APPENDIX A

Strike Valley Section
Cedar Mountain Formation measured by Douglas A. Sprinkel and Elizabeth Balls, August 22, 2000; Dakota Formation measured by Douglas A. Sprinkel and Scott K. Madsen, June 9, 2005
Along US Highway 191 between Steinaker and Red Fleet Reservoirs
N 40° 34.011' W 109° 29.930'

DESCRIPTION	THICKNESS (METERS)	
Dakota Formation	**Interval**	**Cumulative**
Unit 17 – Sandstone and mudstone. Sandstone is yellow-gray to white, fine- to-coarse-grained with lenses of pebble conglomerate, black chert, and white quartz grains, well-sorted, angular to subangular grains, thick-bedded, planar cross-bedding; interbedded mudstone, medium-gray, silty	16.6	24.4
Unit 16 – Mudstone, dark-gray, carbonaceous, contains petrified wood fragments, blocky, slightly silty; sample **SV042605-1** is composite sample collected from near base and from near the top of the mudstone unit (middle to late Albian swamp/deltaic); samples **SKM-1 through SKM-7** were collected about 1 meter apart along a trench dug the length of the unit (SKM-1 through SKM-4, middle to late Albian swamp/deltaic and SKM-6 and SKM-7, late Albian swamp deltaic)	5.8	7.8
Unit 15 – Sandstone and mudstone; sandstone is light-yellow-gray, fine-grained, white quartz grains, well-sorted, angular to subangular grains, non-calcareous, thin-bedded, low-angle cross-bedding; this unit has three subunits of lower resistant sandstone, middle friable sandstone that is orange-yellow stained near top, and upper resistant sandstone	1.8	2.0
Unit 14 – Shale, dark-gray, siliceous, fissile; sample **SV082200-2 and SV060806-2** (middle to late Albian; nearshore marine to estuarine)	0.2	0.2
Cedar Mountain Formation		
Unit 13 – Claystone, purplish-red to green, scattered sand-size grains, non-calcareous to slightly calcareous, blocky; some beds have mudcracks on bedding surface of less silty beds, slight popcorn texture in clay-rich zones, becoming more clay-rich near the top	8.9	35.7
Unit 12 – Siltstone, medium- to dark-gray, contains scattered rounded quartz and red chert sand-size grains, non-calcareous, blocky; some beds		

have mudcracks on bedding surface, slight popcorn texture in clay-rich zones, becoming more clay-rich near the top 9.8 26.8

Unit 11 – Sandstone, purplish-red and mottled yellow, calcareous. Purple sandstone is fine- to coarse-grained, poorly sorted, conglomeratic, yellow sandstone is coarse-grained, moderately sorted 0.5 17.0

Unit 10 – Mudstone that grades upward to silty mudstone and siltstone, dark-purplish-red, non-calcareous, poorly exposed 2.9 16.5

Unit 9 – Calcrete, light-gray to light-purple-gray, dense, irregular thickness 0.3 13.6

Unit 8 – Mudstone that grades upward to silty mudstone and siltstone, dark-purplish-red, non-calcareous, poorly exposed 2.2 13.3

Unit 7 – Limestone, medium-brown-gray with slight purple cast, dense, aphanitic with scattered small dendritic dark minerals (pyrolusite) some of which are oxidized to reddish brown 0.6 11.1

Unit 6 – Mudstone, dark-brownish-gray with slight purple cast, silty, non-calcareous, weathers as small thin plates, poorly exposed 3.1 10.5

Unit 5 – Calcrete (limestone), weathers out as nodules, light-gray calcareous with concentric rind about 5 mm in diameter 0.6 7.4

Unit 4 – Mudstone and siltstone, clay-rich, purple-gray; light-gray calcareous nodules about 5 mm in diameter, poorly exposed 1.8 6.8

Unit 3 – Calcrete (limestone), weathers out as nodules, light-gray calcareous with concentric rind about 5 mm in diameter 1.5 5.0

Unit 2 – Mudstone and siltstone, clay-rich, purple-gray; light-gray calcareous nodules about 5 mm in diameter, poorly exposed 2.3 3.5

Unit 1 – Calcrete, light-gray, chert, thick-bedded, forms prominent resistant ledge; unit thickens and thins as much as 2.5 m along strike 1.2 1.2

