295.0	X		
300	4690		295.0-301.0	X		
305	4685					Total Depth 301.0 ft.
310	4680					

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## BOREHOLE LOG CRJ01-0209

<b>PROJECT</b> MOAB	<b>DATE DRILLED</b> 09/07/2005 to 09/27/2005	<b>BIT SIZE(S) (IN)</b> 8.5
<b>LOCATION</b> Crescent Junction, UT.	<b>DRILLING COMPANY</b> Layne GeoConstruction	<b>CORE SIZE(S) (IN)</b>
<b>SITE</b> Crescent Junction	<b>DRILLING METHOD</b> H.S.A., Rotary Core	<b>LOGGED BY</b> Goodknight, C.
<b>WELL NUMBER</b> CRJ01-0209	<b>SAMPLING METHOD</b> HQ CORE	<b>WL (FT BGS)</b>
<b>NORTH COORD. (FT)</b> 6795168.53	<b>DRILL OPERATOR</b> Neaman, J. (Terra. 1000, BB80), Hyleman, B. (BB80)	
<b>EAST COORD. (FT)</b> 2126441.58	<b>REMARKS</b> 4-inch steel surface casing cemented to depth of 35.0 feet below land surface.	
<b>SURFACE ELEV. ( FT NGVD)</b> 4955.70		
<b>HOLE DEPTH (FT)</b> 300.00		

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT.)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
5	4955	3	0-0.5				0-2.0 ft. CLAYEY SILT (ML); light brownish gray (2.5Y 6/2), highly calcareous, moderate amount of roots, worm hole porosity, mottled at 1.0-2.0 ft.
		3	0.5-1.0				
		4	1.0-1.5				
		4	1.5-2.0				
		3	2.0-2.5				
		4	2.5-3.0				
		7	3.0-3.5				
5	4950	7	5.0-5.5				2.0-5.25 ft. SILTY SAND (SM); pale brown (10 YR 6/3), highly calcareous, trace roots, noncohesive.
		11	5.5-6.0				
		12	6.0-6.5				
		13	6.5-7.0				
10	4945	13	10.0-10.5				5.25-6.75 ft. SAND (SW); light brownish gray (10YR 6/2), moderately calcareous, fine to coarse grained sand with ~2% rock fragments, probably a fluvial channel or sheetwash deposit.
		13	10.5-11.0				
		17	11.0-11.5				
		20	11.5-12.0				
15	4940	35	16.0-21.0				6.75-9.0 ft. CLAYEY SILT (ML); pale brown (10YR 6/3), highly calcareous, compacted, slightly mottled, dry.
		50/4*	21.0-24.0				
20	4935		16.0-21.0				9.0-11.25 ft. SILT (ML); light brownish gray (2.5Y 6/2), highly calcareous, trace very fine grained sand, possibly an eolian deposit.
			21.0-24.0				
			24.0-27.25 ft. No Recovery				
			27.25-30.0 ft. core from 27.25 to 28.25 ft. was ground up in coring process and only rounded pieces are represented, moderately weathered. Horizontal bedding plane fractures spaced about 0.1-0.2 ft. apart from 28.25 ft. to 30.0 ft. Mostly clayey siltstone, gypsum crystal fracture coatings, highly calcareous, trace black fossil impressions in bedding planes with framboidal pyrite, pale yellowish brown (10YR 6/2), slightly weathered hard. Trace of dark carbonaceous material on bedding planes.				
25	4930		25.0-30.0				11.25-16.0 ft. GRAVELLY SAND (SW); alluvial detritus, soft down to 14.0 ft. and increasingly harder 14.0-16.0 ft. Mostly light gray (2.5Y 7/2), highly calcareous, platy shale fragments, trace gypsum crystals that form plates, sandstone rock fragments up to 0.1 ft. long, some dolomitic ironstone fragments up to 0.05 ft. long.
			30.0-35.0				
30	4925		16.0-45.0				16.0-18.5 ft. No Recovery
			30.0-33.0 ft. No Recovery				
			30.0-35.0				21.0-22.75 ft. No Recovery.
							22.75-35.0 ft. WEATHERED MANCOS SHALE BEDROCK: (contact estimated at 22.0 ft.) mostly silty mudstone, light gray (N7), highly calcareous, horizontal bedding plane fractures numerous, pelecypod impression @23.5 ft. A thin 0.05 ft. thick rusty, light brown (5YR 5/6) - colored siltstone bed at 23.0 ft. Soft, moderate to highly weathered.
							24.0-27.25 ft. No Recovery.
							27.25-30.0 ft. core from 27.25 to 28.25 ft. was ground up in coring process and only rounded pieces are represented, moderately weathered. Horizontal bedding plane fractures spaced about 0.1-0.2 ft. apart from 28.25 ft. to 30.0 ft. Mostly clayey siltstone, gypsum crystal fracture coatings, highly calcareous, trace black fossil impressions in bedding planes with framboidal pyrite, pale yellowish brown (10YR 6/2), slightly weathered hard. Trace of dark carbonaceous material on bedding planes.
							30.0-33.0 ft. No Recovery.
							33.0-35.0 ft. horizontal bedding plane fractures spaced ~0.1 ft. apart predominate, a few vertical fractures with gypsum crystal coatings, mostly clayey siltstone, pale yellowish brown (10YR 6/2) to light olive gray (5Y 6/1).

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## BOREHOLE LOG CRJ01-0209

<b>PROJECT</b> <u>MOAB</u>	<b>BOREHOLE NUMBER</b> <u>CRJ01-0209</u>
<b>SITE</b> <u>Crescent Junction Site</u>	<b>DATES DRILLED</b> <u>09/07/2005 to 09/27/2005</u>

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
	4920		35.0-40.5				35.0-300.0 ft. MANCOS SHALE: 35.0-40.5 ft. silty claystone, mainly horizontal fractures spaced every 0.1-0.2 ft. apart, some 0.01 ft. wide vertical fractures filled with crystalline gypsum at 38.0-39.8 ft. Slight to moderately calcareous, even bedded, light olive gray (5Y 6/1), hard, competent material, only slightly weathered especially in upper 2.0-3.0 ft. A 45 degree fracture at ~37.8 ft. that has very thin gypsum coating. Small crystal of amber-colored material at ~38.5 ft., ~0.01 ft. crystal.
40	4915		40.5-45.0				40.5-45.0 ft. mostly silty claystone and even, thinly bedded except for 42.3-42.6 ft., which is bioturbated - these small blotches are dark yellowish orange (10YR 6/6) and rest of rock is light olive gray (5Y 6/1). Mainly horizontal fractures, spaced 0.1-0.2 ft. apart, moderately calcareous, hard, competent rock with 0.01 ft. wide gypsum filled horizontal fracture at 41.2 ft. Vertical fracture at 42.8-43.2 ft.
45	4910		45.0-55.0		45.0-55.0 Poor		45.0-55.0 ft. mostly silty claystone and even, thinly bedded. Trace bioturbated bedding and framboidal pyrite replacing carbonaceous material along some bedding planes. Rock is olive gray (5Y 4/1) for the most part. Rock is more competent - bedding plane fractures are less frequent, spaced 0.3-0.4 ft. apart with limonite - colored (dark yellowish orange, 10YR 6/6) material on some fractures. 30 degree fracture at ~47.2 ft. Limonitic coated fracture at ~51.0 ft. A ~40 degree fracture at ~54.0 ft. with thin gypsum coating. Fossil ammonites and pelecypods noted at ~53.0 ft. A ~45 degree fracture with thin gypsum film at 49.0 ft.
50	4905		55.0-65.0		55.0-68.0 Fair		55.0-65.0 ft. thinly-evenly bedded silty claystone. Trace gypsum in vertical fracture at ~64.7 ft. Hard, competent rock, medium gray (N5), bedding plane fractures become rarer - only one or two per foot. Thin bed ~ 62.3-62.4 ft. that appears to be a coarser grained siltstone and burrowed with hackly fracture, moderate yellowish brown (10 YR 5/4), slightly calcareous.
55	4900		65.0-75.0				65.0-75.0 ft. mostly silty claystone except for a bioturbated section @67.7-68.0 ft. that has wavy bedding and is coarser grained up to very fine grain sand. Large fossil (cephalopod?) at base of this interval at ~68.0 ft. Moderately calcareous in coarser grain interval and slight to moderately calcareous elsewhere. From 65.0-66.0 ft. bedding plane fracturing is frequent (<0.1 ft.) and thick (0.01 ft.) gypsum coating at 65.2 ft., limonitic coating at 65.5 ft. and gypsum coating at 65.7 ft. Vertical fracture at 66.0-66.3 ft. and several at 63.7 ft. and 64.5 ft. Core much harder and more competent (few fractures) below 66.0 ft.
60	4895						
65	4890						
70	4885						

