Appendix 1

Table 1.1. Description of core collected from exploratory borehole LC–F1, southeastern Laramie County, Wyoming.

[Y, yellow; R, red; HCl, hydrochloric acid; %, percent; ?, uncertain; ft, foot; in., inch; <, less than; mm, millimeter; N, neutral color designation for absolute achromatic colors which have zero chroma and no hue; Fm, Formation]

Unit	Depth below land surface (in feet)		Description
	From	To	
Quaternary older alluvial fan deposits	0.0	5.0	Gravelly muddy sand. Brown (10YR 4/3) to yellowish brown (10YR 5/4); dries very pale brown (10YR 7/3) to light gray (10YR 7/2). Organic matter (soil) in upper part of interval, rolls well, some reaction to hydrochloric acid (HCl); clay, little carbonate cementation, some caliche on surface gravel. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some orange and red grains; granitic, some metamorphic rock fragments. Visual grain size estimates are 20% very fine sand, 20% fine sand, 12% silt, 12% medium sand, 10% clay, 10% coarse sand, 7% very coarse sand, 3% very fine pebbles, 2% fine pebbles, 2% medium pebbles, 1% coarse pebbles, and 1% very coarse pebbles. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	5.0	10.0	Muddy sandy gravel. Brown (10YR 4/3) to yellowish brown (10YR 5/4); dries very pale brown (10YR 7/3) to light gray (10YR 7/2). Little reaction to HCl. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some orange and red grains; granitic, some metamorphic rock fragments. Visual grain size estimates are 20% very coarse sand, 20% very fine pebbles, 12% fine pebbles, 9% coarse sand, 8% fine sand, 8% medium sand, 8% medium pebbles, 7% very fine sand, 5% silt, and 3% clay. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	10.0	12.0	Gravel. Weak red (10R 4/4) to light red (2.5YR 6/6) to light gray (5YR 7/1). Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some black to red staining; granitic and some metamorphic rock fragments. Visual grain size estimates are 40% fine pebbles, 25% very fine pebbles, 18% medium pebbles, 5% very coarse sand, 3% medium sand, 3% coarse sand, 2% very fine sand, 2% fine sand, 1% clay, and 1% silt. Other constituents include major quartz, minor feldspar, sparse mica, and minor dark accessory minerals.
	12.0	15.0	Gravel. Very dark greenish gray (10Y 3/1) to brown (7.5YR 5/2). Some clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; granitic and metamorphic rock fragments. Visual grain size estimates are 34% fine pebbles, 34% medium pebbles, 8% coarse pebbles, 5% very fine pebbles, 3% clay, 3% silt, 3% coarse sand, 3% very coarse sand, 2% very fine sand, 2% fine sand, 2% medium sand, and 1% very coarse pebbles. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, and sparse mica.
	15.0	16.5	Gravel. Gravel not recovered in core but some pebbles adhered to sides of fine-grained core.
	16.5	17.8	Slightly gravelly muddy sand. Light olive brown (2.5Y 5/4). Reactive to HCl, some medium pebbles on outer edge of core, none found interior; moderately consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some limonite, some orange to black staining. Visual grain size estimates are 23% very fine sand, 20% fine sand, 16% medium sand, 15% silt, 14% clay, 7% coarse sand, 3% very coarse sand, 1% very fine pebbles, and 1% fine pebbles. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	17.8	18.0	Muddy sand. Light olive gray (5Y 6/2). Reactive to HCl, somewhat layered; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some limonite, some orange to red staining. Visual grain size estimates are 30% very fine sand, 30% fine sand, 20% silt, 12% clay, 6% medium sand, 1% coarse sand, and 1% very coarse sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	18.0	18.2	Muddy sandy gravel. Light olive gray (5Y 6/2). Reactive to HCl, gravel stuck in core barrel, coated in fines; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some limonite, some orange to red staining; granitic and metamorphic rock fragments. Visual grain size estimates are 20% coarse pebbles, 15% medium pebbles, 15% very coarse pebbles, 9% silt, 9% very fine sand, 7% clay, 7% fine sand, 5% fine pebbles, 4% medium sand, 3% coarse sand, 3% very coarse sand, and 3% very fine pebbles. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.

Unit	Depth below land surface (in feet)		Description
	From	To	
Quaternary older alluvial fan deposits	18.2	18.3	Gravelly muddy sand. Light olive brown (2.5Y 5/3). Reactive to HCl; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some yellow to red staining; granitic and metamorphic rock fragments. Visual grain size estimates are 20% fine sand, 15% very fine sand, 15% medium pebbles, 12% clay, 12% silt, 10% medium sand, 7% fine pebbles, 5% coarse pebbles, 2% coarse sand, 1% very coarse sand, and 1% very fine pebbles. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	18.3	21.0	No core was retrieved.
	21.0	29.0	Muddy sandy gravel. Light yellowish brown (2.5Y 6/4) to light reddish brown (5YR 6/4). Gravel does not appear broken by drilling; clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; granitic and metamorphic rock fragments. Visual grain size estimates are 25% very fine pebbles, 25% fine pebbles, 12% very fine sand, 10% silt, 8% clay, 7% fine sand, 5% very coarse sand, 3% medium sand, 3% coarse sand, and 2% medium pebbles. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	29	29.5	Muddy sandy gravel. Light reddish brown (5YR 6/4); gravel is reddish pink, black, clear, white. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some yellow to red to black staining; granitic and metamorphic rock fragments; about 1% siltstone chips. Visual grain size estimates are 30% fine pebbles, 25% very fine pebbles, 22% medium pebbles, 7% very coarse sand, 4% medium sand, 4% coarse sand, 3% fine sand, 2% silt, 2% very fine sand, and 1% clay. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	29.5	35	Slightly gravelly sandy mud. Brown (7.5YR 5/4). Mostly siltstone chips (95%); moderately consolidated; clay, some carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; black staining; red, clear, and white grains. Visual grain size estimates are 45% silt, 35% very fine sand, 11% clay, 3% fine sand, 1% medium sand, 1% coarse sand, 1% very coarse sand, 1% very fine pebbles, 1% fine pebbles, and 1% medium pebbles. Other constituents include minor dark accessory minerals.
	35	40	Gravelly mud. Brown (7.5YR 5/4). Siltstone chips (60%) and gravel (40%), some siltstone chips almost appear layered; siltstone chips poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; granitic, metamorphic, and quartz rock fragments. Visual grain size estimates are 25% silt, 20% very fine sand, 14% clay, 10% very fine pebbles, 10% fine pebbles, 7% very coarse sand, 5% medium pebbles, 4% coarse sand, 3% fine sand, and 2% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
White River Formation	40	41.5	Mudstone. Light brown (7.5YR 6/4) to reddish brown (5YR 4/4); black spots (biotite?). Waxy, split into 0.1–0.2-ft segments, Reactive to HCl, light zones may be siltier, reddish zones more waxy; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal. Visual grain size estimates are 49% clay, 48% silt, and 3% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite. Top of depth interval interpreted as top of White River Formation.
	41.5	42.3	Muddy sandstone. Light brown (7.5YR 6/4) to reddish brown (5YR 4/4); black spots (biotite?). Some zones split into 0.1–0.2-ft segments, Reactive to HCl, light zones sandier, reddish zones more waxy; moderately to well consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal. Visual grain size estimates are 40% very fine sand, 20% silt, 19% clay, 19% fine sand, and 2% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite.
	42.3	43	Mudstone. Reddish brown (5YR 4/4) to light brown (7.5YR 6/4); black spots (biotite?). Some zones split into 0.1–0.2-ft segments, Reactive to HCl, light zones sandier, reddish zones very waxy; moderate to well consolidated; clay, carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal. Visual grain size estimates are 49% clay, 48% silt, and 3% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite.
	43	43.8	Muddy gravel. Brown (7.5YR 5/4). Unconsolidated to poorly consolidated; clay, carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; granitic, metamorphic, and quartzite rock fragments. Visual grain size estimates are 40% medium pebbles, 21% silt, 20% clay, 15% fine pebbles, 2% coarse pebbles, 1% very fine sand, and 1% very fine pebbles. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	43.8	44.2	Mudstone. Light brown (7.5YR 6/4); black spots (biotite?). Thin core (approximately 1.5-in. diameter) of siltstone coated in gravel. Reactive to HCl; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal. Visual grain size estimates are 50% silt, 47% clay, and 3% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite.
	44.2	44.7	Sandy mudstone. Light brown (7.5YR 6/4); black spots (biotite?). Still some gravel coating core. Reactive to HCl; moderately to well consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal. Visual grain size estimates are 35% very fine sand, 33% silt, 29% clay, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite.
	44.7	45.1	Mudstone. Light reddish-brown (5YR 6/4); some black spots (biotite?). Brittle/broken. Reactive to HCl; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red staining. Visual grain size estimates are 50% clay, 49% silt, and 1% very fine sand. Other constituents include major quartz, minor mica, and minor dark accessory minerals. Trace minerals include some biotite.
	45.1	45.8	Sandy mudstone. Yellowish brown (10YR 5/4); black spots (biotite?). Waxy when scraped. Reactive to HCl; moderately to well consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange staining. Visual grain size estimates are 40% silt, 30% clay, 29% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite.
	45.8	46	Mudstone. Brown (7.5YR 5/4); some black spots (biotite?). Somewhat brittle/broken, rolls well. Reactive to HCl; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red staining. Visual grain size estimates are 49% clay, 48% silt, and 3% very fine sand. Other constituents include major quartz, minor mica, and minor dark accessory minerals. Trace minerals include some biotite.
	46	46.3	Muddy gravel. Brown (7.5YR 5/4). Probable gravel zone but cannot determine because gravel coats core for about 1 ft, interior core is mudstone without any gravel; cannot determine quantity of matrix material derived from “ground down” core; clay, carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; granitic, metamorphic, and quartzite rock fragments. Visual grain size estimates are 40% medium pebbles, 30% fine pebbles, 15% clay, 12% silt, 1% very fine sand, 1% very fine pebbles, and 1% coarse pebbles. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	46.3	48.5	Mudstone. Brown (7.5YR 5/4) to yellowish brown (10YR 5/4); some white areas (calcite), some black spots (biotite?). Thin core (approximately 1.5-in. diameter) of mudstone coated in gravel in top part, thickens to full core near 47.4 ft; lighter zones may be siltier; poorly to moderately consolidated, very brittle 47.5–48 ft; clay, carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal. Visual grain size estimates are 49% clay, 48% silt, 2% very fine sand, and 1% fine sand. Other constituents include major quartz, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	48.5	50.1	Muddy gravel. Reddish brown (5YR 5/4); some white areas (calcite?), some black spots (biotite?). Very sticky, matrix rolls very well; poorly consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; granitic, metamorphic, and quartzite rock fragments. Visual grain size estimates are 45% clay, 19% fine pebbles, 17% medium pebbles, 14% silt, 3% very fine pebbles, 1% very fine sand, and 1% coarse pebbles. Other constituents include minor mica and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	50.1	52	Sandy mudstone. Brown (7.5YR 5/4) to light yellowish brown (10YR 6/4); some parts seem mottled or banded (nice banding at 51 ft); some white areas (calcite?), some black spots (biotite?). Upper part is coated in clay and gravel from above; brittle, waxy when scraped; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal. Visual grain size estimates are 48% silt, 42% clay, 9% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	52	52.6	Muddy gravel. Light brown (7.5YR 6/4) to light yellowish brown (10YR 6/4); some white areas (calcite?), some black spots (biotite?). Sticky, some voids that are not due to gravel or drilling; poorly consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; granitic, metamorphic, and quartzite rock fragments. Visual grain size estimates are 50% clay, 19% fine pebbles, 15% silt, 10% medium pebbles, 5% very fine pebbles, and 1% very fine sand. Other constituents include minor mica and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	52.6	53	Silty sandstone. Brown (10YR 5/3); some white areas (calcite?), some black spots (biotite?). Poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 41% silt, 40% very fine sand, 12% clay, and 7% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	53	55	Sandy mudstone. Brown (7.5YR 5/4) to yellowish brown (10YR 5/4); some white areas (calcite?), some black spots (biotite?). Core segmented in approximately 0.05–0.2-ft increments; red zones more clayey, waxy, brittle; lighter zones sandier; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 42% silt, 32% clay, 25% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	55	55.2	Sandy siltstone. Very pale brown (10YR 7/3); white areas (calcite), some black spots (biotite?). Almost fissile; poorly to moderately consolidated; carbonate, some clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 45% silt, 34% very fine sand, 20% clay, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	55.2	55.6	Sandy mudstone. Brown (7.5YR 5/4) to light yellowish brown (10YR 6/4); some white areas (calcite?), some black spots (biotite?). Red zones more clayey, waxy, brittle; lighter zones sandier; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 42% silt, 32% clay, 25% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	55.6	56.2	Sandy mudstone. Brown (7.5YR 5/4) to light yellowish brown (10YR 6/4); white areas (calcite), some black spots (biotite?). Voids lined with clear crystals (very fine to medium grain size, dissolve in HCl); red zones more clayey, waxy, brittle; lighter zones coarser; fewer lighter zones than above; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 39% clay, 37% silt, 20% very fine sand, 3% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite and some biotite.