Basal Cedar Mountain Formation is an alteration zone of varicolored mudstone with chert pebbles and thin zone of chert pebble conglomerate below contact ..... not measured

Morrison Formation

Steinaker Reservoir Section
Measured by Douglas A. Sprinkel and Elizabeth Balls, August 21, 2000
Along US Highway 191 east of Steinaker Reservoir State Park entrance
N 40° 32.031' W 109° 31.204'

DESCRIPTION	THICKNESS (METERS)	
Dakota Formation	**Interval**	**Cumulative**
Unit 11 – Sandstone, yellow-gray to light-gray, fine- to coarse-grained with lenses of conglomerate, black chert, and white quartz grains, thick-bedded, cross-bedded	16.1	53.5
Unit 10 - Mudstone, dark-gray, carbonaceous	17.4	37.4
Unit 9 - Sandstone, yellow-gray to white, fine- to medium grained, well-sorted, thin-bedded, low-angle cross-bedding	4.2	20.0
Unit 8 - Mudstone, dark-gray, carbonaceous	15.0	15.8
Unit 7 - Sandstone, light-gray to yellow-gray, coarse- to medium-grained, subrounded, moderately sorted, calcareous, thin- to medium-bedded, small-scale trough cross-beds	0.8	0.8
Cedar Mountain Formation		
Unit 6 - Siltstone and mudstone; lower half is siltstone, greenish-purple-gray to varicolored beds that grade upward to mudstone, dark-gray, non-calcareous, hard	10.4	20.9
Unit 5 - Claystone (altered ash[?]), medium-gray, contains a few scattered small subhedral biotite and possibly hornblende crystals. Sample **SR-082100-1** (barren of palynomorphs) collected from the darkest gray interval within the unit	0.6	10.5
Unit 4 - Siltstone, purplish-red, calcareous, mostly covered with light-gray popcorn-textured soil. Top 0.3 m becomes grayish-purple with abundant calcareous nodules that are 15 to 30 cm in diameter	1.8	9.9
Unit 3 - Limestone and calcrete, light-gray to light-brown, nodular weathering, thick-bedded, brecciated in part by recrystallization and secondary calcite veining	3.3	8.1

Unit 2 - Claystone and mudstone, purple-gray, gypsum crystals on surface, somewhat of a popcorn texture, poorly exposed 4.0 4.8

Unit 1 – Calcrete, light-brown-gray, nodular weathering, thick-bedded, brecciated in part by recrystallization and secondary calcite veining, thickness varies along strike 0.8 0.8

Basal Cedar Mountain is an alteration zone of varicolored mudstone with chert pebbles and thin zone of chert pebble conglomerate below contact ..... not measured

Morrison Formation

Reef Quarry Section
Measured by James I. Kirkland and Gary Hunt, June 5, 6, and 11, 2010
east of pipeline and ornithopod quarry Utah paleontological locality # Un 153 on south flank of The Reef, north of Island Park road. Measured section runs from N 40° 29'53.4" W 109° 22'3.9" up gulley to north northeast to N 40° 29'58.6" W 109° 22'1.7".

DESCRIPTION	**THICKNESS (METERS)**	
Tununk Shale Member of Frontier Formation	**Interval**	**Cumulative**
Unit 37 – Shale, medium-olive-gray, laminated, sharp lower contact with Mowry Shale	not measured	
Mowry Shale		
Unit 36 – Shale, siliceous, dark-brownish-gray, finely laminated with abundant fish scales and associated fish skeletons on many horizons, numerous orange-stained partings that may represent volcanic ashes, not examined in detail, lower contact sharp and in direct contact with pebbles	27.90	138.76
Dakota Formation		
Unit 35 – Conglomeratic sandstone, 1-3 cm chert and lithic pebbles, bedded at 20-30 cm intervals, yellow-gray to light-gray, fine- to coarse-grained with lenses of conglomerate, black chert, and white quartz grains, thick-bedded, cross-bedded	1.52	110.86
Unit 34 – Sandstone, medium-yellow-brown fine- to medium-grained, low-angle cross-beds 20-30 cm thick,	7.51	109.34
Unit 33 – Interbedded sandy coal and coaly shale, dark-olive-gray to black, abundant plant debris	3.31	101.83
Unit 32 – Sandstone, pale-grayish-yellow, medium- to coarse-grained, cross-bed set 20-40 cm thick,	2.82	98.52
Unit 31 – Interbedded sandy coal and coaly shale, dark-olive-gray to black, abundant plant debris	2.07	95.70
Unit 30 – Bentonite, pale-brown to pale-yellow; zircons were extracted with 44 of 50 grains yielding U-Pb ages between 96-109 Ma and 21 grains yielding ages between 100 and 104 Ma giving a final age of **101.4 ± 0.4 Ma** at ± 2 sigma,	0.31	93.63