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## BOREHOLE LOG CRJ01-0209

<b>PROJECT</b> <u>MOAB</u>	<b>BOREHOLE NUMBER</b> <u>CRJ01-0209</u>
<b>SITE</b> <u>Crescent Junction Site</u>	<b>DATES DRILLED</b> <u>09/07/2005 to 09/27/2005</u>

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
75	4880			X			75.0-85.0 ft. trace bioturbation, mostly even, thin bedding, moderately calcareous, hard competent rock, bedding plane fractures less frequent than 0.5 ft. Vertical fracture(s) from 76.0-77.0 ft. and 84.0-84.5 ft. with limonite coatings. No gypsum seen. Limonitic coating also at 78.0 ft. Trace fine carbonaceous material and framboidal pyrite on bedding planes.
80	4875		75.0-85.0	X			
85	4870			X			85.0-95.0 ft. most bedding is parallel and even, trace-minor bioturbation scattered through interval and is expressed as flaser bedding. Light-colored bioturbated zones are calcareously cemented and coarser grained (very fine grain sand) than rest of core (silty claystone). Rock hard and competent, bedding plane fractures are rare, closed, and coated with limonite (dark yellowish orange, 10YR 6/6). Several fractures 85.0-86.0, 89.0, 91.9, and 94.2 ft. Slightly to moderately calcareous throughout.
90	4865		85.0-95.0	X			
95	4860			X	68.0-120.0 Good		95.0-105.0 ft. fractures infrequent and no limonitic or gypsum coatings observed, therefore fractures seen may be drilling induced. Fine carbonaceous fragments seen on some bedding surfaces.
100	4855		95.0-105.0	X			
105	4850			X			105.0-115.0 ft. fractures infrequent to absent - no gypsum or limonitic coatings observed, so fractures seen may be drilling induced. Color is mostly medium gray (N5). Some white fine calcite films on bedding surfaces and some dark fine grained carbonaceous material disseminated throughout.
110	4845		105.0-115.0	X			

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## BOREHOLE LOG CRJ01-0209

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0209  
**SITE** Crescent Junction Site **DATES DRILLED** 09/07/2005 to 09/27/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
115	4840		115.0-125.0				115.0-125.0 ft. increased bedding plane fractures especially from 118.0-120.0 ft. where spacing is generally <0.1 ft. Some closely spaced fractures also at ~117.2-117.5 ft. in softer shale, possibly related to thin bentonitic (?) layer that was lost. Silty claystone is moderately calcareous. Trace black carbonaceous material and framboidal pyrite associated with fine fossil fragments on bedding. Rock mostly hard and competent below 120.5 ft.
120	4835						
125	4830		125.0-135.0				125.0-135.0 ft. bedding plane fracturing is infrequent, non-fractured segments >1.0 ft. long are the rule. Bioturbated bedding imparting a flaser bedding structure is more frequent and some burrow in fillings are present. Burrow and bioturbation fillings are lighter colored, very light gray (N8), and are composed of very fine grain sand. Moderately calcareous and trace black carbonaceous material and framboidal pyrite associated with fine fossil fragments.
130	4825				120.0-300.0 Excellent		
135	4820		135.0-145.0				135.0-145.0 ft. bedding plane fracturing nearly nonexistent, very competent, hard silty claystone. Bioturbated bedding imparts a flaser and small-scale lenticular bedding. Trace black carbonaceous material and framboidal pyrite associated with fine fossil fragments. A 4.0 ft. and 3.5 ft. unbroken core segments indicate hardness of this interval. Trace calcareous (calcite) fossil shell replacement along some bedding surfaces.
140	4815						
145	4810		145.0-155.0				145.0-155.0 ft. bedding plane fracturing evident only from 146.0-147.0 ft. where they are ~0.1-0.2 ft. apart. Slight bioturbated bedding continues - bedding dips ~5-7 degrees from horizontal. Fresh shale is medium gray (N5) and slightly-moderately calcareous.
150	4805						

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## BOREHOLE LOG CRJ01-0209

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0209
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 09/07/2005 to 09/27/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	DESCRIPTION
155	4800		155.0-165.0	X			155.0-165.0 ft. bedding plane fractures nearly absent- none discernible from drilling induced breaks. Hard, competent core. Bioturbated bedding seems to be increasing, with individual flaser/lenticular bioturbated bed fillings of very fine grain sand up to 0.02 ft. thick. Rock type, overall, approximates siltstone when averaging between medium gray silty claystone and very light gray and very fine grained sandstone facies.
160	4795			X			
165	4790		165.0-175.0	X			165.0-175.0 ft. bedding plane fractures rare - not discernible from drilling-induced fractures. Hard competent rock. Bioturbation increasingly interrupts bedding and burrowed layers are up to 0.05 ft. thick.
170	4785			X	120.0-300.0 Excellent		
175	4780		175.0-185.0	X			175.0-185.0 ft. no discernible bedding plane fractures. Hard competent rock, mostly medium gray (N5). Bioturbation is ubiquitous and the very light gray (N8), very fine grained sandstone filling these burrowings composes ~20% of the rock. Small (<0.001 ft.) fragment of amber (?) colored material at 179.0 ft. Carbonaceous fragment ~0.15 ft. long at 179.7 ft.
180	4775			X			
185	4770		185.0-195.0	X			185.0-195.0 ft. few bedding plane fractures - some possibly between 192.0 and 194.0 ft. At 191.0-191.2 ft. is an abruptly lighter colored layer, yellowish gray (5Y 7/2) and almost a porcelaneous appearance from its very fine grained, dense character - highly calcareous and scattered very small white (calcite?) fragments are distributed in this layer and fine pyrite crystals are also associated with them. Bioturbated bedding also ubiquitous in this interval, and it is hard and competent. Finely divided carbonaceous fragments and pyrite along bedding.
190	4765			X			

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## BOREHOLE LOG CRJ01-0209

<b>PROJECT</b>	MOAB	<b>BOREHOLE NUMBER</b>	CRJ01-0209
<b>SITE</b>	Crescent Junction Site	<b>DATES DRILLED</b>	09/07/2005 to 09/27/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
195	4760		195.0-205.0	X		[Graphic Log]	195.0-205.0 ft. possibly a few bedding plane fractures in 196.0 ft. area and 199.0-200.0 ft. area although no limonitic or gypsum coatings observed. Below 199.0 ft. shale contains more fine black carbonaceous material on bedding surfaces. Also finely divided pyrite associated with this carbonaceous material. Rock only slightly calcareous. Core drilled slower from 200.0-205.0 ft. Moderately bioturbated throughout.
200	4755		205.0-215.0	X		[Graphic Log]	205.0-215.0 ft. no bedding plane fractures observed - fractures in core are drilling induced. Overall rock color is medium gray (N5). Bedding shows lamination by very light gray (N8), thin bands that are composed of very fine grained sand - other very fine grained sand layers are formed from bioturbation and are lenticular or flaser shaped and up to 0.02 ft. thick. Slightly calcareous throughout. Finely divided black carbonaceous material on many bedding surfaces along with framboidal pyrite. Trace fossil impressions.
210	4745		215.0-225.0	X	120.0-300.0 Excellent	[Graphic Log]	215.0-225.0 ft. bedding and fracture features are same as above. Several thin (up to 0.06 ft. thick) segregation of light-colored, very pale orange (10YR 8/2), densely calcareously cemented (almost porcelaneous) very fine grained material (silt size?). Scattered white pieces (<0.01 ft. in diameter) in segregations are highly calcareous and may be shell fragments and occur at 217.7, 218.0, 222.5, and 223.2 ft. Trace fossil shell fragments on bedding surfaces.
220	4735		225.0-235.0	X		[Graphic Log]	225.0-235.0 ft. possible bedding plane fractures (6-8 of them) from 226.0-227.5 ft., but these may be drilling-induced because no indication of limonitic or calcitic/gypsum coatings. Laminated and bioturbated bedding forms continued. One dense calcareous segregation (as described above) at ~227.5-227.6 ft.
225	4730			X		[Graphic Log]	
230	4725			X		[Graphic Log]	

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## BOREHOLE LOG CRJ01-0209

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0209  
**SITE** Crescent Junction Site **DATES DRILLED** 09/07/2005 to 09/27/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
235	4720			X			<p>235.0-245.0 ft. possible bedding plane fractures from 240.0-241.0 ft., but they may be drilling induced because no indication of limonitic or calcitic/gypsum coatings. Laminated and bioturbated bedding forms continued. One dense calcareous segregation at 236.4-236.5 ft. has small scale vertical fractures (~0.02 ft. long) with calcite crystal infillings and masses of fine pyrite also associated with the calcite-filled fractures. These may be related to large cephalopod fossils(?).</p>
240	4715		235.0-245.0	X			
245	4710			X			<p>245.0-255.0 ft. no apparent bedding plane fractures. Laminated and bioturbated bedding forms continued. Dense calcareous segregation at 251.0 ft. and 252.3ft., which has white amorphous calcite fragments. Segregation at 252.3 ft. is a bulge that deforms later bedding above it. Imprint of a fine (framboidal) pyrite replaced fossil in core break at 250.8 ft., fossil is ~0.05 ft. long. Trace minute amber-colored particles in bedding plane at 255.0 ft.</p>
250	4705		245.0-255.0	X	120.0-300.0 Excellent		
255	4700			X			<p>255.0-265.0 ft. no apparent bedding plane fractures. Laminated and bioturbated bedding forms continued. No layers of dense calcareous segregations noted. Imprint at 265.3 ft. of long slender coiled (flattened and mostly stretched out) cephalopod. Coiled cephalopod ~0.1 ft. diameter at 261.8 ft.</p>
260	4695		255.0-265.0	X			
265	4690			X			<p>265.0-275.0 ft. no apparent bedding plane fractures. Laminated and bioturbated bedding forms continued. No layers of dense calcareous segregations noted. Slightly calcareous throughout. Fossil imprints in bedding at 271.6 and 273.5 ft.</p>
			265.0-275.0	X			