	56.2	57.2	Muddy sandstone. Light yellowish brown (10YR 6/4) to light brown (7.5YR 6/4); white areas (calcite), some black spots (biotite?). Red zones more clayey, slightly waxy, brittle, with some calcite in stringers; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 40% very fine sand, 27% silt, 17% clay, 15% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite and some biotite.
	57.2	60.2	Muddy sandstone. Light yellowish brown (10YR 6/4) to brown (7.5YR 4/4); dries very pale brown (10YR 7/3); white areas (calcite), some black spots (biotite?). Red zones claystone/mudstone clasts (?) and (or) partings up to several inches, waxy, brittle to fissile, most breaks occur in clay zones; calcite in voids; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 40% very fine sand, 29% silt, 15% clay, 15% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite and some biotite.
	60.2	60.4	Muddy sandstone. Light gray (10YR 7/2) to brown (7.5YR 4/4); some black spots (biotite?). Waxy, brittle to fissile; poorly to moderately consolidated; carbonate, some clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains; red claystone/mudstone clasts. Visual grain size estimates are 40% very fine sand, 29% silt, 15% clay, 15% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	60.4	60.5	Silty sandstone. Light gray (10YR 7/2); some black spots (biotite?). Waxy, brittle to fissile; sandier at base; poorly to moderately consolidated; carbonate, some clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains; red claystone/mudstone clasts. Visual grain size estimates are 35% very fine sand, 27% fine sand, 24% silt, 12% clay, and 2% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite.
	60.5	60.7	Sandy mudstone. Pale brown (10YR 6/3); some black spots (biotite?). Poorly to moderately consolidated; carbonate, some clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 47% silt, 25% clay, 23% very fine sand, and 5% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite.
	60.7	61.4	Sandy mudstone. Pale brown (10YR 6/3) with some brown (7.5YR 5/4); some reddish clay stringers; some black spots (biotite?). Poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 49% silt, 30% clay, 20% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite.
	61.4	65.5	Mudstone. Brown (7.5YR 5/3) to light yellowish brown (10YR 6/4); becomes mottled at 62 ft; some black spots (biotite?). Brittle, waxy, some plastic zones (63.2 or 64.4 ft); poorly to moderately consolidated; clay, carbonate cementation. Visual grain size estimates are 55% clay, 44% silt, and 1% very fine sand. Other constituents include minor mica and minor dark accessory minerals. Trace minerals include some biotite.
	65.5	67.5	Mudstone. Yellowish brown (10YR 5/4) to brown (7.5YR 5/4); white to clear areas (calcite), some black spots (biotite?) in partings. Plastic (rolls well) top 0.3 ft (just muck from hole?), then very brittle, waxy; poorly to moderately consolidated; clay, carbonate cementation. Visual grain size estimates are 55% clay, 42% silt, 1% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include minor mica and minor dark accessory minerals. Trace minerals include calcite crystals (very fine to medium grained).
	67.5	68.2	Sandy mudstone. Brown (7.5YR 5/4); some white (calcite), some black spots (biotite?). Brittle to plastic; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to well rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 38% clay, 37% silt, 22% very fine sand, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	68.2	69.4	Mudstone. Yellowish brown (10YR 5/4) to brown (7.5YR 5/4); white to clear areas (calcite), some black spots (biotite?) in partings. Brittle, waxy when scraped, broken into <0.1-ft segments; poorly to moderately consolidated; clay, carbonate cementation. Visual grain size estimates are 51% clay, 48% silt, and 1% very fine sand. Other constituents include minor mica and minor dark accessory minerals. Trace minerals include calcite (very fine to medium grained crystals).
	69.4	70	Mudstone. Yellowish brown (10YR 5/4) to brown (7.5YR 5/4); white to clear areas (calcite), some black spots (biotite?) in partings. Brittle, waxy when scraped, broken into <0.1-ft segments; poorly to moderately consolidated; clay, carbonate cementation. Visual grain size estimates are 52% silt, 45% clay, and 3% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite crystals (very fine to medium grained).
	70	71.2	Sandy mudstone. Brown (10YR 5/3 to 7.5YR 5/4); some white to clear areas (calcite), some black spots (biotite?). Breaks along partings, slightly brittle, slightly waxy when scraped; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 45% silt, 30% clay, 23% very fine sand, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	71.2	72	Mudstone. Brown (10YR 5/3 to 7.5YR 5/4); some white to clear areas (calcite), some black spots (biotite?). Breaks along partings, slightly brittle, slightly waxy when scraped; poorly to moderately consolidated; clay, carbonate cementation. Visible grains include some red to orange grains. Visual grain size estimates are 47% silt, 45% clay, 7% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	72	76	Mudstone. Reddish brown (5YR 5/4) to brown (7.5YR 5/4) to grayish brown (10YR 5/2); banded, lighter silty/sandy zones with reddish clayey zones; some white to clear areas (calcite), some black spots (biotite?). Hard, slightly waxy when scraped; lighter zones often siltier (some very fine sand in upper part), reddish zones appear to have more clay; moderately to well consolidated; carbonate, clay cementation. Visible grains include some red to orange grains. Visual grain size estimates are 50% clay, 48% silt, and 2% very fine sand. Other constituents include minor mica and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	76	77	Sandy mudstone. Yellowish brown (10YR 5/4) to brown (10YR 5/3). Hard to firm; moderately to well consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 50% silt, 35% clay, and 15% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	77	77.8	Sandy mudstone. Light brownish gray (10YR 6/2) to white (10YR 8/1). Hard to firm; white areas have little/no reaction to HCl (ash? gypsum?); moderately to well consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; some small brown clay nodules (1–2 mm [0.04–0.08 in.]). Visual grain size estimates are 50% silt, 30% clay, and 20% very fine sand. Other constituents include major quartz, sparse feldspar, sparse mica, and sparse dark accessory minerals.
	77.8	78.3	Sandy mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3); some white areas (little/no reaction to HCl, ash? gypsum?). Moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; some small reddish-brown clay nodules (1–3 mm [0.04– 0.12 in.]). Visual grain size estimates are 51% silt, 35% clay, and 14% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	78.3	81.8	Mudstone. Brown (10YR 5/3); strong brown (7.5YR 5/3) clay stringer at 79.4 ft; some black spots (biotite and [or] some other constituent). Starts to react to HCl at bottom of interval; poorly to moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 52% silt, 41% clay, and 7% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite.
	81.8	83.8	Mudstone. Pale brown (10YR 6/3); black spots (biotite and [or] some other constituent), some white spots. Hard; moderately to well consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 50% silt, 45% clay, and 5% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite.
	83.8	84.3	Mudstone. Pale yellowish brown (10YR 6/2); black spots (biotite and [or] some other constituent), some white spots. Very hard; well consolidated; carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 52% silt, 47% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	84.3	87.1	Mudstone. Pale brown (10YR 6/3) to brown (10YR 5/3); black spots (biotite and [or] some other constituent), white spots (calcite). Hard; well consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; some reddish-brown clay nodules. Visual grain size estimates are 51% silt, 46% clay, and 3% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	87.1	87.8	Mudstone. Light gray (10YR 7/2); black spots (biotite), white spots (calcite). Very hard; well consolidated/cemented; carbonate cementation. Visible grains subangular to rounded; prismoidal to discoidal; some reddish-brown clay nodules. Visual grain size estimates are 49% silt, 48% clay, 1% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite flakes and calcite crystals as much as 0.5 mm (0.02 in.).
	87.8	91	Sandy mudstone. Brown (10YR 5/3); black spots (biotite), white spots (calcite). Breaks easily; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; prismoidal to discoidal; reddish-brown clay nodules as much as 1 mm (0.04 in.). Visual grain size estimates are 41% silt, 38% clay, 10% very fine sand, 5% fine sand, 3% medium sand, and 3% coarse sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite flakes and calcite crystals as much as 1 mm (0.04 in.).

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	91	91.7	Sandy mudstone. Pale brown (10YR 6/3); black spots (biotite), white spots (calcite). Very hard; well consolidated/cemented; carbonate cementation. Visible grains subangular to rounded; prismoidal to discoidal; reddish-brown clay nodules (more than above) as much as 0.5 mm (0.02 in.). Visual grain size estimates are 45% silt, 42% clay, 10% very fine sand, 2% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite flakes and calcite crystals as much as 0.5 mm (0.02 in.).
	91.7	92	Sandy mudstone. Brown (10YR 5/3); black spots (biotite), white spots (calcite). Breaks easily; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; prismoidal to discoidal; reddish-brown clay nodules, more than above and as much as 4 mm (0.16 in.). Visual grain size estimates are 48% silt, 39% clay, 10% very fine sand, 2% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite flakes and calcite crystals as much as 1 mm (0.04 in.).
	92	92.9	Mudstone. Pale brown (10YR 6/3) to brown (7.5YR 5/4) at bottom of interval; black spots (biotite), white spots (calcite). Very hard; well consolidated/cemented; carbonate cementation. Visible grains subangular to rounded; prismoidal to discoidal; reddish-brown clay nodules (more than above). Visual grain size estimates are 48% silt, 45% clay, 5% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite flakes and calcite crystals as much as 0.5 mm (0.02 in.).
	92.9	95.5	Mudstone. Brown (7.5YR 5/4) to yellowish red (5YR 4/6); somewhat mottled appearance in upper and lower parts; black spots (biotite), white (calcite). Red and clay increase downward to 94.9 ft, then decrease rapidly; waxy when scraped; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; reddish-brown clay nodules (increasing with depth in size and frequency until red clay is primary at 94.9 ft, then decreases rapidly). Visual grain size estimates are 55% clay, 42% silt, 2% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite flakes as much as 0.5 mm (0.02 in.) and calcite crystals.
	95.5	97	Siltstone. Pale brown (10YR 6/3); black spots (biotite), white spots (calcite). Hard; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; reddish-brown clay nodules. Visual grain size estimates are 67% silt, 30% clay, 2% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite flakes as much as 0.5 mm (0.02 in.) and calcite crystals.