Unit 29 – Interbedded sandy coal and coaly shale, dark-olive-gray to black, abundant plant debris, ... 2.05 93.32

Unit 28 – Conglomeratic sandstone, light- to medium-orangish gray with dark orange fracture staining, chert and lithic pebbles, basal 20 cm poorly consolidated with pebbles 1-2 cm and 20 cm of erosional relief, abundant plant debris 1.11 91.17

Unit 27 – Interbedded shale, siltstone, and fine sandstone at 1-5 cm scale, dark-olive-gray overall with orangish-stained partings and buff-colored sandstone layers, abundant organic debris, ... 6.12 90.06

Unit 26 – Sandstone, light-orangish-brown, fine to medium grained, low-angle cross-beds 20-40 cm thick, soft; no better indurated than shalely units above and below, few organic debris rich layers, few vertical burrows, *Skolithos*? 5.25 83.94

Cedar Mountain Formation

Unit 25 – Claystone, light-olive-gray, smectitic, poorly exposed 1.65 77.79

Unit 24 – Claystone, dark-olive-gray, olive-green, and purplish, gray slightly gritty, slightly smectitic, ornithopod dinosaur skeleton (Un 153) collected 870 cm above base of unit about 100 meters to west of measured section associated with an approximately 1 meter interval of poorly developed iron stained nodules and iron stained fractures 14.64 76.14

Unit 23 – Gritty mudstone with iron-stained carbonate nodules ~ 10 cm thick by 20-50 cm across, olive-gray 1.80 61.50

Unit 22 – Calcrete in gritty mudstone, dark-purplish-red weathering to reddish-mauve; with sandstone of unit 18 forms prominent hogback near middle of Cedar Mountain Formation in this area 3.38 60.70

Unit 21 – Gritty mudstone with small carbonate nodules, light greenish-gray 1.95 57.32

Unit 20 – Sandy mudstone, light-gray, carbonate cemented, moderately resistant, tiny mm scale oncoids 0.80 54.37

Unit 19 – Gritty mudstone like unit 17 but with fewer and smaller gray pedogenetic and palustrine carbonate nodules, dark-purplish-gray 4.70 54.57

Unit 18 – Coarse sandstone, pale-brownish-gray, sublithic arenite, trough and planar cross-bed sets 40-70 cm thick, conglomeratic lenses of chert

pebbles and lithic fragments, laterally extensive across visible outcrop belt (> 1 mile) 4.05 49.87

Unit 17 – Gritty mudstone, dark-purplish-red weathering to pale-maroon, with abundant gray pedogenetic and palustrine carbonate nodules, horizons of large septarized nodules 30-50 cm across every 0.5 - 1.0 meter on average, chert replacement along septarian fractures common 18.50 45.78

Unit 16 – Sandy mudstone, dark-reddish-brown, scattered chert pebbles ~ 1 cm, few pedogenic slickensides 1.36 27.28

Unit 15 – Sandy mudstone dark-reddish-brown, with numerous gray chert laminae and chert-replaced roots, capped by 3 cm thick chert layer 0.45 25.92

Unit 14 – Interclast conglomerate, matrix medium-purplish-red mudstone with grain supported gray angular clasts <5 mm of mudstone and siltstone, lower contact irregular with as much as 10 cm of relief 0.10 25.47

Unit 13 – Pebbly mudstone, medium-purplish-red 0.49 25.37

Unit 12 – Gritty mudstone. Light-olive-gray, with rare pebbles and scattered ash laminae 0.56 24.88

Unit 11 – Mudstone, mottled medium-red and olive-gray, pebbly, rooted, with thin ash laminae at 6 cm up and at top 0.13 24.32