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## BOREHOLE LOG CRJ01-0209

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0209
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 09/07/2005 to 09/27/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
275	4680		275.0-285.0	X			275.0-285.0 ft. bedding becomes more laminated with less bioturbated lenticular bedding. Slightly calcareous throughout. Rock is generally finer grained, medium dark gray (N4), generally a silty claystone, and the core fractures more easily when handling along bedding planes. At 282.5 ft. is a tight 20 degree inclined fracture with no coating on its surface. At ~280.0 ft. is an imprint of a large cephalopod. Fossil imprints are moderately abundant in this section. Fine black carbonaceous material on bedding planes.
285	4670		285.0-295.0	X	120.0-300.0 Excellent		285.0-295.0 ft. bedding planes are mostly even and laminated, bioturbation is rare. No natural fractures observed. Core breaks readily along bedding. At ~287.0 ft. is imprint of a long, narrow, coiled cephalopod; at ~295.0 ft. is an imprint of a pelecypod ~0.15 ft. diameter. Fine black carbonaceous material along bedding surfaces.
295	4660		295.0-300.0	X			295.0-300.0 ft. no natural fractures observed. Rock is hard and competent, but breaks readily along bedding surfaces. At 297.0 ft. is a large pyrite-plated mollusk imprint.
300	4655						Total Depth 300.0 ft.
305	4650						Note: When broken open, inside of core was dry throughout length of hole.

## BOREHOLE LOG CRJ01-0210

PROJECT <u>MOAB</u>	DATE DRILLED <u>08/30/2005 to 10/07/2005</u>	BIT SIZE(S) (IN) <u>8.5</u>
LOCATION <u>Crescent Junction, UT.</u>	DRILLING COMPANY <u>Layne GeoConstruction</u>	CORE SIZE(S) (IN)
SITE <u>Crescent Junction</u>	DRILLING METHOD <u>H.S.A., Rotary Core</u>	LOGGED BY <u>Goodknight, C.</u>
WELL NUMBER <u>CRJ01-0210</u>	SAMPLING METHOD <u>HQ CORE</u>	WL (FT BGS)
NORTH COORD. (FT) <u>6797035.78</u>	DRILL OPERATOR <u>Neaman, J. (CME 750), Hyleman, B. (CS1000)</u>	
EAST COORD. (FT) <u>2127690.41</u>	REMARKS <u>4-inch steel surface casing cemented to depth of 23.0 feet below</u>	
SURFACE ELEV. ( FT NGVD) <u>4998.60</u>	<u>land surface.</u>	
HOLE DEPTH (FT) <u>302.00</u>		

DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT.)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG
		2 2 4 5	0-0.5 0.5-1.0 1.0-1.5 1.5-2.0			0-3.0 ft. SILT (ML); grayish brown (10YR 5/2), highly calcareous, moderate roots, wormhole porosity, ~1-2% small rock fragments.
5	4995	9 50/5"	5.0-5.5 5.5-6.0			3.0-5.0 ft. CLAYEY SILT (ML); light brownish gray (10YR 6/2), highly calcareous, some mottling, ~2% small rock fragments.
10	4990	50/5"	10.0-10.5			5.0-10.0 ft. WEATHERED MANCOS SHALE BEDROCK; soft, highly weathered to 5.5 ft., grayish orange (10YR 7/4), highly calcareous, mostly siltstone. At 5.5-6.0 ft., is hard, very fine grained sandy dolomite, slightly calcareous, pale yellowish brown (10YR 6/2). Through sandy dolomite layer by ~7.0 ft. and into softer weathered Mancos Shale consisting mainly of siltstone, highly calcareous. @6.0 FIRST REFUSAL
15	4985		10.5-15.0			10.0-302.0 ft. MANCOS SHALE: 10.0-10.5 ft. mostly siltstone, moderately weathered, grayish orange (10YR 7/4) to pale yellowish brown (10YR 6/2), highly calcareous. 10.5-11.5 ft. No Recovery.
20	4980		15.0-20.0			11.5-15.0 ft. moderately weathered (more abundant bedding plane fractures) to ~13.5 ft. Slightly weathered below to 15.0 ft. with bedding plane fractures spaced ~0.1-0.2 ft. apart. Wavy bedding and some bioturbation. Some carbonaceous material and fine framboidal pyrite on bedding surfaces. Highly calcareous, mostly siltstone, mostly yellowish gray (5Y 7/2), gypsum crystals on some fractures. 15.0-16.8 ft. No Recovery.
25	4975		20.0-23.0			16.8-20.0 ft. moderately weathered as indicated by bedding plane fractures spaced generally <0.1 ft. apart, gypsum crystals along bedding fractures, wavy bedding and some bioturbation, yellowish gray (5Y 7/2) to medium light gray (N6), highly calcareous.
30	4970		23.0-26.0		11.0-35.0 Very Poor	20.0-21.5 ft. much softer dark shale/mudstone, dark yellowish brown (10YR 4/2 - a damp color), highly calcareous. 21.5-23.0 ft. mainly siltstone, highly calcareous, pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2), with bioturbated bedding. @22.5 ft. ~0.1 ft. thin light brown (5YR 5/6) bed, soft, highly calcareous, mostly silty claystone. From 22.6-23.0 ft. harder siltstone, bioturbated, gypsum fracture coatings, and pale yellowish brown (10YR 6/2) to dark yellowish brown (10YR 4/2), highly calcareous.
	4965		26.0-36.0			23.0-26.0 ft. moderately to highly weathered, abundant bedding plane fractures spaced about 0.02 ft. apart, bedding is bioturbated, mostly very fine grained sandstone with some siltstone, highly calcareous, trace limonitic coatings along a few bedding plane fractures, trace black carbonaceous material, fine sandstone is yellowish gray (5Y 7/2) and darker silty layers are medium gray (N5). 26.0-36.0 ft. bedding plane fractures decrease with depth to about every 0.5 ft. at 36.0 ft. Fractures at 32.6, 34.2, and 35.0 ft. have gypsum crystal fillings up to 0.01 ft. thick. A 40 degree inclined fracture at 35.3 ft. has thin white gypsum coating. Moderately calcareous throughout. Less very fine grained sandstone with depth - below ~29.0 ft. is mostly a silty claystone, medium gray (N5) with minor very light gray (N8) very fine grained sandstone filling bioturbated layers. From 26.0-29.0 ft., lithology is the same as from 23.0-26.0 ft. above. At 34.1-34.2 ft. is a thin layer of light brown (5YR 5/6) clayey siltstone with trace of black carbonaceous material; this layer is noncalcareous.

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## BOREHOLE LOG CRJ01-0210

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0210  
**SITE** Crescent Junction Site **DATES DRILLED** 08/30/2005 to 10/07/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
40	4960		36.0-46.0	X	35.0-43.0 Poor		<p>36.0-45.0 ft. fracture zone with limonitic coloration @36.7-36.9 ft. and a similar layer @38.1 ft. From ~37.0-45.0 ft. mostly siltstone, medium dark gray (N4), slightly calcareous. Fractures with thin limonitic coating at 41.3 and 42.5 ft. - no natural fractures noted below that point. Trace bioturbation and carbonaceous material. Siltstone is mostly competent, hard, and brittle. Possible vertical fracture from 41.0-41.8 ft. with no coating and is tight.</p>
45	4955			X			
50	4950		46.0-56.0	X	43.0-55.0 Fair		<p>45.0-56.0 ft. From 45.0-46.0 ft. very fine grained sandstone, medium dark gray (N4), slightly calcareous, hard, competent, trace carbonaceous material. very fine grained sandstone and about 20% siltstone. Moderately bioturbated throughout. Slightly calcareous overall, moderately calcareous in coarser (very fine grained) sandstone fills of bioturbation layers. No natural fractures noted and no limonitic coloration or films of calcite or gypsum. Rock hard and competent throughout. At ~53.6-53.7 ft. is a rounded mass ~0.15 ft. in diameter and 0.1 ft. high of moderately to highly calcareous, dense, very fine grained sandstone that is lighter colored, medium light gray (N6), than rest of rock. Trace carbonaceous material fragments.</p>
55	4945			X			
60	4940		56.0-66.0	X			<p>56.0-66.0 ft. mostly sandy siltstone - siltstone ~60% and very fine grained sandstone ~40.0%. Most sandstone is in coarser grained bioturbation fills. Moderately bioturbated throughout. Trace black carbonaceous material on bedding planes. Rock is hard and competent, no natural fractures detected, moderately calcareous. Cephalopod imprint at 61.2 ft.</p>
65	4935			X			
70	4930		66.0-76.0	X	55.0-85.0 Good		<p>66.0-76.0 ft. moderately bioturbated throughout. Fine carbonaceous material along bedding throughout. Rock hard and competent - no natural fractures detected. Moderately calcareous in coarser grained material and slightly calcareous in finer siltstone material. Fossil impressions on some bedding surfaces.</p>
75	4925			X			