	97	98.8	Siltstone. Brown (10YR 5/3); some white areas (calcite), some black spots (biotite). Breaks easily; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; reddish-brown clay nodules. Visual grain size estimates are 65% silt, 30% clay, 4% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	98.8	100.1	Sandy siltstone. Brown (10YR 4/3); white areas (calcite), some black spots (biotite). Breaks easily; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; few reddish-brown clay nodules. Visual grain size estimates are 58% silt, 29% clay, 12% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	100.1	102	Sandy siltstone. Yellowish brown (10YR 5/4); white areas (calcite), some black spots (biotite). Breaks easily; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; few reddish-brown clay nodules. Visual grain size estimates are 55% silt, 27% clay, 17% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	102	102.6	Sandy siltstone. Light gray (10YR 7/2); white areas (calcite), some black spots (biotite). Very hard; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 58% silt, 29% clay, 12% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	102.6	104.4	Sandy siltstone. Pale brown (10YR 6/3) to brown (10YR 5/3); white areas (calcite), some black spots (biotite?). Hard to firm; well consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 57% silt, 27% clay, 15% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	104.4	105.1	Mudstone. Pale brown (10YR 6/3); white areas (calcite), some black spots (biotite). Hard; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; few reddish-brown clay nodules. Visual grain size estimates are 61% silt, 32% clay, and 7% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	105.1	107	Mudstone. Yellowish brown (10YR 5/4); white areas (calcite), some black spots (biotite?). Hard; well consolidated/cemented; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; few reddish-brown clay nodules. Visual grain size estimates are 60% silt, 32% clay, 7% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	107	108.4	Mudstone. Light yellowish brown (10YR 6/4); some black spots (biotite?). Breaks easily; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 60% silt, 32% clay, 7% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals. Trace minerals include biotite.
	108.4	109	Mudstone. Pale brown (10YR 6/3); some white areas (calcite), some black spots (biotite?). Hard; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 60% silt, 35% clay, 4% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals. Trace minerals include biotite and calcite.
	109	111.4	Siltstone. Brown (10YR 5/3); some black spots (biotite?). Hard, broken, worn down pieces; recovered pieces well consolidated/cemented; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 62% silt, 30% clay, 7% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals. Trace minerals include biotite.
	111.4	111.8	Mudstone. Pale brown (10YR 6/3); white areas (calcite), some black spots (biotite). Very hard, dense; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 60% silt, 35% clay, 4% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals. Trace minerals include biotite and calcite.
	111.8	112	Mudstone. Brown (10YR 5/3); some white areas (calcite), some black spots (biotite?). Hard, slightly waxy when scraped; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 62% silt, 32% clay, 5% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals. Trace minerals include biotite and calcite.
	112	115.5	Sandy siltstone. Dark yellowish brown (10YR 4/4) to brown (7.5YR 5/4); white spots (calcite), some black spots (biotite?). Hard, waxy when scraped; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; few reddish-brown clayey siltstone clasts. Visual grain size estimates are 57% silt, 26% clay, 15% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, and sparse mica. Trace minerals include biotite and calcite.
	115.5	116.3	Sandy siltstone. Dark yellowish brown (10YR 4/4) to brown (7.5YR 5/4); white spots (calcite), some black spots (biotite?). Hard; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 41% very fine sand, 40% silt, 17% clay, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, and sparse mica. Trace minerals include biotite and calcite.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	116.3	116.7	Sandy siltstone. Brown (10YR 5/3); white spots (calcite), some black spots (biotite?). Hard, waxy when scraped; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; few reddish-brown clayey siltstone clasts. Visual grain size estimates are 57% silt, 27% clay, 15% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, and sparse mica. Trace minerals include biotite and calcite.
	116.7	117	Sandy siltstone. Brown (10YR 5/3 to 7.5YR 5/4); white spots (calcite), some black spots (biotite?). Hard, waxy when scraped; well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains; few reddish-brown clay clasts. Visual grain size estimates are 57% silt, 26% clay, 15% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, and sparse mica. Trace minerals include biotite and calcite.
	117	119.2	Muddy sandstone. Brown (7.5YR 5/4) to yellowish brown (10YR 5/4); some white spots (calcite), some black spots (biotite?). A bit finer at top of interval; very poorly to moderately consolidated; some carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains; few reddish-brown clay clasts. Visual grain size estimates are 32% very fine sand, 28% fine sand, 21% silt, 17% clay, and 2% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	119.2	121.3	Muddy sandstone. Dark yellowish brown (10YR 4/4); some white spots (calcite), some black spots (biotite and something else), large area of black at 121 ft (not biotite). Top of interval has less clay, some areas have more clay; very poorly to moderately consolidated; some carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains; few reddish-brown clay clasts. Visual grain size estimates are 34% very fine sand, 31% fine sand, 18% silt, 12% clay, and 5% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	121.3	123.5	Muddy sandstone. Brown (10YR 5/3); some white spots (calcite), some black spots (biotite?), some large reddish-brown (5YR 4/4) clay clasts. Poorly to moderately consolidated; some carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains; some large reddish-brown clay clasts. Visual grain size estimates are 38% very fine sand, 23% silt, 20% fine sand, 17% clay, and 2% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include biotite and calcite.
	123.5	127.4	Muddy sandstone. Brown (10YR 5/3); some reddish-brown (5YR 4/4) clay clasts/partings, some white spots (calcite), some black spots. Upper part broken up (from drilling?), lower 0.4 ft breaks easily; some clay clasts becoming thin clay partings with depth, frequency increases with depth; poorly to moderately consolidated; some carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains; some large reddish-brown clay clasts/partings. Visual grain size estimates are 38% very fine sand, 28% silt, 21% clay, 12% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite, calcite, and sparse magnetite.
	127.4	128	Mudstone. Brown (10YR 5/3 to 7.5YR 4/4); some white spots (calcite), some black spots (biotite and something else). Breaks easily; poorly to moderately consolidated; some carbonate, some clay cementation. Visible grains include some red to orange grains. Visual grain size estimates are 49% clay, 49% silt, and 2% very fine sand. Other constituents include minor mica and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	128	130.1	Sandy mudstone. Pale brown (10YR 6/3); some black spots (biotite and something else), few white spots (calcite). Breaks easily; poorly to moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains; few reddish-brown clay clasts/nodules. Visual grain size estimates are 50% silt, 35% clay, and 15% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and sparse calcite.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	130.1	130.5	Mudstone. Light brownish gray (10YR 6/2) to light gray (10YR 7/2); some white spots (calcite), some black spots (biotite and [or] some other constituent). Hard, broken by drilling; well consolidated/cemented; carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 55% silt, 40% clay, and 5% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	130.5	131	Mudstone. Light brownish gray (10YR 6/2) to light gray (10YR 7/2); some white spots (calcite), some black spots (biotite and [or] some other constituent). Very hard; well consolidated/cemented; carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 52% clay, 47% silt, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some biotite and calcite.
	131	132	Mudstone. Pale brown (10YR 6/3); white spots (calcite), some black spots (biotite and [or] some other constituent). Hard; well consolidated/cemented; carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 53% silt, 42% clay, and 5% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite and some biotite.
	132	139	Sandy mudstone. Brown (10YR 5/3) to light yellowish brown (10YR 6/4) to very pale brown (10YR 7/4); some black spots (biotite and something else), few white spots (calcite?), become more frequent around 134 ft. Breaks easily; poorly to moderately consolidated; clay, some carbonate cementation below 134 ft. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 58% silt, 30% clay, and 12% very fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals. Trace minerals include some biotite and sparse calcite.
	139	141.3	Sandy mudstone. Yellowish brown (10YR 5/4) to white (10YR 8/1); somewhat mottled appearance from numerous white spots (calcite), some black spots (biotite and [or] some other constituent). Moderately to well consolidated; carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 55% silt, 28% clay, 14% very fine sand, and 3% fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals. Trace minerals include calcite and some biotite.
	141.3	144.2	Sandy mudstone. Yellowish brown (10YR 5/4); somewhat mottled appearance from all the white spots (as much as 1 mm [0.04 in.], decreasing frequency with depth, calcite?), some black spots (biotite and something else). Moderately to well consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 58% silt, 32% clay, and 10% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and sparse dark accessory minerals. Trace minerals include calcite and some biotite flakes as much as 1 mm (0.04 in.).
	144.2	147	Sandy mudstone. Yellowish brown (10YR 5/4); some white spots (as much as 1 mm [0.04 in.], calcite?), some black spots (biotite and something else). Moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 50% silt, 40% clay, and 10% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and sparse dark accessory minerals. Trace minerals include calcite and some biotite flakes as much as 1 mm (0.04 in.).
	147	152	Mudstone. Brown (10YR 5/3); some white spots (as much as 2 mm [0.08 in.], calcite? gypsum?), some black spots (biotite and something else). Breaks easily; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 52% silt, 40% clay, and 8% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and some biotite flakes as much as 0.5 mm (0.02 in.).
	152	153.6	Mudstone. Pale brown (10YR 6/3); some white spots/streaks (calcite? gypsum?), some black spots (biotite and something else). Moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 53% silt, 40% clay, and 7% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and some biotite flakes as much as 0.5 mm (0.02 in.).

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	153.6	154	Mudstone. Light gray (10YR 7/2 to 10YR 5/3); black spots (magnetite?), some white spots (calcite? gypsum?). Hard to firm; moderately to well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 53% silt, 41% clay, and 6% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some calcite or gypsum, biotite, and magnetite.
	154	154.7	Mudstone. Brown (10YR 5/3) to light gray (10YR 7/2); some white spots (calcite? gypsum?), some black spots (biotite and something else). Moderately to well consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some red to orange grains. Visual grain size estimates are 53% silt, 41% clay, and 6% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some calcite or gypsum and biotite.
	154.7	161	Mudstone. Brown (10YR 5/3 to 10YR 7/2); white spots (calcite? gypsum?), black spots (biotite and something else). Slightly waxy when scraped; moderately to well consolidated; clay, some carbonate (decreases with depth) cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 52% silt, 45% clay, and 3% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	161	162	Mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3); white spots (calcite? gypsum?), black spots (biotite and something else). Slightly waxy when scraped; moderately to well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 52% silt, 47% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	162	164	Mudstone. Pale brown (10YR 6/3) to brown (10YR 5/3); white spots (calcite? gypsum?), black spots (biotite and something else). Breaks easily, slightly waxy when scraped; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 52% silt, 45% clay, and 3% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum (as much as 3 mm [0.12 in.]) and biotite.
	164	167.1	Mudstone. Pale brown (10YR 6/3) to brown (10YR 5/3); white spots (calcite? gypsum?), black spots (biotite and something else). Breaks easily, slightly waxy when scraped; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 55% silt, 39% clay, and 6% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	167.1	168	Mudstone. Pale brown (10YR 6/3) to brown (10YR 5/3); white spots (calcite? gypsum?), black spots (biotite and something else). Waxy when scraped; moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 51% silt, 48% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	168	172	Mudstone. Pale brown (10YR 6/3) to brown (10YR 5/3); white spots (calcite? gypsum?), black spots (biotite and something else). Breaks easily, slightly waxy when scraped; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 40% clay, and 4% very fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	172	182	Mudstone. Yellowish brown (10YR 5/4) to pale brown (10YR 6/3); white spots (calcite? gypsum?), black spots (biotite and something else). One well rounded, 2-mm (0.08-in.) quartz grain at 175.9 ft; varies between highly reactive to nonreactive to HCl; bioturbation (?) at 173.1 ft; moderately consolidated; carbonate and (or) clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 42% clay, and 2% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	182	183.4	Mudstone. Yellowish brown (10YR 5/4) to pale brown (10YR 6/3); white spots (calcite? gypsum?), black spots (biotite and something else). Breaks easily; poorly to moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 42% clay, and 2% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	183.4	184.5	Mudstone. Pale brown (10YR 6/3) to brown (10YR 5/3); white spots (calcite? gypsum?), black spots (biotite and something else). Hard; moderately to well consolidated/cemented; carbonate and (or) clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 42% clay, and 2% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	184.5	191.7	Mudstone. Yellowish brown (10YR 5/4) to pale brown (10YR 6/3); white spots (calcite? gypsum?), black spots (biotite and something else). Breaks easily; poorly to moderately consolidated; carbonate and (or) clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 42% clay, and 2% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	191.7	192	Mudstone. Pale brown (10YR 6/3) to very pale brown (10YR 8/2); white spots (calcite? gypsum?), black spots (biotite and something else). Hard; moderately to well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 42% clay, and 2% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	192	200.5	Mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3); white spots (calcite? gypsum?), black spots (biotite and something else). Firm to hard; waxy when scraped; may be more clay around 199 ft; moderately to well consolidated/cemented; carbonate and (or) clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 57% silt, 42% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	200.5	201.8	Mudstone. Pale brown (10YR 6/3) to light gray (10YR 7/2); white spots (calcite? gypsum?), black spots (biotite and something else). Hard; moderately to well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 43% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	201.8	203.7	Mudstone. Pale brown (10YR 6/3) to light gray (10YR 7/2); white spots (calcite? gypsum?), black spots (biotite and something else). Breaks easily; moderately consolidated/cemented; carbonate and (or) clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 43% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include calcite or gypsum and biotite. Fossils include Poebrotherium jawbone at 202.7 ft.