Unit 10 – Bentonite(?), pale-yellowish-gray, waxy 0.06 24.19

Unit 9 – Siltstone to gritty mudstone, mottled medium-red and olive-gray, contains about 1-cm-diameter chert pebbles, a bit better indurated than mudstones below, 2 cm pale-yellowish-green claystone at base 0.33 24.13

Unit 8 – Mudstone, dark-brownish-red, few scattered 1-cm-diameter chert pebbles 0.48 23.80

Unit 7 – Mudstone, medium-purplish-red, gritty, resting on waxy parting, may represent volcanic ash. 0.17 23.32

Unit 6 – Mudstone, dark-purplish-gray in lower 50 cm, becoming medium-greenish-gray to olive-gray with rare yellow mottles up section, middle 2 meters preserves common iron-stained mottling with granules of chert common from 2-3 mm and rarely to 5 mm 6.53 23.15

Morrison Formation (not completely measured)

Unit 5 – Indurated siltstone "porcellanite," similar to some altered volcanic ashes, zircons small (mostly < than 30 microns) and rounded, laser ablation for U-Pb dating revealed a suite of Upper Jurassic (153.05 ± 3.69 Ma at ± 2 sigma) and many Precambrian grains typical of the detrital zircon suites from the Morrison Formation; because of the fine grain size unit is reinterpreted as a loessite derived from wind deflation of the Morrison Formation	0.66	16.62
Unit 4 – Mudstone, medium-purplish-gray weathering to pale-mauve, some yellow staining on fractures, deeply weathered	4.5	15.96
Unit 3 – Claystone-mudstone, moderate-red with some minor yellow staining, smectitic(?), poorly exposed	5.83	11.46
Unit 2 – Conglomerate and coarse sandstone, somewhat fining upward with decreasing cross-bed set thickness from 50 to 20 cm, lithic and chert pebbles purple	1.74	5.53
Unit 1 – Smectitic claystone-mudstone, pale at base darkening to medium-dark-red, upper 10 cm bleached to pale-greenish-gray	3.79	3.79
Unit 0 – Coarse sandstone, pale-yellow-gray, trough cross-bedded, some lithic pebbles, lenticular (several meters across), forms hogback	not measured	

Pipeline Access Section
Measured by Scott K. Madsen and Dale Gray, October 24, 2006
West of pipeline access road, south of Island Park road, west nose of Split Mountain anticline; N 40° 28.360' W 109° 22.539'

DESCRIPTION	**THICKNESS (METERS)**	
Dakota Formation	**Interval**	**Cumulative**
Unit 10 – Sandstone, yellow-gray to light-gray, fine- to coarse-grained with lenses of conglomerate, black chert, and white quartz grains, thick-bedded, cross-bedded	4.9	37.2
Unit 9 – Covered and slope-forming interval; likely mudstone dominated	14.3	32.3
Unit 8 – Sandstone, yellow-gray to light-gray, fine-grained	1.0	18.0
Unit 7 – Mudstone, light- to dark-gray, carbonaceous, non-calcareous, contains root casts near base; sample **SKM102406-1** collected 15 cm above base of unit and **SKM102406-2** collected 50 cm above base of unit (both samples barren)	3.3	17.0
Unit 6 – Sandstone, light-brown (buff) to greenish-gray, fine-grained, non-calcareous	1.2	13.7
Unit 5 – Mudstone, light-brown to light-gray, silty, non-calcareous, bentonitic; section was too wet to trench but looked to contain carbonaceous material (one test hole revealed sandstone stringer)	3.7	12.5
Unit 4 – Sandstone, light-brown, light-gray to gray, weathers light-brown to pink, non-calcareous, fine-grained, bed thickens laterally to west from 0.5 to 1.0 m (this sandstone unit caps previously sampled mudstone interval)	0.3	8.8
Unit 3b – Shale, dark-gray to black, fissile, **PA060806-3** collected at top of unit (middle to late Albian nearshore marine to estuarine)	1.0	8.5
Unit 3a– Mudstone, black, highly carbonaceous; two samples collected from this unit; **PA060806-1** collected at base of unit (middle Albian to early late Albian swamp-deltaic), **PA060806-2** collected about 3 m from base of unit (middle to late Albian nearshore marine to estuarine)	5.0	7.5
Unit 2 – Sandstone, light-brown, poorly exposed (was not trenched because section was too wet), untrenched surface has pebbly and lignitic appearance	1.0	2.5