## BOREHOLE LOG CRJ01-0210

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0210  
**SITE** Crescent Junction Site **DATES DRILLED** 08/30/2005 to 10/07/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
75				X			<p>76.0-86.0 ft. moderately to highly bioturbated throughout. Fine carbonaceous material along bedding, vertical fractures ~76.6 to 76.6 ft. and 82.0-82.8 ft., no fracture coatings and both are tight. Fossil impressions on some bedding planes.</p>
80	4920		76.0-86.0	X			
85	4915			X			
90	4910		86.0-96.0	X			
95	4905			X			<p>96.0-107.0 ft. about equal amounts of very fine grained sandstone and siltstone. Moderately bioturbated. Core slightly more competent but still prone to break along siltstone bedding planes. No natural fractures observed. Dry inside core when broken. Trace fossil imprints, finely divided carbonaceous material along bedding, and fine framboidal pyrite.</p>
100	4900		96.0-107.0	X	85.0-302.0 Excellent		
105	4895			X			
110	4890		107.0-117.0	X			<p>107.0-117.0 ft. moderately to highly bioturbated throughout. Approximately equal amounts of very fine grained sandstone, very light gray (N8) and siltstone, medium dark gray (N4). Core mostly hard and competent. Prone to break along siltstone bedding planes. No natural fractures observed. Dry inside core when broken. Finely divided carbonaceous material along bedding.</p>

## BOREHOLE LOG CRJ01-0210

<b>PROJECT</b> MOAB	<b>BOREHOLE NUMBER</b> CRJ01-0210
<b>SITE</b> Crescent Junction Site	<b>DATES DRILLED</b> 08/30/2005 to 10/07/2005

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
115	4885			X			
120	4880		117.0-127.0	X			117.0-127.0 ft. same as above interval.
125	4875			X			
130	4870		127.0-137.0	X	85.0-302.0 Excellent		127.0-137.0 ft. light colored, very fine grained sand in bioturbated layers can be as much as 0.1 ft. thick. Slightly calcareous throughout. Dry inside when broken.
135	4865			X			
140	4860		137.0-147.0	X			137.0-147.0 ft. fossil impression at 137.0 ft. Below about 140.0 ft., finer grained overall - generally siltstone, with only about 10-20% very fine grained sandstone that depicts bioturbated layers. Slightly calcareous throughout. More fine carbonaceous material along bedding. Bedding more laminated and less bioturbated. Calcareous material layer as a fossil impression at ~139.5 ft.
145	4855			X			
150	4850		147.0-157.0	X			147.0-157.0 ft. bioturbated layers become increasingly rare. Rock is hard and competent, no natural fractures observed. Rock is generally medium dark gray (N4), slightly calcareous, and is a clayey siltstone. Flattened cephalopods and pelecypods occur in a few bedding planes. Finely divided carbonaceous material seen in shallower parts of hole is nearly absent here.

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## BOREHOLE LOG CRJ01-0210

<b>PROJECT</b> <u>MOAB</u>	<b>BOREHOLE NUMBER</b> <u>CRJ01-0210</u>
<b>SITE</b> <u>Crescent Junction Site</u>	<b>DATES DRILLED</b> <u>08/30/2005 to 10/07/2005</u>

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DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
155	4845			X			
160	4840		157.0-167.0	X			157.0-167.0 ft. @160.0-164.0 ft., thin laminated (fissile) bedding in Mancos becomes less competent allowing it to fracture along bedding easily. Light-colored very fine grained sandstone to siltstone that defines the bioturbated layers composes only ~5% of the rock in this interval.
165	4835			X			
170	4830		167.0-177.0	X	85.0-302.0 Excellent		167.0-177.0 ft. competent, hard rock throughout. Most bedding is laminated (parallel) and only <5% bioturbated bedding. Slightly calcareous throughout. Mostly medium dark gray (N4) clayey siltstone to silty claystone. Parts of flattened cephalopods along a few bedding planes.
175	4825			X			
180	4820		177.0-187.0	X			177.0-187.0 ft. core is mostly intact initially throughout, but breaks readily due to its fissile character upon handling and drying. Rock is mostly silty claystone with moderately abundant imprints of fossils on bedding planes. Dry inside core when broken.
185	4815			X			
190	4810			X			187.0-197.0 ft. essentially same as last interval. Rare bioturbated layers.

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## BOREHOLE LOG CRJ01-0210

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0210  
**SITE** Crescent Junction Site **DATES DRILLED** 08/30/2005 to 10/07/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	ROD Description from core (FT)	GRAPHIC LOG	
195	4805		187.0-197.0	X			
200	4800		197.0-207.0	X			197.0-207.0 ft. rock somewhat coarser grained and is mostly clayey siltstone. Core much less prone to break upon handling - much more competent and hard. Fossil imprints moderately common along bedding. Only trace bioturbated bedding; most bedding is parallel.
205	4795		197.0-207.0	X			
210	4790		207.0-217.0	X	85.0-302.0 Excellent		207.0-217.0 ft. unchanged from 197.0-207.0 ft. interval. Large cephalopod imprint at ~210.0 ft.
215	4785		207.0-217.0	X			
220	4780		217.0-227.0	X			217.0-227.0 ft. unchanged from 197.0-207.0 ft. above. Core more prone to fracturing from ~218.0-220.0 ft. indicating greater fissility and possibly more claystone facies.
225	4775		217.0-227.0	X			
230	4770		217.0-227.0	X			227.0-237.0 ft. mostly silty claystone. Core is competent when first out in core barrel, but soon fractures along fissile bedding planes. Slightly calcareous throughout. Trace fine carbonaceous material on bedding planes. Trace amber in some bedding planes. Bioturbation present but <5% of bedding planes. Core dry inside when broken.

## BOREHOLE LOG CRJ01-0210

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0210  
**SITE** Crescent Junction Site **DATES DRILLED** 08/30/2005 to 10/07/2005

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DEPTH (FT BGL)	ELEV (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
235	4765		227.0-237.0	X			
240	4760			X			237.0-247.0 ft. same as above interval.
245	4755		237.0-247.0	X			
250	4750			X			247.0-257.0 ft. unchanged from above interval (227.0-237.0 ft.). Bedding appears to dip ~5-7 degrees from horizontal throughout.
255	4745		247.0-257.0	X	85.0-302.0 Excellent		
260	4740			X			257.0-267.0 ft. unchanged from above interval (227.0-237.0 ft.). Core nearly unbroken initially. Fissile interval ~0.2 ft. thick at ~264.0 ft. that breaks easily. Bioturbation layers expressed as very light gray (N8) color and are ~1-2% of layering.
265	4735		257.0-267.0	X			
270	4730			X			267.0-279.0 ft. essentially unchanged from 227.0-237.0 ft. interval. Bioturbation ~1% or less of bedding - some of the coarser grained layering may be due to storm events rather than bioturbation. Thin fissile interval at ~271.0 ft. Weakly calcareous throughout. Trace fossil imprints - one large flattened cephalopod at ~ 270.7 ft. Trace very fine (framboidal) pyrite and amber.