	203.7	204.6	Mudstone. Pale brown (10YR 6/3) to light gray (10YR 7/2); white spots (calcite? gypsum?), black spots (biotite and something else). Very hard; well consolidated/cemented; carbonate and (or) clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 55% silt, 44% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	204.6	207.9	Mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3); white spots (calcite? gypsum?), black spots (biotite and something else). Breaks easily; moderately consolidated/cemented; carbonate and (or) clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 43% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	207.9	208.5	Mudstone. Pale brown (10YR 6/3) to light gray (10YR 7/2); white spots (calcite? gypsum?), black spots (biotite and something else). Very hard; well consolidated/cemented; carbonate and (or) clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 55% silt, 44% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	208.5	210.4	Mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3); white spots (calcite? gypsum?), black spots (biotite and something else). Breaks easily; moderately consolidated/cemented; carbonate and (or) clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 56% silt, 43% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	210.4	212	Sandy mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3); "salt and pepper" appearance, white (calcite? gypsum?) and black (biotite and undetermined minerals) specks as much as 1 mm (0.04 in.). Breaks easily; moderately consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 47% silt, 27% clay, 24% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	212	215.5	Sandy mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3); "salt and pepper" appearance, white (calcite? gypsum?) and black (biotite and undetermined minerals) specks as much as 1 mm (0.04 in.), some yellowish-brown areas. Firm to hard; moderately consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 40% very fine sand, 32% silt, 20% clay, 5% fine sand, and 3% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	215.5	216.4	Sandy mudstone. Yellowish brown (10YR 5/4) to pale brown (10YR 6/3); "salt and pepper" appearance, white (calcite? gypsum?) and black (biotite and undetermined minerals) specks as much as 1 mm (0.04 in.). Firm to hard; moderately consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 47% silt, 26% clay, 25% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum and biotite.
	216.4	222	Sandy mudstone. Yellowish brown (10YR 5/4) to pale brown (10YR 6/3); "salt and pepper" appearance diminishing, white and black specks as much as 1 mm (0.04 in.). Firm to hard; moderately consolidated/cemented; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; red to orange grains. Visual grain size estimates are 59% silt, 30% clay, and 11% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include calcite or gypsum, and biotite.
	222	239.3	Siltstone. Moderate yellowish brown (10YR 5/4). Lighter and more cemented 222–222.5 and 225.6–225.8 ft. Core collected from 222 to 402 ft below land surface was described only in the field, so a simplified description of this depth interval is provided herein.
	239.3	241.1	Sandy siltstone. Moderate yellowish brown (10YR 5/4).
	241.1	242	Siltstone. Moderate yellowish brown (10YR 5/4).
	242	251.1	Mudstone and claystone. Moderate yellowish brown (10YR 5/4) with greenish-gray (5GY 6/1) mottling.
	251.1	252	Mudstone. Moderate yellowish brown (10YR 5/4).
	252	261.5	Mudstone and claystone. Moderate yellowish brown (10YR 5/4) with greenish-gray (5GY 6/1) mottling.
	261.5	262	No core was retrieved.
	262	269.4	Mudstone and claystone. Greenish gray (5GY 6/1).
	269.4	277	Mudstone and claystone. Moderate yellowish brown (10YR 5/4).
	277	293.1	Mudstone and claystone. Moderate yellowish brown (10YR 5/4) with greenish-gray (5GY 6/1) mottling.
	293.1	297	No core was retrieved.
	297	349.4	Mudstone and claystone. Moderate yellowish brown (10YR 5/4) with greenish-gray (5GY 6/1) mottling.
	349.4	349.9	No core was retrieved.
	349.9	379.6	Mudstone and claystone. Moderate yellowish brown (10YR 5/4) with greenish-gray (5GY 6/1) mottling.
	379.6	387.4	Mudstone and claystone. Moderate yellowish brown (10YR 5/4) with greenish-gray (5GY 6/1) mottling. Some zones waxy.
	387.4	389.2	Mudstone and claystone. Light yellowish brown (10YR 6/4); white spots.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	389.2	392	Mudstone and claystone. Light yellowish brown (10YR 6/4) with greenish-gray (5GY 6/1) mottling; green increases with depth.
	392	402	Mudstone and claystone. Greenish gray (5GY 6/1) with light yellowish-brown (10YR 6/4) mottling.
	402	402.5	Mudstone. Greenish gray (5GY 6/1) to light brownish gray (2.5Y 6/2); white spots of clear to translucent grains (calcite). Moderately well to well consolidated; carbonate, clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; few orange, red grains. Visual grain size estimates are 64% silt, 35% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and sparse dark accessory minerals. Trace minerals include calcite.
	402.5	404.6	Mudstone. Light brownish gray (2.5Y 6/2) with mottled greenish gray (5GY 6/1); white spots (as much as 30 mm [1.18 in.]) to veins of clear to translucent grains (calcite). Well consolidated; carbonate, clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; few orange, red grains. Visual grain size estimates are 62% silt, 35% clay, 1% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and sparse dark accessory minerals. Trace minerals include calcite as much as 8 mm (0.32 in.).
	404.6	406.4	Mudstone. Greenish gray (5GY 6/1) to light brownish gray (2.5Y 6/2); white spots of clear to translucent grains (calcite). Moderately well to well consolidated; carbonate, clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; few orange, red grains. Visual grain size estimates are 60% silt, 38% clay, 1% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and sparse dark accessory minerals. Trace minerals include some mica flakes as much as 0.5 mm (0.02 in.).
	406.4	411.8	Mudstone. Light brownish gray (2.5Y 6/2) with mottled greenish gray (5GY 6/1); white spots of clear to translucent grains (calcite), more green mottling near bottom of interval. Well consolidated; carbonate, clay cementation. Visible grains subprismoidal to subdiscoidal; few orange, red grains. Visual grain size estimates are 58% silt, 40% clay, 1% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and sparse dark accessory minerals. Trace minerals include some mica flakes as much as 0.5 mm (0.02 in.).
	411.8	419.7	Mudstone. Light brownish gray (2.5Y 6/2) with mottled light greenish gray (5GY 7/1) to grayish brown (2.5Y 5/2); white spots of clear to translucent grains (calcite). Moderately well to well consolidated; carbonate, clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; small yellowish brown spots (about 0.1 mm [0.004 in.]) at 413 ft; few orange, red grains. Visual grain size estimates are 60% silt, 36% clay, 3% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and sparse dark accessory minerals. Trace minerals include some mica flakes as much as 0.5 mm (0.02 in.).
	419.7	422	Mudstone. Brown (10YR 5/3) with mottled greenish gray (5G 6/1). Some very fine to medium clear grains near bottom of interval; moderately well to well consolidated; carbonate, clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal. Visual grain size estimates are 60% silt, 37% clay, 1% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals.
	422	423.7	Mudstone. Pale brown (10YR 6/3) with mottled greenish gray (5G 6/1). Some void spaces but cannot determine if larger ones are lacking cementation and were washed out; moderately consolidated; carbonate, clay cementation. Visible grains subprismoidal to subdiscoidal. Visual grain size estimates are 52% silt, 47% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals.
	423.7	425.7	Mudstone. Pale brown (10YR 6/3) to greenish gray (5GY 6/1); some white spots (calcite?). Brittle; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subprismoidal to subdiscoidal; few orange grains. Visual grain size estimates are 52% silt, 47% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals.
	425.7	427	Mudstone. Pale brown (10YR 6/3) to greenish gray (5GY 6/1). Some void spaces; some parts may be siltier; some calcite grains (as much as 0.25 mm [0.010 in.]); one 2-mm (0.08-in.), rounded quartz grain near bottom of interval; moderately well consolidated; clay, some carbonate cementation. Visible grains subprismoidal to subdiscoidal; few orange grains. Visual grain size estimates are 50% silt, 46% clay, 1% very fine sand, 1% fine sand, 1% medium sand, and 1% very coarse sand. Other constituents include major quartz, minor feldspar, sparse mica, and sparse dark accessory minerals.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	427	433.7	No core was retrieved. Cuttings indicate some gravel in parts of this depth interval.
	433.7	434.7	Slightly conglomeratic mudstone. Pale brown (10YR 6/3) to greenish gray (5GY 6/1); some white areas (calcite?). Appears to be ripped up and redeposited clayey siltstone (?); one 5-mm (0.20-in.), subrounded quartz grain; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subprismoidal to subdiscoidal; few orange grains. Visual grain size estimates are about 50% silt, 45% clay, 2% very fine sand, 1% fine sand, 1% medium sand, and less than 1% fine pebbles. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, and sparse mica.
	434.7	435.2	Conglomeratic mudstone. Pale brown (10YR 6/3) to greenish gray (5GY 6/1). More gravel with depth, top only has scattered very fine to fine pebbles; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; few orange grains; greenish-gray to reddish-brown mudstone, few granitic, few dark mafic rock fragments. Visual grain size estimates are 25% silt, 23% clay, 17% very fine sand, 12% fine pebbles, 9% fine sand, 7% very fine pebbles, 3% medium pebbles, 2% medium sand, 1% coarse sand, and 1% very coarse sand. Other constituents include major quartz (mostly clear grains), minor feldspar, minor mica, and minor dark accessory minerals.
	435.2	435.8	Muddy sandy conglomerate. Greenish gray (5GY 6/1) to pale brown (10YR 6/3). Poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; greenish-gray grains (feldspar?), few orange grains; some pale mudstone, few pink granitic, few dark mafic rock fragments. Visual grain size estimates are 25% fine pebbles, 15% medium pebbles, 12% silt, 10% clay, 10% very fine sand, 10% very fine pebbles, 5% fine sand, 5% very coarse sand, 4% medium sand, and 4% coarse sand. Other constituents include major quartz (clear grains), minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include one 0.7-mm (0.028-in.) magnetite grain.
	435.8	437	Conglomeratic sandy mudstone. Pale brown (10YR 6/3) to greenish gray (5GY 6/1); greenish-gray color in gravel, but not in matrix. Poorly to moderately consolidated; clay, little carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; greenish-gray grains (feldspar?), few orange grains; some pale mudstone, few pink granitic, few dark mafic rock fragments. Visual grain size estimates are 21% silt, 17% clay, 15% very fine sand, 14% fine pebbles, 9% very fine pebbles, 6% fine sand, 6% very coarse sand, 5% medium sand, 5% coarse sand, and 2% medium pebbles. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	437	437.6	Conglomeratic sandy mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3). Poorly to moderately consolidated; clay, little carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; greenish-gray grains (feldspar?), few orange grains; some pale mudstone, few pink granitic rock fragments. Visual grain size estimates are 22% silt, 20% clay, 14% very fine sand, 12% fine pebbles, 7% fine sand, 7% very fine pebbles, 6% very coarse sand, 5% medium sand, 5% coarse sand, and 2% medium pebbles. Other constituents include major quartz (clear grains), minor feldspar, minor dark accessory minerals, and sparse mica. Trace minerals include sparse dark mafic grains (including magnetite?).
	437.6	438.4	Slightly conglomeratic mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3); some white areas. Some intervals waxy when scraped; gravel occurrence decreases with depth; moderately to well consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; greenish-gray grains (feldspar?) grains; some pale mudstone rock fragments. Visual grain size estimates are 50% clay, 38% silt, 2% very fine sand, 2% fine sand, 1% medium sand, 2% very fine pebbles, 2% fine pebbles, 1% coarse sand, 1% very coarse sand, and 1% medium pebbles. Other constituents include major quartz (clear grains), minor feldspar, minor dark accessory minerals, and sparse mica. Trace minerals include sparse dark mafic grains (magnetite?).