Cedar Mountain Formation (not completely measured)

Unit 1 – Mudstone, purple 1.5 1.5

Dinosaur National Monument - DNM 16 (sauropod locality)
Measured by Scott K. Madsen, October 2001
Started just west of DNM 16 on north side of hogback at highest white sandstone in Morison Formation; strike 68° W, dip 64° south

DESCRIPTION	THICKNESS (METERS)	
Dakota Formation	**Interval**	**Cumulative**
Unit 42 – Sandstone, yellow-gray to light-gray, fine- to coarse-grained with pebble conglomerate beds, well sorted, normally graded, planar cross-beds, limonitic staining is greater at the top of the unit; uppermost sandstone beds also exhibit siliceous deformation veining	12.8	30.8
Unit 41 – Mudstone, dark-gray to black, yellow surface stains, very deeply weathered slope, forms slope between unit 40 (lowest Dakota Formation bed) and main Dakota Formation ledge	14.0	18.0
Unit 40 – Sandstone, weathers yellow-gray, with light rust color, white on unweathered surface, non-calcareous, well-sorted, very fine grained, steeply inclined cross-beds; forms yellow-weathering blocky slopes and has same features as main Dakota Formation ledge above. Contact appears scoured at top and bottom	2.0	4.0
Unit 39a – Mudstone, very dark gray to black, deeply weathered, very carbonaceous with sandstone stringers; similar in lithology and stratigraphic position to unit 3 of the Pipeline Access section that yielded significant palynology; originally included in uppermost 2 m of unit 39	2.0	2.0
Cedar Mountain Formation		
Unit 39 – Siltstone and mudstone; siltstone, very light gray, light-brown (sometimes green), slope weathers pale-yellow and light-gray; bottom 2 m not trenched due to debris; lower 4.6 m is highly calcareous alternating siltstone, mudstone, and calcareous nodule beds (calcareous beds are mostly thin 1 to 5 cm thick and rare); mudstone, light-olive-gray and pale-olive, yellow surface stains and blotches; calcareous beds are light-gray; upper 4 m of slope is generally more yellow, deeply weathered, and hard to trench; yellow blotches on surface; rare gypsum on surface (not found in unit below); no "gastroliths" and few nodules; popcorn weathering	13.6	68.9

Section offset approximately 100 m east above unit 38 for better exposures.

Unit 38 – Sandstone and mudstone, interbedded; deeply weathered, yellowish subsoil, some sandstone stringers; top 2 m slightly more resistant with multiple sandstone layers (approximately 30 m west of section beds are approximately 50 cm thick), discontinuous; top bed extensively bioturbated, burrows average approximately 1 cm in diameter, some burrows penetrate beds	8.4	55.3
Unit 37 – Sandstone, light-gray (unweathered) that weathers brown, matrix dull white, dark and light grains giving "salt and pepper" appearance, minor red grains, subrounded to angular, well-sorted, some fining upward, laminae approximately 2 mm thick, cross-beds appear as climbing ripples; unit contains three prominent ledge-forming beds with many minor sandstone lenses; bottom ledge-forming sandstone bed contains bone and a base that undulates with approximately 20 cm of relief	1.4	46.9
Unit 36 – Mudstone and siltstone, brown-gray, highly calcareous, deeply weathered, numerous gray nodules (0.5 to 2 cm in diameter); includes some white calcareous nodular (up to 50 cm in diameter) irregularly shaped blocks, spongy, and weathered	4.5	45.5
Unit 35 – Clastic zone of calcrete, sandstone, and claystone (rip-up), mostly yellowish-gray (fresh surface); weathered, trench samples are mostly 1 cm in diameter or smaller fragments with nodules up to 5 cm in diameter, most nodules are white on freshly broken surface; blocky to angular, weakly bedded	2.5	41.0
Unit 34 – Calcareous zone, basal calcrete, dark-gray to black, 1 cm in diameter pebbles and calcareous nodules in matrix overlain by white to light-yellow, weakly calcareous, nodule zone; upper 40 cm is more resistant, compact calcrete, weathers light-gray with dull rust color, contains calcareous nodules (0.5 to 1 cm in diameter) and gray chert (1 cm in diameter), possible rhizoids or burrows; "gastroliths" on slope	0.9	38.5
Unit 33 – Siltstone, mostly pale-blue with mottled red and blue grading to blue at bottom, coarse at top, very calcareous, calcite veins, deeply weathered and hard to trench in. Top 1 m contains calcareous nodules and thin (5 cm thick) calcrete beds	2.2	37.6
Unit 32 – Mudstone, red, silty, deeply weathered, weakly calcareous	1.0	35.4
Unit 31 – Calcrete and calcareous nodules, some weakly calcareous; looks like sandstone altered to calcrete bed, many inclusions of clastics, includes red mudstone rip-ups, small calcareous nodules 1 to 3 cm in diameter; contains possible root casts or rhizoliths	0.5	34.4