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## BOREHOLE LOG CRJ01-0210

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0210  
**SITE** Crescent Junction Site **DATES DRILLED** 08/30/2005 to 10/07/2005

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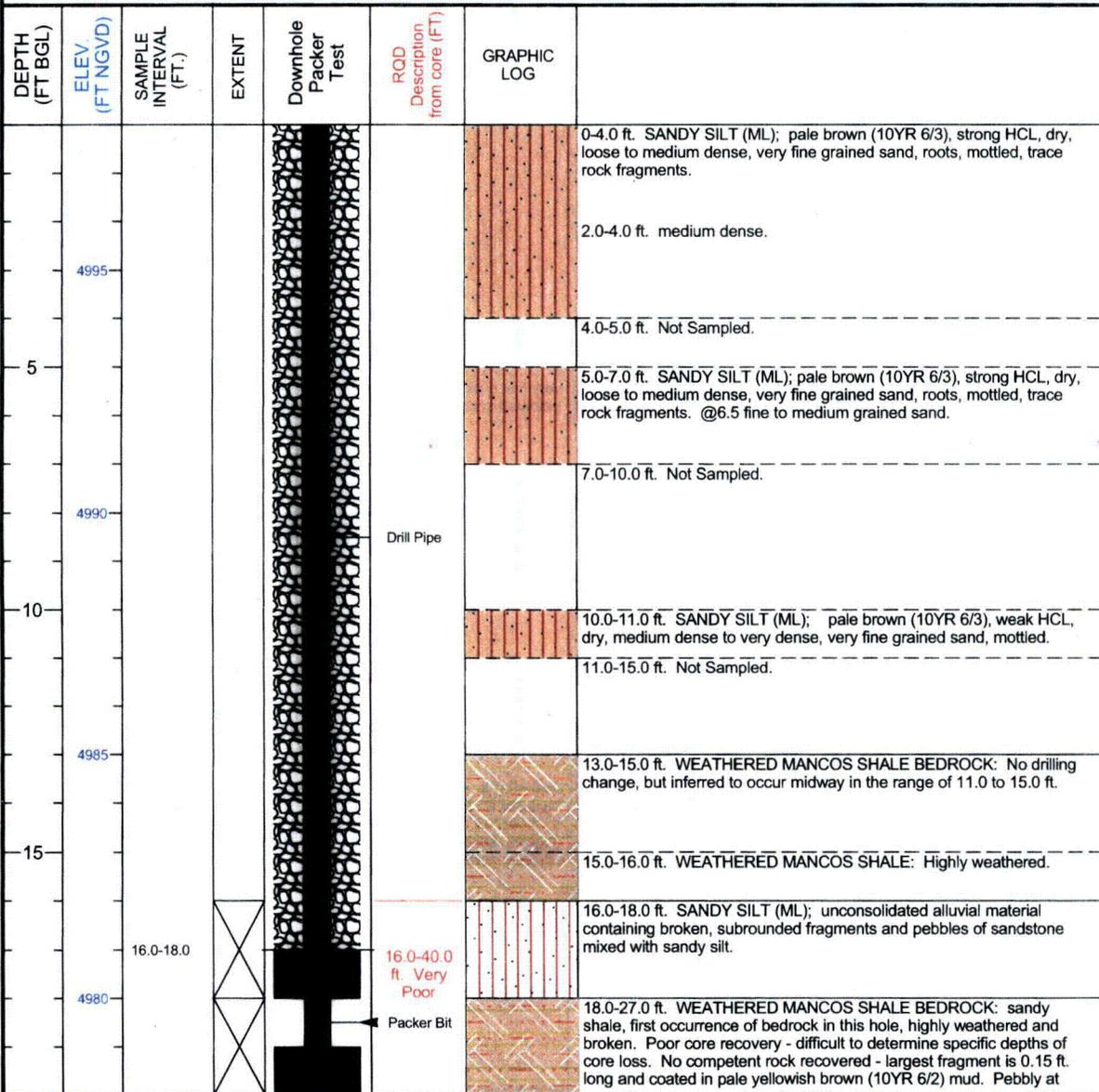
DEPTH (FT BGL)	ELEV. (FT NGVD)	BLOW COUNTS	SAMPLE INTERVAL (FT)	EXTENT	RQD Description from core (FT)	GRAPHIC LOG	
-275	4725		267.0-277.0	X			
-280	4720			X			279.0-289.0 ft. unchanged from 227.0-237.0 ft. interval. Thin fissile interval at ~282.5 ft. (~0.2 ft. thick). Trace of fossil imprints throughout.
-285	4715		279.0-289.0	X	85.0-302.0 Excellent		
-290	4710			X			289.0-299.0 ft. unchanged from 227.0-237.0 ft. interval. Bioturbated/storm event layers of very fine grained sandstone are ~1% of layers, which may be up to 0.02 ft. thick.
-295	4705		289.0-299.0	X			
-300	4700		299.0-302.0	X			299.0-302.0 ft. unchanged from 227.0-237.0 ft. interval. Small flattened cephalopod fossil imprint at 301.0 ft.
-305	4695						Total Depth 302.0 ft. Note: Core is dry throughout length of hole when broken open.
-310	4690						

**Appendix B**

**Borehole Logs for Packer Testing**

## BOREHOLE LOG CRJ01-0211

PROJECT <u>MOAB</u>	DATE DRILLED <u>11/20/2005 to 11/22/2005</u>	BIT SIZE(S) (IN) <u>4.0</u>
LOCATION <u>Crescent Junction, UT.</u>	DRILLING COMPANY <u>Layne GeoConstruction</u>	CORE SIZE(S) (IN) <u>3.0</u>
SITE <u>Crescent Junction</u>	DRILLING METHOD <u>Casing Advance/HQ Core</u>	LOGGED BY <u>Rupp, R.</u>
WELL NUMBER <u>CRJ01-0211</u>	SAMPLING METHOD <u>HQ CORE</u>	WL (FT BGS)
NORTH COORD. (FT) <u>6796327.81</u>	DRILL OPERATOR <u>Hyleman, B.</u>	
EAST COORD. (FT) <u>2123173.42</u>	REMARKS <u>Packer test location approximately 10 ft. west of borehole 0026.</u>	
SURFACE ELEV. ( FT NGVD) <u>4998.00</u>	Log for borehole 0026 used for 0-16.0 ft.	
HOLE DEPTH (FT) <u>40.00</u>		



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## BOREHOLE LOG CRJ01-0211

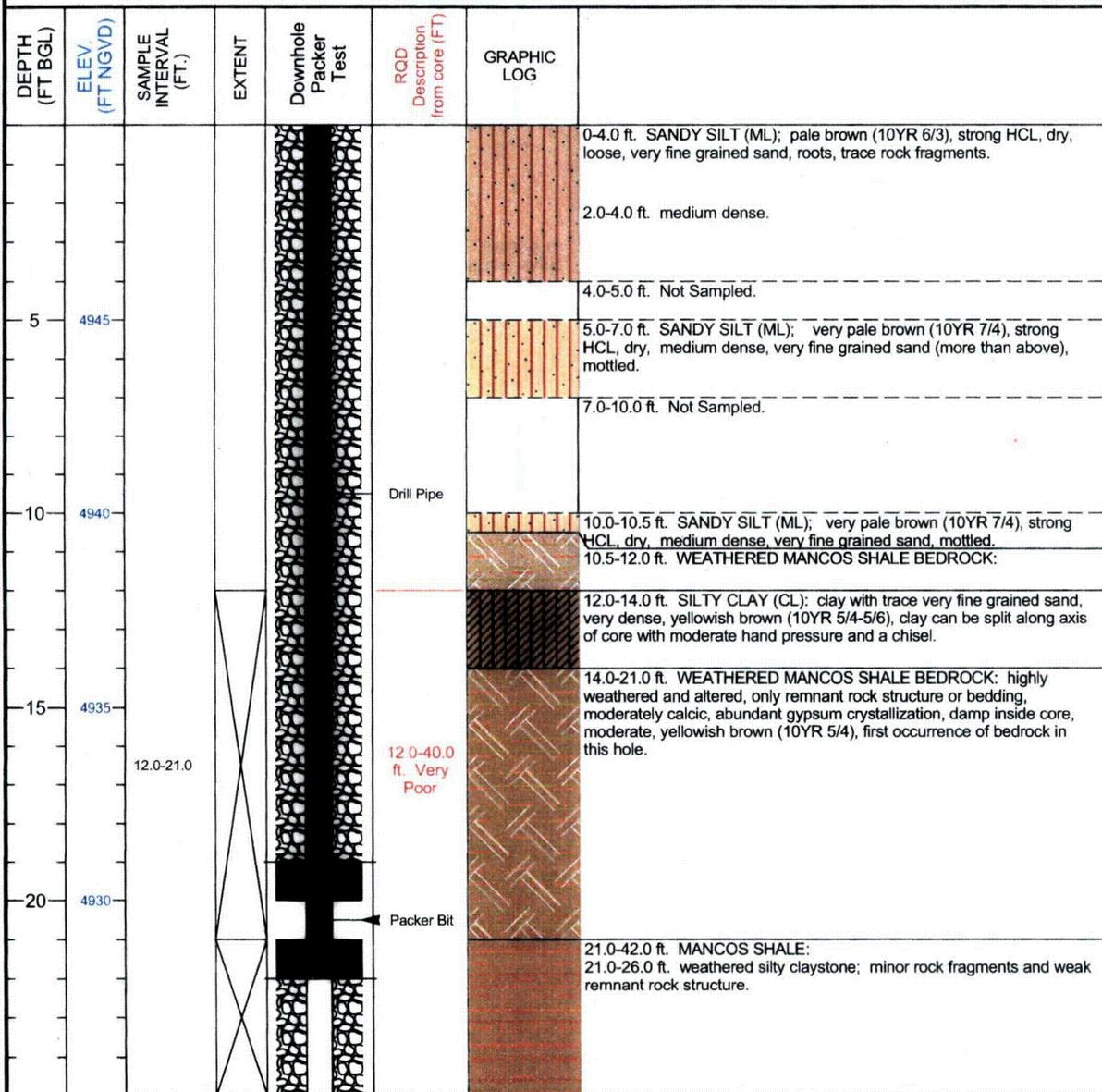
PROJECT	MOAB	BOREHOLE NUMBER	CRJ01-0211
SITE	CRJ01-0211	DATES DRILLED	11/20/2005 to 11/22/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	SAMPLE INTERVAL (FT)	EXTENT	Downhole Packer Test	ROD Description from core (FT)	GRAPHIC LOG	
		18.0-27.0					bottom of run.
25	4975				Test Zone #1 20-30'		
	4970	27.0-30.0			16.0-40.0 ft. Very Poor		27.0-40.0 ft. MANCOS SHALE: 27.0-30.0 ft. Sandy, silty shale, soft, thinly bedded, limonite-stained, very fine grained subrounded to rounded quartz sand, moderate yellowish brown (10YR 5/4) to dark yellowish brown (10YR 4/2).
30							30.0-36.0 ft. Sandy shale, very broken and highly weathered (as above) with 60% silty sandy clay mud - few shale fragments of any size - usually angular fragments (up to 0.15 ft. wide), moderate yellowish brown (10YR 5/4).
	4965	30.0-36.0			Test Zone #2 30-40'		
35							36.0-40.0 ft. very broken and moderately weathered shale, sandy, fractured on bedding with longest piece of competent rock about 0.15 ft., moderate yellowish brown (10YR 5/4), dip of bedding is about 5 degrees, some iron staining but no gypsum crystallization as it was probably washed out.
40	4960	36.0-40.0					
Total Depth 40.0 ft.							