	438.4	439.8	Clay/claystone and mudstone. Brown (10YR 5/3) to pale brown (10YR 6/3). Clay was plastic (immediately after collection) and compressed into segments from drilling/coring process. Parts of mudstone waxy when scraped; clay/claystone segmented; poorly to moderately consolidated; clay, little carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some orange grains. Visual grain size estimates are 65% clay, 33% silt, 1% very fine sand, and 1% fine sand. Other constituents include sparse mica and sparse dark accessory minerals; many sand grains appear to be quartz.

Unit	Depth below land surface (in feet)		Description
	From	To	
White River Formation	439.8	442.7	Slightly conglomeratic mudstone and claystone. Grayish brown (10YR 5/2) to pale brown (10YR 6/3). Some intervals waxy when scraped; scattered pebbles and coarse sand in mudstone; moderately to well consolidated; clay, little carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some orange grains. Visual grain size estimates are 61% clay, 32% silt, 1% very fine sand, 1% fine sand, 1% medium sand, 1% coarse sand, 1% very coarse sand, 1% very fine pebbles, and 1% fine pebbles. Other constituents include minor mica and minor dark accessory minerals; many sand grains and pebbles appear to be quartz.
	442.7	446.4	No core was retrieved.
	446.4	447.3	Slightly conglomeratic mudstone. Brown (10YR 5/3) to pale brown (2.5Y 6/3) with dark yellowish brown (10YR 4/6). Waxy when scraped, slightly plastic; scattered pebbles and coarse sand; poorly to moderately consolidated; clay, little carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; clear to greenish, some orange, red, yellow grains. Visual grain size estimates are 54% clay, 40% silt, 2% very fine sand, 1% fine sand, 1% very coarse sand, 1% very fine pebbles, and 1% fine pebbles. Other constituents include minor mica and minor dark accessory minerals; some black grains, biotite and some magnetite (?). Bottom of depth interval interpreted as bottom of the White River Formation
Weathered zone of the Lance Formation	447.3	448.9	Mudstone. Variegated coloring: brown (10YR 5/3) to light yellowish brown (2.5Y 6/3) with white (2.5Y 8/1), dark yellowish brown (10YR 4/6 to 10YR 5/6), greenish gray (5GY 6/1 to 10Y 6/1); white zones (calcite, gypsum?). Brittle, slightly waxy to chalky when scraped; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; clear to greenish, some orange, red, yellow grains; limonite zones (clay pebbles?), cherty zones. Visual grain size estimates are 52% clay, 45% silt, 2% very fine sand, and 1% fine sand. Other constituents include minor mica and minor dark accessory minerals. Trace minerals include some calcite or gypsum and some black grains (biotite and some carbonaceous material?). Top of depth interval is interpreted as top of a weathered zone derived from and consisting of the Lance Formation.
	448.9	450.2	Mudstone. Variegated coloring: greenish gray (10Y 6/1) to yellowish brown (10YR 5/6) with weak (10R 5/4) to pale red (10R 6/4), light greenish gray (10Y 7/1), dark grayish brown (10YR 4/2). Waxy when scraped; poorly to moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite zones, some black staining; orange, red, yellow grains. Visual grain size estimates are 50% clay, 43% silt, 4% very fine sand, 1% fine sand, 1% medium sand, and 1% coarse sand. Other constituents include minor mica and sparse dark accessory minerals; most sand grains appear to be quartz, few calcite grains.
	450.2	451.3	Sandy mudstone. Variegated coloring: greenish gray (10Y 6/1) to light greenish gray (10Y 7/1) to pale red (10R 6/4), with yellowish brown (10YR 5/6), dark grayish brown (10YR 4/2). Poorly to moderately consolidated; clay, some carbonate cementation near bottom. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite zones; orange, red, yellow grains. Visual grain size estimates are 59% silt, 30% clay, 9% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor mica, sparse feldspar, and sparse dark accessory minerals.
	451.3	452.5	Sandy siltstone. Variegated coloring: light greenish gray (10Y 7/1) to yellowish brown (10YR 5/6), dark grayish brown (10YR 4/2). Somewhat brittle; some zones of hard cementation; poorly to moderately consolidated; carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite zones; orange, yellow, some red grains. Visual grain size estimates are 59% silt, 25% clay, 15% very fine sand, and 1% fine sand. Other constituents include major quartz, minor mica, sparse feldspar, and sparse dark accessory minerals.
	452.5	453.1	Sandy mudstone. Variegated coloring: yellowish brown (10YR 5/6) to light yellowish brown (2.5Y 6/4) to light greenish gray (10Y 7/1) to weak red (10R 5/3). Transitional/disturbed bedding, clay zones; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; orange, yellow, red grains. Visual grain size estimates are 50% silt, 39% clay, 10% very fine sand, and 1% fine sand. Other constituents include major quartz, minor mica, sparse feldspar, and sparse dark accessory minerals.
	453.1	455	Claystone. Variegated, mottled, and banded coloring: greenish gray (5GY 6/1) to weak red (10R 5/3) with yellowish brown (10YR 5/6). Plastic; moderately consolidated; clay, some carbonate cementation. Visible grains have some black staining; red, orange grains. Visual grain size estimates are 67% clay, 31% silt, and 2% very fine sand. Other constituents include minor mica and minor dark accessory minerals.

Unit	Depth below land surface (in feet)		Description
	From	To	
Weathered zone of the Lance Formation	455	455.6	Sandy siltstone. Variegated coloring: greenish gray (5GY 6/1) to light greenish gray (10Y 7/1) to weak red (10R 5/3) to yellowish brown (10YR 5/6). Transitional/disturbed bedding, clay zones, sandier zones, micaceous zones, may be thin carbonaceous streak near bottom; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some black staining; red, orange, yellow grains. Visual grain size estimates are 59% silt, 25% clay, 15% very fine sand, and 1% fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, and sparse feldspar.
	455.6	456.5	Sandy siltstone. Pale yellow (2.5Y 7/4) to light greenish gray (10Y 7/1). Breaks easily; poorly to moderately consolidated; carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; orange, yellow, red grains. Visual grain size estimates are 48% silt, 37% very fine sand, 14% clay, and 1% fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, and sparse feldspar.
	456.5	457.5	Sandy mudstone. Yellowish brown (10YR 5/6) to very pale brown (10YR 8/2) to black (10YR 2/1) to light olive brown (2.5Y 5/3). Transitional, sandy at top and bottom, micaceous at bottom; may be thin carbonaceous streaks; yellowish-brown areas plastic, very pale brown areas brittle; poorly to moderately well consolidated; carbonate, clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite, black staining; orange, yellow, red grains. Visual grain size estimates are 50% silt, 42% clay, 7% very fine sand, and 1% fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, and sparse feldspar.
	457.5	459.8	Silty sandstone. Light yellowish brown (2.5Y 6/3); some dark yellowish brown (10YR3/4) clayey streaks (largest 458.5–458.6 ft). Poorly to moderately consolidated; carbonate cementation, decreasing with depth. Visible grains subangular to rounded; subprismoidal to subdiscoidal; orange, yellow, red, green grains. Visual grain size estimates are 70% very fine sand, 20% silt, 8% clay, and 2% fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, sparse feldspar.
	459.8	461.7	Silty sandstone. Light yellowish brown (2.5Y 6/3); some dark yellowish-brown (10YR3/4) clayey streaks. Very poorly to poorly consolidated; some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; orange, yellow, red, green grains. Visual grain size estimates are 70% very fine sand, 20% silt, 8% clay, and 2% fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, and sparse feldspar.
	461.7	462	No core was retrieved. Probably unconsolidated or poorly consolidated sand.
	462	462.9	Silty sandstone. Light yellowish brown (2.5Y 6/3); some dark yellowish-brown (10YR3/4) clayey streaks. Unconsolidated to very poorly consolidated; some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; orange, yellow, red grains. Visual grain size estimates are 70% very fine sand, 20% silt, 8% clay, and 2% fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, and sparse feldspar.
	462.9	463.5	Mudstone. Banded coloring: yellowish brown (10YR 5/6) to light olive brown (2.5Y 5/4) to greenish gray (5GY 6/1) to very pale brown (10YR 8/2) to black (10YR 2/1). Plastic, some areas brittle, some zones siltier; poorly to moderately well consolidated; some carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite, black staining; orange, yellow, red grains. Visual grain size estimates are 50% clay, 45% silt, and 5% very fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, and sparse feldspar.
	463.5	465.6	Claystone. Banded coloring: olive (5Y 4/3) to light olive brown (2.5Y 5/4) to yellowish brown (10YR 5/6) to greenish gray (5GY 6/1) to weak red (10R 4/4). Plastic, some areas brittle, some zones siltier, waxy when scraped; moderately consolidated; clay, some carbonate cementation in upper part. Some visible grains; limonite, black staining; orange, yellow, red grains. Visual grain size estimates are 70% clay, 29% silt, and 1% very fine sand. Other constituents include minor mica and minor dark accessory minerals.
	465.6	468.8	Claystone. Banded coloring: greenish gray (10Y 5/1) with dark reddish brown (2.5YR 3/4) to yellowish red (5YR 5/8), yellowish brown (10YR 5/4), and weak red (10R 4/4); mottled to streaked; few black spots (biotite and [or] some other constituent). Very waxy, plastic; segmented (approximately 0.5–0.1 ft); may be some silt-sized mica, waxy when scraped; moderately consolidated; clay cementation. Yellow to red grains. Visual grain size estimates are 90% clay and 10% silt. Other constituents include minor mica and sparse dark accessory minerals. Trace minerals include some biotite.

Unit	Depth below land surface (in feet)		Description
	From	To	
Weathered zone of the Lance Formation	468.8	470.1	Claystone. Banded coloring: grayish red (5R 4/2) to weak red (10R 4/4) with greenish gray (10Y 5/1) and yellowish brown (10YR 5/6); mottled to streaked; few black spots (biotite and [or] some other constituent); few white areas in lower part (calcite?). Very waxy, plastic; segmented (approximately 0.5–0.1 ft); may be some silt-sized mica; limonite zones may be siltier, become primary near bottom of interval; moderately consolidated; clay cementation. Visible grains have limonite staining; yellow to red grains. Visual grain size estimates are 90% clay and 10% silt. Other constituents include minor mica and sparse dark accessory minerals. Trace minerals include some biotite and calcite. Bottom of depth interval is interpreted as bottom of a weathered zone derived from and consisting of the Lance Formation.
Lance Formation	470.1	471.1	Muddy sandstone. Brownish yellow (10YR 6/8) to greenish gray (10Y 6/1). Unconsolidated to very poorly consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 60% medium sand, 15% fine sand, 9% very fine sand, 8% clay, and 8% silt. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Top of depth interval is top of unweathered Lance Formation.
	471.1	472	No core was retrieved. Probably uncemented sand.
	472	473.9	Muddy sandstone. Banded, greenish gray (10Y 6/1) with brownish yellow (10YR 6/8). Unconsolidated to very poorly consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 43% medium sand, 34% fine sand, 9% very fine sand, 7% clay, and 7% silt. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, and sparse mica.
	473.9	476.7	Muddy sandstone. Banded, greenish gray (10Y 6/1) with brownish yellow (10YR 6/8). Few cemented layers/areas (calcite) with more mica (muscovite); very poorly to moderately consolidated; clay, some carbonate cementation around 470.5 ft. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 43% medium sand, 34% fine sand, 9% very fine sand, 7% clay, and 7% silt. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include muscovite.
	476.7	477	No core was retrieved. Probably uncemented sand.
	477	481.4	Muddy sandstone. Greenish gray (10Y 6/1) to light olive brown (2.5Y 5/6); some color banding (gray with limonite stripes), some “salt and pepper” appearance. Few cemented layers/areas (calcite) with more mica (muscovite); unconsolidated to moderately consolidated; clay, some carbonate cementation around 472 and 476 ft. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 52% fine sand, 21% medium sand, 11% very fine sand, 8% clay, and 8% silt. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include muscovite.