Unit 30 – Mudstone and siltstone, red with some blue mottling, weakly calcareous, 15-cm calcareous pillows, fairly deeply weathered.....2.7 33.9

Unit 29 – Sandstone, white (weathered surface), red (unweathered surface), very calcareous, some 1-mm sized grains with white halos.....0.1 31.2

Unit 28 – Sandstone, white-red, fine-grained, very calcareous.....0.1 31.1

Unit 27 – Sandstone, brown-gray, mix of clear, dark-red, orange grains, dominantly angular to rounded, fine-grained, highly calcareous; bottom 75 cm is very coarse grained to gravelly with same color grains as above; contains green mudstone rip-ups 0.5 to 1.5 cm in diameter; top of bed has 4- to 5-sided polygons with rounded "pillow-like" surfaces with abundant burrows; lower beds contain low-angle and trough cross-beds showing east-directed flow; east and west of section this unit is mostly slope covered with abundant "gastroliths" of mostly shades of red with some gray and white, up to 2 cm in diameter; abundant calcareous nodules (0.5 to 7 cm in diameter) weathered out on slope; lowest part of unit contains 75 percent calcareous nodules, white and gray, clasts 1 to 3 cm in diameter, also minor black and red rounded pebbles; some beds sit directly on calcrete bed composed of same material as nodules in sandstone above, sauropod skull (*Abydosaurus mcintoshi*) excavated from this unit 2.4 31.0

Unit 26 – Calcrete and siltstone interbedded; calcrete, dull white, pale-gray-blue (unweathered surface), weathers dull red-brown; no spar, some nodules in beds 5 cm in diameter and possible relic bedding; calcite crystals and calcite veins found in bed 20 m west; calcrete beds approximately 20 cm thick; minor siltstone, fissile, blocky, deeply weathered, brown, drab green, calcareous; bottom 20 to 30 cm is pale blue, well indurated, fine-grained, weakly calcareous, blocky weathering.....2.5 28.6

Note: south-facing slope above contains almost no "gastroliths" or quartz-chert pebbles; north-facing slope in lower section (below massive basal calc beds) has much silcrete debris but could not find in place; some chalcedony/silcrete scattered on south-facing slope to the west.

Unit 25 – Mudstone, mottled medium-gray, light-green, and minor amount of red, calcareous, blocky to fissile, carbonate nodules 0.5 to 20 cm in diameter 2.6 26.1

Unit 24 – Calcrete, weathers tan, light-rusty-brown, mostly micrite, much white calcite crystal; no visible grains; irregular base that is pipe-shaped (dimensions of 20 x 40 cm); top is irregular with medium-grained mudstone, mottles, calcareous, possible relict bedding traces 1.7 23.5

Section offset approximately 7 m west

Unit 23 – Mudstone, dark-gray-purple, some green mottling, fissile, contains calcareous nodules up to 7 cm in diameter 0.8 21.8

Unit 22 – Mudstone, dark gray, non-calcareous 0.5 21.0

Unit 21 – Mudstone, dull green, very calcareous 0.4 20.5

Unit 20 – Calcrete, white to light-gray, with minor siltstone, weathers brown to rusty red; minor calcite crystals and calcite veins 0.6 20.1

Unit 19 – Mudstone, light-green-gray, non-calcareous; interbedded with minor sandstone, red-green, and calcrete; calcrete beds up to 8 cm thick and located at 9 cm, 144 cm, 200 cm above base of unit; carbonate nodules 0.5 to 20 cm in diameter throughout unit 2.6 19.5