## BOREHOLE LOG CRJ01-0212

PROJECT <u>MOAB</u>	DATE DRILLED <u>11/22/2005 to 11/30/2005</u>	BIT SIZE(S) (IN) <u>4.0</u>
LOCATION <u>Crescent Junction, UT.</u>	DRILLING COMPANY <u>Layne GeoConstruction</u>	CORE SIZE(S) (IN) <u>3.0</u>
SITE <u>Crescent Junction</u>	DRILLING METHOD <u>Casing Advance/HQ Core</u>	LOGGED BY <u>Rupp, R.</u>
WELL NUMBER <u>CRJ01-0212</u>	SAMPLING METHOD <u>HQ CORE</u>	WL (FT BGS)
NORTH COORD. (FT) <u>6794311.80</u>	DRILL OPERATOR <u>Hyleman, B.</u>	
EAST COORD. (FT) <u>2123552.99</u>	REMARKS <u>Packer test location approximately 6.0 ft. east of borehole 0041.</u>	
SURFACE ELEV. ( FT NGVD) <u>4950.00</u>	Log for borehole 0041 used for 0-12.0 ft.	
HOLE DEPTH (FT) <u>42.00</u>		



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## BOREHOLE LOG CRJ01-0212

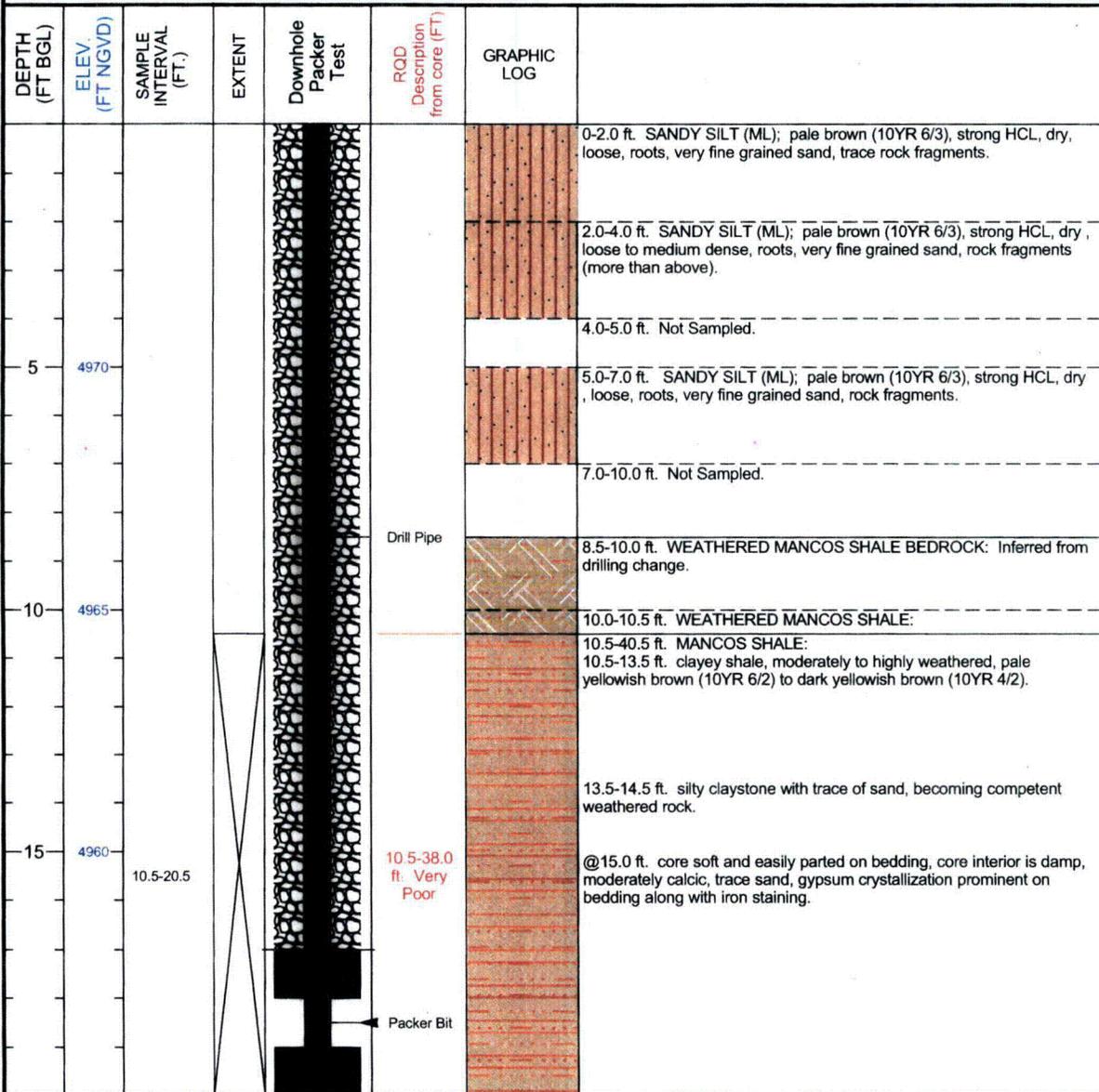
**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0212  
**SITE** CRJ01-0212 **DATES DRILLED** 11/22/2005 to 11/30/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	SAMPLE INTERVAL (FT)	EXTENT	Downhole Packer Test	RQD Description from core (FT)	GRAPHIC LOG	
		21.0-31.0			12.0-40.0 ft. Very Poor		26.0-31.0 ft. gray decrepit shale, poor rock structure and bedding, parts easily on bedding and has significant gypsum mineralization and crystals on bedding fractures, usually filling the openings. Damp to dry and friable, core is stuck to liner and crumbles during removal and placement into core box.
30	4920				Test Zone #1 22-30'		31.0-36.0 ft. very weathered and broken shale, calcic, yellowish brown (10YR 5/4) to olive gray (5Y 4/1). Core loss from 31.0 to 32.0 ft., which is extremely fragmented and broken rock. Clayey from 34.0-35.0 ft. From 35.0-35.5 ft. gypsum infilling on bedding fracture, some limonitic alteration throughout.
35	4915	31.0-36.0					36.0-42.0 ft. very weathered and broken. Clay alteration at 36.0 to 38.5 ft. Slightly more competent, but fissile at 38.5 to 40.8 ft. Most competent weathered rock at 40.8 to 42.0 ft., but has heavy iron alteration and gypsum crystallization on bedding.
40	4910	36.0-42.0			40.0-42.0 ft. Poor		
Total Depth 42.0 ft.							
45	4905						
50	4900						