	481.4	482	No core was retrieved. Probably sand.
	482	483.8	Muddy sandstone. Light olive brown (2.5Y 5/6) to greenish gray (10Y 6/1); banding (gray, yellowish-brown to reddish-brown stripes), olive yellow lenses at bottom of interval. Few cemented layers/areas (calcite) with more mica (muscovite); siltier with depth, silty clay lenses at bottom of interval; very poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 45% fine sand, 20% very fine sand, 12% silt, 12% medium sand, and 11% clay. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include muscovite.
	483.8	484.2	Sandy mudstone. Greenish gray (10Y 6/1) to light olive brown (2.5Y 5/6); banded. Clayey sand at top, sandy clay at base; rolls well, sticky; unconsolidated to poorly consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 40% clay, 35% silt, 20% very fine sand, and 5% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	484.2	484.9	Muddy sandstone. Greenish gray (10Y 6/1) to light olive brown (2.5Y 5/6); some color banding (gray, yellowish-brown to reddish-brown stripes), some “salt and pepper” appearance. Unconsolidated to poorly consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 52% fine sand, 22% very fine sand, 12% medium sand, 7% clay, and 7% silt. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	484.9	485.4	Muddy sandstone. Greenish gray (10Y 6/1) to light olive brown (2.5Y 5/6); banding (gray, yellowish-brown to reddish-brown stripes), some "salt and pepper" appearance. Poorly consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 52% fine sand, 17% very fine sand, 11% medium sand, 10% clay, and 10% silt. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	485.4	486.4	Muddy sandstone. Greenish gray (10Y 6/1) to light olive brown (2.5Y 5/6); "salt and pepper" appearance, some color banding (yellowish-brown to reddish-brown stripes). Poorly consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 52% fine sand, 23% very fine sand, 11% medium sand, 7% clay, and 7% silt. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	486.4	487	Muddy sandstone. Greenish gray (10Y 6/1) to light olive brown (2.5Y 5/6); "salt and pepper" appearance, some color banding (yellowish-brown to reddish-brown stripes). Core loss likely from this zone; unconsolidated to poorly consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 50% fine sand, 20% very fine sand, 12% clay, 11% silt, and 7% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	487	488.1	Muddy sandstone. Olive gray (5Y 5/2); "salt and pepper" appearance, some color banding (yellowish brown). Poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 39% very fine sand, 38% fine sand, 9% silt, 8% clay, and 6% medium sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	488.1	489	Sandy siltstone. Light yellowish brown (2.5Y 6/4) to light gray (2.5Y 7/2); faint color banding. Very hard, broken interval at 488.5 ft (area of core loss?); interval below broken interval alternates siltier and sandier zones; moderately to very well consolidated/cemented; carbonate, some clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; black staining; yellow to red grains. Visual grain size estimates are 63% silt, 20% very fine sand, 15% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	489	490.5	No core was retrieved.
	490.5	491.3	Interbedded sandy mudstone and silty sandstone. Color banding: dusky red (10R 3/2), yellowish brown (10YR 5/6), dark greenish gray (10Y 4/1), reddish gray (10R 6/1), brownish yellow (10YR 6/6), light yellowish brown (2.5Y 6/4), light gray (2.5Y 7/2). Darker zones most often mudstone, lighter zones most often sandstone, some zones micaceous; poorly to moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite, black staining; orange, yellow, red grains. Visual grain size estimates for entire interbedded interval are 37% clay, 37% very fine sand, and 26% silt. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	491.3	491.4	Silty sandstone. Brownish yellow (10YR 6/6). Poorly to moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite, black staining; orange, yellow, red grains. Visual grain size estimates are 50% very fine sand, 40% silt, and 10% clay. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	491.4	492.6	Interbedded sandy mudstone and silty sandstone. Color banding: dusky red (10R 3/2), yellowish brown (10YR 5/6), dark greenish gray (10Y 4/1), reddish gray (10R 6/1), brownish yellow (10YR 6/6), light yellowish brown (2.5Y 6/4), light gray (2.5Y 7/2). Darker zones most often mudstone (waxy when scraped) or muddy shale, lighter zones most often sandstone, some zones micaceous; poorly to moderately consolidated; clay, some carbonate in upper part cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite, black staining; orange, yellow, red grains. Visual grain size estimates for entire interbedded interval are 37% silt, 32% clay, and 31% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	492.6	493.9	Interbedded sandy mudstone, carbonaceous muddy shale, and silty sandstone. Color banding: black (2.5Y 2.5/1), dark gray (2.5Y 4/1), dark yellowish brown (10YR 4/6), greenish gray (10Y 6/1), light olive brown (2.5Y 5/4), pale yellow (2.5Y 7/3). Darker zones most often mudstone or muddy shale (waxy when scraped), lighter zones most often silty sandstone, some zones micaceous; poorly to moderately consolidated; clay, some carbonate cementation in upper part. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite, black staining; orange, yellow, red, green grains. Visual grain size estimates for entire interbedded interval are 45% silt, 40% clay, and 15% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	493.9	494.1	Silty sandstone. Pale yellow (2.5Y 7/3) to yellow (2.5Y 7/6); slight color banding. Poorly to moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite staining; orange, yellow, red, green grains. Visual grain size estimates are 52% very fine sand, 42% silt, and 6% clay. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	494.1	497	Interbedded silty sandstone, muddy shale, and sandy mudstone. Color banding: light olive brown (2.5Y 5/4), dark gray (2.5Y 4/1), black (2.5Y 2.5/1), dark yellowish brown (10YR 4/6), greenish gray (10Y 6/1), pale yellow (2.5Y 7/3). Darker zones most often muddy shale or mudstone (waxy when scraped), carbonaceous; lighter zones most often silty sandstone, some zones micaceous; poorly to moderately consolidated; clay, some carbonate cementation in lower part (shell area). Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite, black staining; orange, yellow, red, green grains. Visual grain size estimates for entire interbedded interval are 36% very fine sand, 33% silt, 30% clay, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor carbonaceous material, sparse dark accessory minerals, and sparse fossils. Fossils include shells at 496.6–496.8 ft.
	497	502	Silty sandstone. Light yellowish brown (2.5Y 6/4) to gray (2.5Y 6/1) to light olive brown (2.5Y 5/6) with brownish yellow (10YR 6/8); slight banding. Unconsolidated to poorly consolidated; clay, little carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite staining; orange, yellow, red, green grains. Visual grain size estimates are 58% very fine sand, 26% silt, 9% clay, and 7% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Some swelling clay (?).
	502	508.7	Silty sandstone. Light yellowish brown (2.5Y 6/4) to light gray (2.5Y 7/1) with yellowish brown (10YR 5/6), gray dominant in lower part; banding, more obvious where core is intact. Unconsolidated to moderately consolidated. Areas of stronger cementation coated by loose material from areas of poor cementation (examples 502.3–502.7, 504.5–504.7, and 506.7–507 ft); clay, carbonate (in upper zones) cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; limonite staining; orange, yellow, red, green grains. Visual grain size estimates are 43% very fine sand, 35% silt, 15% clay, and 7% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.
	508.7	510.4	Interbedded carbonaceous muddy shale and silty sandstone. Black (2.5Y 2.5/1) with light brownish gray (2.5Y 6/2) to light gray (2.5Y 7/1); color banding, black muddy shale/clay and gray silty sand. Plastic clayey zones waxy when scraped, with zones of silty sand (as above); core coated in places by silty sand squeezed out from sand layers; moderately consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow, red, green grains. Visual grain size estimates for entire interbedded interval are 49% silt, 38% clay, 12% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Woody plant material.
	510.4	511	Interbedded silty sandstone and carbonaceous muddy shale. Light brownish gray (2.5Y 6/2) to light gray (2.5Y 7/1) with dark gray (2.5Y 4/1) to black (2.5Y 2.5/1); color banding, gray silty sand and dark muddy shale/clay. Silty sand with some plastic clayey zones (waxy when scraped); core seems compacted; unconsolidated to poorly consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow, red, green grains. Visual grain size estimates for entire interbedded interval are 40% very fine sand, 36% silt, 20% clay, and 4% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	511	512.4	Interbedded carbonaceous muddy shale and silty sandstone. Black (2.5Y 2.5/1) to dark gray (2.5Y 4/1) with light brownish gray (2.5Y 6/2) to light gray (2.5Y 7/1); banding, dark muddy shale/clay with gray silty sand. Plastic clayey zones waxy when scraped, some silty sand (as above); core compacted, central core coated in plastic shale or silty sand; moderately consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow, red, green grains. Visual grain size estimates for entire interbedded interval are 50% silt, 40% clay, and 10% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include microscopic pyrite in some carbonaceous areas. Woody plant material.
	512.4	513.7	Interbedded silty sandstone and carbonaceous muddy shale. Dark grayish brown (2.5Y 4/2) to light olive brown (2.5Y 5/3) with dark gray (2.5Y 4/1) to black (2.5Y 2.5/1) to dark brown (10YR 3/3); some color banding, gray silty sand with minor dark muddy shale/clay. Silty sand with minor plastic clayey zones (waxy when scraped); core seems compacted; unconsolidated to poorly consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow, red, green grains. Visual grain size estimates for entire interbedded interval are 49% very fine sand, 32% silt, 17% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.
	513.7	514.9	Interbedded carbonaceous muddy shale and silty sandstone. Black (2.5Y 2.5/1) to dark gray (2.5Y 4/1) with dark grayish brown (2.5Y 4/2) to light olive brown (2.5Y 5/3); banded, dark muddy shale/clay with minor gray silty sand. Plastic clayey zones (waxy when scraped) with minor gray silty sand (as above); core compacted, central core coated in plastic shale or silty sand; moderately consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow, red grains. Visual grain size estimates for entire interbedded interval are 50% silt, 40% clay, and 10% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include microscopic pyrite in some carbonaceous areas. Woody plant material.
	514.9	515.3	Silty sandstone. Dark grayish brown (2.5Y 4/2) to light olive brown (2.5Y 5/3); slight banding. Core seems compacted; unconsolidated to poorly consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow, red grains. Visual grain size estimates are 61% very fine sand, 25% silt, 9% clay, and 5% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material.
	515.3	515.6	Interbedded carbonaceous muddy shale and silty sandstone. Black (2.5Y 2.5/1) to dark gray (2.5Y 4/1) with dark grayish brown (2.5Y 4/2) to light olive brown (2.5Y 5/3); banded, dark muddy shale/clay with minor gray silty sand. Plastic clayey zones (waxy when scraped) with minor silty sand (as above); core compacted; moderately consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow grains. Visual grain size estimates for entire interbedded interval are 55% silt, 35% clay, and 10% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include microscopic pyrite in some carbonaceous areas. Woody plant material.
	515.6	517	Silty sandstone. Dark grayish brown (2.5Y 4/2) to light olive brown (2.5Y 5/3) to gray (2.5Y 5/1); slight banding. Core seems compacted; unconsolidated to poorly consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow, red grains. Visual grain size estimates are 61% very fine sand, 25% silt, 9% clay, and 5% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material.
	517	517.5	Interbedded carbonaceous muddy shale and silty sandstone. Black (2.5Y 2.5/1) to dark gray (2.5Y 4/1) with dark grayish brown (2.5Y 4/2) to light olive brown (2.5Y 5/3); banded, dark muddy shale/clay with minor gray silty sand. Plastic clayey zones (waxy when scraped) with minor silty sand (as above); core compacted; moderately consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow grains. Visual grain size estimates for entire interbedded interval are 55% silt, 38% clay, and 7% very fine sand. Other constituents include minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include microscopic pyrite in some carbonaceous areas. Woody plant material.