Section offset approximately 3 m west to ridge top

Unit 18 – Calcrete, white to light-brown (unweathered), dense crystalline cores, sandy rinds with box-like structures, chemical weathered in relief; most calcrete beds form vertical pipe-like structures that protrude down into underlying red mudstone unit; an excavated structure in lowest part of unit extends 43 cm down into mudstone and approximately 5 cm wide; others are 32 cm wide at top and more than 36 cm deep; holds up ridge 5.4 16.9

Unit 17 – Mudstone, red, blocky to fissile, silty to sandy, minor red, subangular quartz grains, approximately 1 to 3 cm in diameter; unit contains calcrete beds (three beds 4 to 10 cm thick), pale-blue, calcareous nodules 0.5 to 7 cm in diameter throughout unit, some calcite veins, 3 mm thick; top is in-filled with protruding pipe-like structures of unit 18 ..... 2.5 11.5

Unit 16 – Calcrete, blue-gray, weathers rusty brown, lower part is very crystalline and bottom 1 to 5 cm is very platy; may thicken east; base of unit is sandstone, very minor red with blue-colored clay clasts, fine-grained; upper 25 cm is poorly cemented sandstone, bright green, very fine-grained, non-calcareous 0.5 9.0

Unit 15 – Sandstone and siltstone, maroon grading upward to pale-bluish-green, fine-grained, minor interbedded mudstone, calcareous; abundant grains (up to 1 cm in diameter), mostly red, orange, black, and brown, subangular; green clay rip-up clasts; abundant limonite especially in calcareous beds and limonite rims around nodules and grains 1.7 8.5

Unit 14 – Calcrete, white to pale-blue, mostly blocky weathering and with some nodules; flat bottom to bed, irregular top, grades upward to siltstone; fairly uniform with minor lithic grains, dull red, black, and gray, 0.5 to 5

mm in diameter, angular to rounded; some rounded crystalline infilling may be root or burrow traces; first major calcrete bed in Cedar Mountain Formation.....0.3 6.8

Strike and dip on bottom of calcareous bed, N74W, dip 63° S

Unit 13 – Mudstone, mottled drab red, green, and gray, well indurated, contains very minor quartz grains, some clays, calcareous.....0.8 6.5

Unit 12 – Mudstone, green, well indurated; minor quartz grains (red, orange, black), 0.5 mm in diameter; scattered silcrete/calcrete nodules (1 to 4 cm in diameter) and stringers 0.9 5.7

Unit 11 – Mudstone, green, with abundant quartz grains, mostly black, drab red, gray, rounded to subangular, some grains 2.5 to 3 cm in diameter.....0.2 4.8

Unit 10 – Calcrete, silcrete, and mudstone (3 alternating layers); mudstone, green, like unit 9 but contains no limonite; calcrete, rusty brown, black, and green (unweathered), top and bottom with clay contacts, irregular thickness (approximately 3 to 4 cm thick), slightly calcareous; silcrete.....0.9 4.6

Unit 9 – Mudstone and siltstone, light-green with black and red grains, abundant limonite 0.2 3.7

Unit 8 – Siltstone, pale-green, blocky; sandstone, black, red, and gray grains, rounded, up to 1 cm in diameter 0.4 3.5

Unit 7 – Mudstone, gray to pale-green, becoming green upward; interbedded siltstone; some limonite; scattered non-calcareous nodules to 8 cm in diameter; abundant clay rip-ups, green and purple; upward becoming silty with sandstone, clear, red, and gray grains, 1 to 5 mm in diameter 2.7 3.1

Unit 6 – Mudstone, green, blocky with abundant limonite; minor sandstone, non-calcareous; contact at base of "alteration zone" 0.4 0.4

Morrison Formation (Morrison was not completely measured)

Unit 5 – Mudstone, gray-green, silty to sandy 0.3 3.7

Unit 4 – Sandstone, light-green, coarse-grained, angular to subangular, white quartz and plagioclase grains, 1 to 5 mm in diameter 0.3 3.4

Unit 3 – Mudstone, light-green, silty, non-calcareous 0.2 3.1

Unit 2 – Mudstone, purple-medium green, blocky weathering	1.4	2.9
Unit 1 – Sandstone, white to pale-blue, fine-grained, grades to purple below and purple above, non-calcareous	1.5	1.5