## BOREHOLE LOG CRJ01-0213

<b>PROJECT</b> MOAB	<b>DATE DRILLED</b> 12/01/2005 to 12/02/2005	<b>BIT SIZE(S) (IN)</b> 4.0
<b>LOCATION</b> Crescent Junction, UT.	<b>DRILLING COMPANY</b> Layne GeoConstruction	<b>CORE SIZE(S) (IN)</b> 3.0
<b>SITE</b> Crescent Junction	<b>DRILLING METHOD</b> Casing Advance/HQ Core	<b>LOGGED BY</b> Rupp, R.
<b>WELL NUMBER</b> CRJ01-0213	<b>SAMPLING METHOD</b> HQ CORE	<b>WL (FT BGS)</b>
<b>NORTH COORD. (FT)</b> 6795880.41	<b>DRILL OPERATOR</b> Hyleman, B.	
<b>EAST COORD. (FT)</b> 2125591.86	<b>REMARKS</b> Packer test location approximately 6.0 ft. east of borehole 0079.	
<b>SURFACE ELEV. ( FT NGVD)</b> 4975.00	Log for borehole 0079 used for 0-10.5 ft.	
<b>HOLE DEPTH (FT)</b> 40.50		



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# BOREHOLE LOG CRJ01-0213

**PROJECT** MOAB **BOREHOLE NUMBER** CRJ01-0213  
**SITE** CRJ01-0213 **DATES DRILLED** 12/01/2005 to 12/02/2005

*Continued from Previous Page*

DEPTH (FT BGL)	ELEV. (FT NGVD)	SAMPLE INTERVAL (FT)	EXTENT	Downhole Packer Test	RQD Description from core (FT)	GRAPHIC LOG	
25	4950	20.5-30.5	X	X	10.5-38.0 ft. Very Poor		<p>20.5-30.5 ft. clayey shale, weathered, fissile, bedded, damp, most of run is stuck to the core barrel liner and must be pried off, thus crumbling into soil-like particles and clumps and losing all rock integrity and structure. Limonite and gypsum mineralization is well developed. Strongly calcic in places.</p>
30	4945		X	X	Test Zone #1 20-30'		
35	4940	30.5-38.5	X	X	Test Zone #2 30-40'		<p>30.5-40.5 ft. silty claystone with trace of very fine grained sand, moderately weathered, rock becoming more competent. Limonitic and gypsum mineralization on bedding planes. At 36.0 ft., fracture 40 degrees inclined to core axis that is gypsum filled. Other fractures are about 80 degrees inclined to core axis throughout run. Core easily parted, fissile sections are crumbly.</p>
40	4935	38.5-40.5	X	X	38.0-40.5 ft. Poor		
Total Depth 40.5 ft.							

U.S. Department of Energy—Grand Junction, Colorado

Calculation Cover Sheet

Calc. No.: MOA-02-03-2006-1-11-00  
Doc. No.: X0155900

Discipline: Geologic and  
Geophysical Properties

No. of Sheets: 8

Location: Attachment 5 Vol. I, Appendix B

Project: Moab UMTRA Project

Site: Crescent Junction, Utah

Feature: Borehole Logs for the Crescent Junction Site

Sources of Data:

Borehole logs

Sources of Formulae and References:

DOE (U.S. Department of Energy), 2005. *Work Plan for Characterization of Crescent Junction Disposal Site*, DOE-EM/GJ912-2005, August 12.

Preliminary Calc.

Final Calc.

Supersedes Calc. No.

Author:

RKH 31 May 07  
Name Date

Checked by:

S. Gray 5/30/07  
Name Date

Approved by:

Kend Kay 5/31/07  
Name Date

Ring Gooding 31 May 07  
Name Date

Paul Kauter 5-31-07  
Name Date

D. Metz MAY 31, 07  
Name Date

No text for this page

## **Problem Statement:**

Preliminary site selection performed jointly by the U.S. Department of Energy (DOE) and the Contractor has identified a 2,300-acre withdrawal area in the Crescent Flat area just northeast of Crescent Junction, Utah, as a possible site for a final disposal cell for the Moab uranium mill tailings. The proposed disposal cell would cover approximately 250 acres. Based on the preliminary site-selection process, the suitability of the Crescent Junction disposal site is being evaluated from several technical aspects, including geomorphic, geologic, hydrologic, seismic, geochemical, and geotechnical. The objective of this calculation set is to present the geotechnical borehole logs generated during the drilling program to investigate subsurface geologic conditions at the Crescent Junction Disposal Site.

This calculation will be incorporated into Attachment 2 (Geology) of the Remedial Action Plan and Site Design for Stabilization of Moab Title I Uranium Mill Tailings at the Crescent Junction, Utah, Disposal Site (RAP), and summarized in the appropriate sections of the Remedial Action Selection (RAS) report for the Moab Site.

## **Method of Solution:**

One hundred geotechnical boreholes were drilled to depths of up to 25.75 feet (ft) through the surficial unconsolidated material into the shallow weathered Mancos Shale as shown in Figure 1 and Table 1. These were drilled by Layne GeoConstruction using hollow-stem auger (HSA) with split-barrel sampling. The bit size was 8 inches, with sample diameter at 2.5 inches. Borehole termination was at depth of blow count refusal in the weathered Mancos Shale. Samples were logged in the field using visual soil-classification procedures described in the *Work Plan for Characterization of Crescent Junction Disposal Site* (DOE 2005, pp.4-6). Field logs were digitized and standardized using the gINT computer software program (gINT Software USA 2005). Appendix A contains the borehole logs for the Crescent Junction Site. These data are also available in the SEEPro database at the DOE Grand Junction office.

## **Assumptions:**

N/A

## **Calculation:**

N/A

## **Discussion:**

Results and evaluation of the borehole drilling activities at the Crescent Junction Disposal Site during 2005 are discussed in detail in Attachment 2 (Geology) of the RAP and summarized in relevant sections of the RAS.

## **Conclusion and Recommendations:**

N/A

## **Computer Source:**

gINT computer software (2005) was used to digitize and standardize all field-generated drill logs.