	517.5	519	No core was retrieved.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	519	524	Interbedded carbonaceous muddy shale and silty sandstone. Black (2.5Y 2.5/1) to dark gray (2.5Y 4/1) with dark grayish brown (2.5Y 4/2) to light olive brown (2.5Y 5/3); banded with thin gray zones/partings. Somewhat plastic, waxy when scraped; minor very silty sand streaks; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; some orange, yellow, red, brown grains. Visual grain size estimates for entire interbedded interval are 55% silt, 40% clay, and 5% very fine sand. Other constituents include minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include microscopic pyrite in some carbonaceous areas, some thin layers of pyrite, and some clear prismatic crystals growing on woody plant material areas (some areas surrounded by brown rings). Woody plant material.
	524	525.5	Carbonaceous muddy shale. Black (5Y 2.5/2). Waxy when scraped, sparse thin gray silt/sandy silt zones/partings; moderately to well consolidated; clay, carbonate cementation. Visual grain size estimates are 55% silt, 44% clay, and 1% very fine sand. Other constituents include minor carbonaceous material. Trace minerals include microscopic pyrite. Woody plant material.
	525.5	534.8	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/2) to very dark grayish brown (2.5Y 3/2) and gray (2.5Y 6/1) to light yellowish brown (2.5Y 6/3); banded, dark muddy shale/clay with gray silty sand; yellowish to reddish-brown clayey spots; tan mudstone layer. Hard, but splits easily; banded muddy shale (slightly to moderately carbonaceous, waxy when scraped) and minor plastic clayey layers with thin gray silt and sand zones/partings (increasing with depth); some bioturbation (tracks, burrows?); well cemented mudstone 529.4–529.5 ft; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, brown, green grains. Visual grain size estimates for entire interbedded interval are 50% silt, 29% clay, 19% very fine sand, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include microscopic pyrite and magnetite; some microscopic botryoidal blue-green to brown streaks (related to bioturbation?). Woody plant material. Fossils include sparse shells/shell fragments (bivalve) and indeterminate fossil at 531.9 ft.
	534.8	542	Interbedded sandy siltstone, silty sandstone, and muddy shale. Gray (2.5Y 6/1) to light yellowish brown (2.5Y 6/3) and black (5Y 2.5/2) to very dark grayish brown (2.5Y 3/2); banded to mottled, gray silt/sand with thin dark muddy shale/clay; yellowish to reddish-brown clayey spots. Silt and sand with thin dark shale (slightly carbonaceous) and plastic clay; bioturbation (tracks, burrows?); poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, brown, green grains. Visual grain size estimates for entire interbedded interval are 43% silt, 29% very fine sand, 19% clay, and 9% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include microscopic pyrite and magnetite. Woody plant material. Fossils include sparse scattered shell fragments (bivalve, cone).
	542	546	Interbedded sandy siltstone, silty sandstone, and muddy shale. Olive brown (5Y 5/2) to light olive brown (2.5Y 5/4) to gray (2.5Y 6/1) and black (5Y 2.5/2) to very dark grayish brown (2.5Y 3/2); mottled to banded, gray silt/sand with thin dark muddy shale/clay; yellowish to reddish-brown clayey spots. Silt and sand (very fine, decreasing with depth; medium grains scattered throughout, mostly in bioturbated areas) with thin dark muddy shale (slightly carbonaceous) and plastic clay; bioturbation (tracks, burrows?); poorly to moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; brown, some yellow, and red grains. Visual grain size estimates for entire interbedded interval are 48% silt, 26% very fine sand, 19% clay, 5% fine sand, and 2% medium sand. Other constituents include major quartz, minor feldspar, minor mica (as much as 1.5 mm [0.059 in.]), minor dark accessory minerals, and minor carbonaceous material. Trace minerals include some microscopic magnetite and pyrite, gypsum (?), and some brown translucent grains (amber?) in areas with coal fragments. Woody plant material. Fossils include a few scattered shell fragments.
	546	547	No core was retrieved.
	547	548	Sandy mudstone. Dark gray (5Y 4/1) to greenish gray (10Y 6/1), with black (N 1) and yellowish-brown spots (10YR 5/6); mottled; yellowish to reddish-brown clayey spots. Bioturbated, fine to medium sand in tracks/burrows; moderately to well consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; brown, some yellow, and red grains. Visual grain size estimates are 52% silt, 36% clay, 10% very fine sand, 1% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include some microscopic pyrite and gypsum (?). Woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	548	549	Carbonaceous muddy shale. Black (2.5Y 2.5/1); some brown streaks, some blue-green streaks. Hard, but splits easily; some bioturbation (tracks, burrows?); moderately to well consolidated; clay cementation. Visual grain size estimates are 51% silt, 48% clay, and 1% very fine sand. Other constituents include minor carbonaceous material. Trace minerals include gypsum, some microscopic pyrite, and blue-green streaks (botryoidal). Woody plant material.
	549	552	No core was retrieved.
	552	556.6	Mudstone and muddy shale. Black (2.5Y 2.5/1) to gray (2.5Y 6/1) with dark yellowish-brown (10YR 4/6) areas; brown areas decrease in size and frequency with depth. Hard, but splits easily in some areas; lighter hard mudstone and darker muddy shale (waxy when scraped); some bioturbation (tracks, burrows?); carbonaceous material increases in size and frequency with depth; few very fine sand stringers near bottom of interval; moderately to well consolidated; clay, carbonate cementation. Visual grain size estimates are 51% silt and 49% clay. Other constituents include minor carbonaceous material. Trace minerals include some microscopic pyrite and gypsum. Woody plant material.
	556.6	557.2	Muddy sandstone and coal. Light gray (5Y 7/1) and black (N 1); reddish-brown clay/mud in coal areas. Gray sand with carbonaceous stringers and black coal; unconsolidated to poorly consolidated; clay cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some yellow, brown, red, and green grains. Visual grain size estimates are 35% very fine sand, 26% silt, 21% fine sand, 17% clay, and 1% medium sand. Other constituents include major coal, major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include magnetite; some yellow powdery oxidation on outside of core, sulfur (?). Woody plant material.
	557.2	558.1	Sandy mudstone and muddy shale. Black (5Y 2.5/1) to olive brown (2.5Y 4/3) to light yellowish brown (2.5Y 6/4); black shale and brown mudstone, minor light gray silty sand stringers; yellowish to reddish-brown clayey spots. Hard, breaks easily along carbonaceous/coal vein (vertical); shale and mudstone with some silty sand stringers near carbonaceous veins; upper 0.2 ft transitional with overlying sand and coal, disturbed bedding, thin layers; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some yellow, brown, red, and green grains. Visual grain size estimates are 48% silt, 38% clay, 12% very fine sand, and 2% fine sand. Other constituents include minor carbonaceous material and sparse coal. Trace minerals include some microscopic pyrite. Fossils include woody plant material (nearly vertical layer/vein).
	558.1	560.5	Interbedded carbonaceous muddy shale, sandy siltstone, and silty sandstone. Black (2.5Y 2.5/1) to very dark grayish brown (2.5Y 3/2) and dark gray (2.5Y 4/1) to light brownish gray (2.5Y 6/2); dark shale and lighter mudstone, minor light gray silty sand stringers; yellowish to reddish-brown clayey spots. Hard, shale and mudstone with minor silty sand stringers; some thin layers, disturbed bedding (presumably bioturbation); hard yellowish-brown mudstone at 559.2 ft; moderately to well consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, brown, and green grains. Visual grain size estimates for entire interbedded interval are 51% silt, 37% clay, and 12% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include some microscopic pyrite. Woody plant material.
	560.5	562.2	Carbonaceous muddy shale and coal. Black (N 1 to 2.5Y 2.5/1); few yellowish to reddish-brown clayey spots. Moderately to well consolidated; clay cementation. Visual grain size estimates are 52% silt, 43% clay, and 5% very fine sand. Other constituents include minor coal and minor carbonaceous material. Trace minerals include gypsum, some coal zones oxidized yellow (sulfur). Woody plant material.
	562.2	562.9	No core was retrieved.
	562.9	568.4	Mudstone and muddy shale. Black (2.5Y 2.5/1) to dark olive gray (5Y 3/2) to gray (5Y 5/1); yellowish to reddish-brown clay/mud clasts. Hard to firm; hard shale splits easily; waxy when scraped; moderately to well consolidated; clay, carbonate cementation. Visual grain size estimates are 52% silt, 47% clay, and 1% very fine sand. Other constituents include minor carbonaceous material. Trace minerals include some microscopic pyrite. Woody plant material.
	568.4	569.7	Interbedded muddy shale and sandy siltstone. Black (2.5Y 2.5/1) to dark olive gray (5Y 3/2) to gray (5Y 4/1); some color banding, darker shale and lighter siltstone; yellowish to reddish-brown clayey spots. Hard, waxy when scraped; some bioturbation; moderately to well consolidated; clay, carbonate cementation. Visual grain size estimates for entire interbedded interval are 53% silt, 43% clay, and 4% very fine sand. Other constituents include minor carbonaceous material and sparse fossils. Fossils include woody plant material and few shell fragments.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	569.7	571.2	Muddy shale. Black (2.5Y 2.5/1) to dark olive gray (5Y 3/2); yellowish to reddish-brown clayey spots. Hard, splits easily; waxy when scraped; moderately to well consolidated; clay, carbonate cementation. Visual grain size estimates are 52% silt, 47% clay, and 1% very fine sand. Other constituents include minor fossils and minor carbonaceous material. Trace minerals include microscopic pyrite. Fossils include woody plant material and shells (bivalves).
	571.2	572	Interbedded sandy siltstone, silty sandstone, and muddy shale. Black (2.5Y 2.5/1) to olive gray (5Y 5/2) to dark yellowish brown (10YR 3/4); yellowish to reddish-brown clayey spots. Firm; poorly to moderately consolidated; clay, carbonate cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some yellow, brown, and green grains. Visual grain size estimates for entire interbedded interval are 35% silt, 30% clay, 29% very fine sand, 5% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, minor fossils, and minor carbonaceous material. Fossils include woody plant material, shells (bivalves as much as 3.8 centimeters ([1.5 in.]) and shell fragments (shells are very brittle).
	572	573.4	Interbedded sandy siltstone, silty sandstone, and muddy shale. Black (2.5Y 2.5/1) to olive gray (5Y 5/2) to dark yellowish brown (10YR 3/4); banded, darker shale/mud and lighter silt/sand; yellowish to reddish-brown clayey spots. Poorly to moderately consolidated; clay, carbonate cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some yellow, brown, red, and green grains. Visual grain size estimates for entire interbedded interval are 37% silt, 28% clay, 28% very fine sand, 6% fine sand, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, minor carbonaceous material, and sparse fossils. Trace minerals include some magnetite. Fossils include woody plant material, few shells/shell fragments, and oyster bed at bottom of depth interval.
	573.4	574.3	Coal and carbonaceous muddy shale. Black (N 1 to 2.5Y 2.5/1). Brittle coal/lignite with carbonaceous muddy shale (mostly on top and bottom of interval); poorly to moderately consolidated; clay cementation. Visual grain size estimates are 51% silt and 49% clay. Other constituents include major coal and major carbonaceous material. Trace minerals include gypsum. Woody plant material.
	574.3	575.8	Carbonaceous muddy shale and mudstone. Black (N 1 to 5Y 2.5/1) to dark brown (10YR 3/3); dark yellowish-brown layer at 575 ft. Waxy when scraped; splits easily, somewhat conchoidal break, with some fissility; hard mudstone nodule/layer at 575 ft; poorly to moderately consolidated; clay, some carbonate cementation. Visual grain size estimates are 51% silt, 48% clay, and 1% very fine sand. Other constituents include minor carbonaceous material. Trace minerals include microscopic pyrite, gypsum, botryoidal blue-green areas. Woody plant material.
	575.8	577	No core was retrieved.
	577	577.4	Carbonaceous muddy shale. Black (N 1 to 5Y 2.5/1). Waxy when scraped; splits easily; moderately to well consolidated; clay cementation. Visual grain size estimates are 51% silt, 48% clay, and 1% very fine sand. Other constituents include minor carbonaceous material. Trace minerals include some microscopic pyrite. Woody plant material.