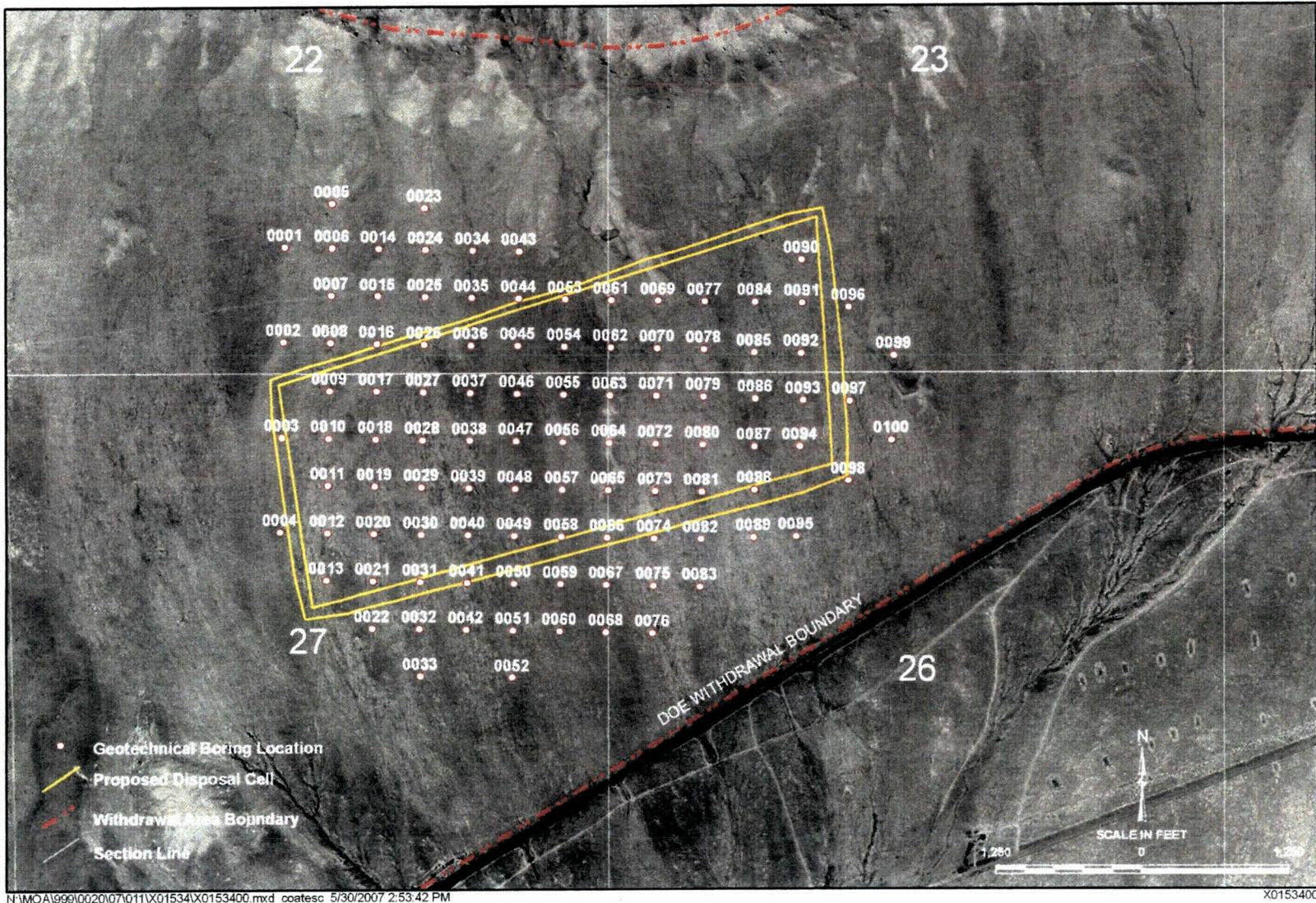


Figure 1. Location of Boreholes at the Crescent Junction Site

Table 1. Borehole Specifications at the Crescent Junction Site

Borehole No.	N Coordinate <sup>a</sup>	E Coordinate <sup>a</sup>	Ground Elevation (ft ngvd) <sup>b</sup>	Total Depth (ft)	Date Completed	Geophysical Logs	Hole Size (in)	Casing (ft)	Sample Type	Drilling Method <sup>c</sup>
CRJ01-0001	6797154.03	2121993.62	5019.50	20.00	4-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0002	6796350.68	2121978.38	4996.90	20.75	4-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0003	6795547.32	2121963.14	4977.70	15.80	4-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0004	6794743.96	2121947.90	4962.50	15.80	3-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0005	6797522.39	2122396.60	5030.60	10.80	3-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0006	6797146.41	2122395.30	5019.30	15.60	3-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0007	6796744.73	2122387.68	5008.40	15.75	3-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0008	6796343.05	2122380.06	4997.50	15.80	3-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0009	6795941.38	2122372.44	4988.30	10.40	3-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0010	6795539.70	2122364.82	4978.90	10.80	3-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0011	6795138.02	2122357.20	4969.50	15.80	3-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0012	6794736.34	2122349.58	4961.40	11.00	3-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0013	6794334.66	2122341.96	4954.10	11.00	2-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0014	6797138.79	2122796.98	5021.00	25.50	2-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0015	6796737.11	2122789.36	5009.20	20.75	2-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0016	6796335.43	2122781.74	4997.60	20.40	2-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0017	6795933.76	2122774.12	4987.70	15.90	2-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0018	6795532.08	2122766.50	4978.50	15.30	2-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0019	6795130.40	2122758.88	4969.70	11.00	2-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0020	6794728.72	2122751.26	4960.90	10.50	1-Nov-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0021	6794327.04	2122743.63	4952.80	10.75	27-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0022	6793925.37	2122736.02	4945.40	10.50	27-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0023	6797485.70	2123187.03	5035.50	11.40	27-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0024	6797131.17	2123198.66	5023.30	20.30	26-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0025	6796729.49	2123191.04	5010.10	25.75	26-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0026	6796327.81	2123183.42	4997.90	16.00	26-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0027	6795926.14	2123175.80	4987.60	20.50	26-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0028	6795524.46	2123168.17	4977.30	21.00	26-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0029	6795122.78	2123160.56	4967.80	30.40	26-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0030	6794721.10	2123152.93	4959.00	20.75	25-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0031	6794319.42	2123145.31	4951.60	15.75	25-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0032	6793917.75	2123137.69	4944.10	11.00	25-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0033	6793515.74	2123147.56	4936.80	10.75	25-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0034	6797123.55	2123600.34	5021.80	15.50	25-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0035	6796721.87	2123592.71	5009.00	15.25	25-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0036	6796320.19	2123585.09	4997.40	20.40	25-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0037	6795918.52	2123577.47	4985.90	20.40	25-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0038	6795516.84	2123569.85	4975.30	15.75	24-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0039	6795115.16	2123562.23	4966.90	20.75	24-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0040	6794713.48	2123554.61	4957.60	20.50	24-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0041	6794311.80	2123546.99	4949.80	12.00	23-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0042	6793910.12	2123539.37	4941.90	16.00	23-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0043	6797115.93	2124002.01	5018.70	11.00	23-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0044	6796714.25	2123994.39	5006.40	11.00	23-Oct-05	no	8.5	n/a	SS 2.5"	HSA

Table 1 (continued). Borehole Specifications at the Crescent Junction Site

Borehole No.	N Coordinate <sup>a</sup>	E Coordinate <sup>a</sup>	Ground Elevation (ft ngvd) <sup>b</sup>	Total Depth (ft)	Date Completed	Geophysical Logs	Hole Size (in)	Casing (ft)	Sample Type	Drilling Method <sup>c</sup>
CRJ01-0045	6796312.57	2123986.77	4993.60	11.00	23-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0046	6795910.90	2123979.15	4985.00	15.60	23-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0047	6795509.22	2123971.53	4974.40	15.50	23-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0048	6795107.54	2123963.91	4964.40	16.50	23-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0049	6794705.86	2123956.29	4955.80	17.00	23-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0050	6794304.18	2123948.67	4948.00	20.50	22-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0051	6793902.50	2123941.05	4940.30	11.00	22-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0052	6793500.83	2123933.43	4933.50	15.75	22-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0053	6796706.63	2124396.07	5007.70	10.40	22-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0054	6796304.95	2124388.45	4993.10	11.25	22-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0055	6795903.27	2124380.83	4982.10	11.75	22-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0056	6795501.60	2124373.21	4972.60	11.80	21-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0057	6795099.92	2124365.59	4962.90	15.75	21-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0058	6794698.24	2124357.97	4954.10	15.50	21-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0059	6794296.56	2124350.35	4946.20	20.50	21-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0060	6793894.88	2124342.73	4938.10	12.00	21-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0061	6796699.01	2124797.75	5002.00	10.70	21-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0062	6796297.33	2124790.13	4989.10	10.50	21-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0063	6795895.65	2124782.51	4979.80	7.00	21-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0064	6795493.98	2124774.89	4973.80	6.00	20-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0065	6795092.30	2124767.27	4960.90	5.80	20-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0066	6794690.62	2124759.65	4952.60	10.80	20-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0067	6794288.94	2124752.02	4944.70	10.20	20-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0068	6793887.26	2124744.40	4936.60	10.50	20-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0069	6796691.39	2125199.43	4996.80	7.00	20-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0070	6796289.71	2125191.81	4986.90	21.00	20-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0071	6795888.03	2125184.19	4976.90	11.00	20-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0072	6795486.36	2125176.56	4967.30	11.50	20-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0073	6795084.68	2125168.94	4959.50	11.00	19-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0074	6794683.00	2125161.32	4950.90	6.50	19-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0075	6794281.32	2125153.70	4941.70	10.75	19-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0076	6793879.64	2125146.08	4933.90	10.50	19-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0077	6796683.77	2125601.10	4997.10	10.75	19-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0078	6796282.09	2125593.48	4985.50	15.50	19-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0079	6795880.41	2125585.86	4974.86	10.70	19-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0080	6795478.74	2125578.24	4966.70	15.70	19-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0081	6795077.06	2125570.62	4958.00	16.00	18-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0082	6794675.38	2125563.00	4949.10	16.75	18-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0083	6794273.70	2125555.38	4941.00	10.70	13-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0084	6796681.41	2126032.90	4993.00	11.00	12-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0085	6796253.92	2126024.79	4982.60	16.50	12-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0086	6795863.61	2126033.25	4972.90	16.00	12-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0087	6795461.93	2126025.63	4963.00	11.50	12-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0088	6795092.63	2126024.46	4954.90	16.50	12-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0089	6794690.96	2126016.84	4947.00	20.70	12-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0090	6797038.22	2126429.83	4999.40	15.50	11-Oct-05	no	8.5	n/a	SS 2.5"	HSA

Table 1 (continued). Borehole Specifications at the Crescent Junction Site

Borehole No.	N Coordinate <sup>a</sup>	E Coordinate <sup>a</sup>	Ground Elevation (ft ngvd) <sup>b</sup>	Total Depth (ft)	Date Completed	Geophysical Logs	Hole Size (in)	Casing (ft)	Sample Type	Drilling Method <sup>c</sup>
CRJ01-0091	6796673.79	2126434.58	4990.20	10.80	11-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0092	6796246.30	2126426.47	4980.40	15.50	11-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0093	6795850.05	2126440.65	4971.00	20.70	11-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0094	6795460.44	2126411.56	4961.80	21.50	10-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0095	6794697.78	2126376.72	4945.50	15.75	10-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0096	6796636.02	2126834.80	4988.50	20.50	10-Oct-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0097	6795842.42	2126842.33	4969.40	19.70	27-Sep-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0098	6795171.16	2126829.42	4954.30	20.00	27-Sep-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0099	6796226.49	2127221.52	4977.40	9.75	26-Sep-05	no	8.5	n/a	SS 2.5"	HSA
CRJ01-0100	6795514.03	2127198.93	4961.20	12.50	26-Sep-05	no	8.5	n/a	SS 2.5"	HSA

<sup>a</sup>Local coordinate system based on modified state plane coordinate system NAD 83 Utah Central Zone.

<sup>b</sup>ngvd = National geodetic vertical datum

<sup>c</sup>HSA = Hollow stem auger

End of current text