	577.4	578.4	Interbedded sandy siltstone, silty sandstone, and muddy shale. Black (2.5Y 2.5/1) to dark olive gray (5Y 3/2) to gray (5Y 4/1); mottled to banded, darker shale/mud and lighter silt/sand; yellowish to reddish-brown clayey spots/stains. Bioturbation; moderately to well consolidated; clay, carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some yellow, brown, red, and green grains. Visual grain size estimates for entire interbedded interval are 49% silt, 27% very fine sand, 22% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include some magnetite. Woody plant material.
	578.4	580.1	Silty sandstone. Greenish gray (10Y 6/1); yellowish to reddish-brown clayey spots and few streaks. Siltier in places; sparse clay and carbonaceous streaks; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, green, and red grains. Visual grain size estimates are 50% very fine sand, 21% fine sand, 19% silt, 9% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include some magnetite.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	580.1	582.4	Interbedded sandy siltstone, silty sandstone, and muddy shale. Light olive gray (5Y 6/2) to dark olive gray (5Y 3/2) to black (2.5Y 2.5/1); banded to mottled, lighter silt/sand and darker shale/mud; top 0.4 ft light gray; yellowish to reddish-brown clayey spots, layers, and hard nodules. Some bioturbation; top 0.4 ft well cemented; concretions; poorly to well consolidated/cemented; clay, carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some yellow, brown, red, and green grains. Visual grain size estimates for entire interbedded interval are 52% silt, 24% clay, 23% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include some magnetite. Woody plant material.
	582.4	586.5	Interbedded muddy shale and sandy siltstone. Black (2.5Y 2.5/1) to dark olive gray (5Y 3/2) to gray (5Y 4/1); banding, darker shale and lighter siltstone; yellowish to reddish-brown clayey spots. Hard, waxy to plastic when scraped; some bioturbation; some silty sand; some dark, plastic clay, coats core in places; moderately to well consolidated; clay, carbonate cementation. Visual grain size estimates for entire interbedded interval are 51% silt, 42% clay, and 7% very fine sand. Other constituents include minor carbonaceous material and sparse fossils. Trace minerals include some microscopic pyrite. Fossils include woody plant material, some shell fragments, and some fish scales (?).
	586.5	589.8	Muddy shale. Black (2.5Y 2.5/1) to dark olive gray (5Y 3/2); minor banding, dark shale with lighter silt/sand; some yellowish to reddish-brown clayey spots. Hard, waxy when scraped; minor siltstone/sand stringers, sandy siltstone 589.7–589.8 ft with hard concretion; some bioturbation; moderately to well consolidated; clay cementation. Visual grain size estimates are 51% silt, 47% clay, and 2% very fine sand. Other constituents include minor carbonaceous material and sparse fossils. Trace minerals include microscopic pyrite. Fossils include shells (bivalve, spiral cone) and shell fragments.
	589.8	592.9	Carbonaceous muddy shale, mudstone, and coal. Black (N 1 to 10YR 2/1) to very dark grayish brown (10YR 3/2); minor banding, dark shale with sparse lighter silt/sand. Hard, waxy to plastic; minor siltstone/sand stringers and bioturbation; coal 590.4–590.6 ft; carbonaceous material decreases with depth; moderately to well consolidated; clay cementation. Visual grain size estimates are 50% silt, 49% clay, and 1% very fine sand. Other constituents include minor carbonaceous material and sparse coal. Trace minerals include gypsum and pyrite. Woody plant material.
	592.9	594.4	Interbedded sandy siltstone, silty sandstone, and muddy shale. Light olive gray (5Y 6/2) to dark olive gray (5Y 3/2) to black (2.5Y 2.5/1); banded to mottled, lighter silt/sand and darker shale/mud; yellowish to reddish-brown clayey spots/layers. Some bioturbation; moderately to well consolidated; clay, carbonate cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some yellow, brown, red, and green grains. Visual grain size estimates for entire interbedded interval are 47% silt, 27% clay, 21% very fine sand, and 5% fine sand. Other constituents include major quartz, minor feldspar, minor mica, sparse dark accessory minerals, and sparse carbonaceous material. Trace minerals include magnetite. Woody plant material.
	594.4	595.1	Carbonaceous muddy shale and mudstone. Black (2.5Y 2.5/1) to very dark gray (10YR 3/1) to yellowish brown (10YR 5/6) to gray (5Y 4/1); minor banding, dark shale with some lighter silt/sand; some yellowish to reddish-brown clayey spots. Hard, waxy to plastic; minor siltstone/sand stringers and bioturbation; moderately to well consolidated; clay, some carbonate cementation. Visual grain size estimates are 53% silt, 39% clay, 7% very fine sand, and 1% fine sand. Other constituents include minor carbonaceous material. Woody plant material.
	595.1	595.5	Coal. Black (N 1). Broken by joints, somewhat brittle; moderately to well consolidated.
	595.5	597.4	Carbonaceous muddy shale and mudstone. Black (N 1) to very dark gray (5Y 3/1) to gray (5Y 6/1); minor banding, dark shale with some lighter silt/sand. Hard, some areas plastic; minor siltstone/sand stringers and bioturbation; moderately to well consolidated; clay, some carbonate cementation. Visual grain size estimates are 54% silt, 45% clay, and 1% very fine sand. Other constituents include minor carbonaceous material. Woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	597.4	600.4	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (2.5Y 2.5/1) to dark gray (5Y 4/1) to light olive gray (5Y 6/2) to light olive brown (2.5Y 5/4); banded, darker shale and lighter silt/sand; yellowish to reddish-brown clayey spots/layers. Hard; shale with siltstone and silty sand; some bioturbation; some dark, plastic clay, coats core in places; clayey spots and very hard layers (largest 599.9–600.05 ft); finer in lower part, less carbonaceous material, some scattered shells; moderately to well consolidated; clay, some carbonate cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some brown, yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 52% silt, 35% clay, 12% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, sparse fossils, and sparse carbonaceous material. Trace minerals include some microscopic pyrite. Fossils include woody plant material and rare shells (bivalve) near bottom.
	600.4	601.5	Muddy shale. Black (5Y 2.5/1) to dark gray (5Y 4/1); minor banding, dark shale with some lighter silt/sand; some yellowish to reddish-brown clayey spots. Hard, waxy when scraped; minor siltstone/sand stringers; some bioturbation; moderately to well consolidated; clay, some carbonate cementation. Visual grain size estimates are 57% silt, 42% clay, and 1% very fine sand. Other constituents include minor fossils and sparse carbonaceous material. Trace minerals include some microscopic pyrite. Fossils include shells (bivalve), shell fragments, woody plant material, and leaf (?) at 600.6 ft.
	601.5	606.4	Interbedded muddy shale and siltstone. Black (N 1 to 2.5Y 2.5/1) to very dark gray (5Y 3/1) to light olive gray (5Y 6/2) to light olive brown (2.5Y 5/4); sparse banding, darker shale/clay and lighter siltstone; yellowish to reddish-brown clayey spots; 603.8–604.3 ft dusky red when cored, later black upon drying. Hard to brittle; slightly to very carbonaceous; few zones with siltstone/sand stringers; some bioturbation (?); sandy zones at 603.2 and 606.7 ft; poorly to moderately consolidated; clay cementation. Visual grain size estimates for entire interbedded interval are 52% silt, 46% clay, 1% very fine sand, and 1% fine sand. Other constituents include minor carbonaceous material. Trace constituents include microscopic pyrite and amber (?). Fossils include woody plant material (some large streaks/pieces) and rare shell fragments.
	606.4	607.9	Carbonaceous muddy shale and lignite. Black (N 1 to 2.5YR 2.5/1). Waxy to plastic; splits easily; carbonaceous muddy shale and clay with lignite in middle of interval (approximately 607.3–607.7 ft), gradational contacts; moderately to well consolidated; clay cementation. Visual grain size estimates are 52% clay and 48% silt. Trace minerals include some microscopic pyrite and gypsum. Woody plant material.
	607.9	609	Carbonaceous muddy shale and mudstone. Dark olive gray (5Y 3/2) to black (5Y 2.5/1 to N 1). Waxy to plastic; breaks easily; moderately consolidated; clay cementation. Visual grain size estimates are 52% clay and 48% silt. Other constituents include minor carbonaceous material. Trace minerals include some microscopic pyrite. Woody plant material.
	609	610.1	Carbonaceous muddy shale and mudstone. Black (N 1 to 2.5Y 2.5/1); brown sandy silt area at 609.5 ft. Hard, splits easily; may be some lignite; moderately consolidated; clay cementation. Visual grain size estimates are 53% silt, 46% clay, and 1% very fine sand. Other constituents include minor carbonaceous material. Trace minerals include some microscopic pyrite, gypsum, and some amber (?). Woody plant material.
	610.1	611.2	Interbedded sandy siltstone, silty sandstone, and muddy shale. Light olive gray (5Y 6/2) to light yellowish brown (2.5Y 6/4); dark olive gray (5Y 3/2); black (2.5Y 2.5/1 to N 1); banded, lighter silt/sand and darker shale/mud; yellowish to reddish-brown clayey spots. Some disturbed bedding; shale increasing with depth; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some brown, yellow, and gray grains. Visual grain size estimates for entire interbedded interval are 46% silt, 29% clay, 23% very fine sand, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor carbonaceous material, and sparse dark accessory minerals. Woody plant material.
	611.2	611.9	Carbonaceous muddy shale and mudstone. Black (N 1 to 2.5Y 2.5/1); some reddish-brown clayey spots. Hard, splits easily; scattered thin streaks/lenses of silt/sand; middle part of interval very carbonaceous; moderately consolidated; clay cementation. Visual grain size estimates are 53% silt, 46% clay, and 1% very fine sand. Trace minerals include some microscopic pyrite. Woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	611.9	613	Interbedded sandy siltstone, silty sandstone, and muddy shale. Light olive gray (5Y 6/2) to dark olive gray (5Y 3/2) to black (2.5Y 2.5/1 to N 1); banded, lighter silt/sand and darker shale/mud; yellowish to reddish-brown clayey spots. Some disturbed bedding; some dark plastic clay/mud squeezed out (?) and coating core; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some yellow, brown, and gray grains. Visual grain size estimates for entire interbedded interval are 43% silt, 32% very fine sand, 24% clay, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, sparse dark accessory minerals, and sparse carbonaceous material. Trace minerals include some magnetite. Woody plant material.
	613	614	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (2.5Y 2.5/1) to dark gray (5Y 4/1) to light olive gray (5Y 6/2) to light olive brown (2.5Y 5/4); banded, darker shale and lighter silt/sand; yellowish to reddish-brown clayey spots/layers. Hard; some bioturbation; some dark, plastic clay/mud, coats core in places; moderately to well consolidated; clay, carbonate cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some brown, yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 45% silt, 38% clay, 16% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Woody plant material.
	614	614.2	Muddy shale and claystone. Black (N 1 to 2.5Y 2.5/1). Hard; waxy in places when split; waxy when scraped; moderately consolidated; clay cementation. Visual grain size estimates are 52% clay and 48% silt. Other constituents include minor carbonaceous material and sparse fossils. Fossils include some woody plant material and some small (1 mm [0.04 in.]) shells.
	614.2	614.8	No core was retrieved.
	614.8	616	Muddy shale and mudstone. Olive gray (5Y 4/2) to black (5Y 2.5/1 to N 1); faint banding. Hard; waxy in places when split; waxy when scraped; moderately to well consolidated; clay, some carbonate cementation. Visual grain size estimates are 52% clay and 48% silt. Other constituents include minor carbonaceous material. Woody plant material.
	616	617.9	Muddy shale. Black (N 1 to 5Y 2.5/1) to dark gray (5Y 4/1); faint banding. Hard; waxy when scraped; few small sand streaks (very fine); moderately to well consolidated; clay, some carbonate cementation. Visual grain size estimates are 56% silt and 44% clay. Other constituents include minor fossils and minor carbonaceous material. Trace minerals include some microscopic pyrite. Fossils include shells (bivalve) and some woody plant material.
	617.9	619	Mudstone. Black (5Y 2.5/1) to dark gray (5Y 4/1); light yellowish brown (2.5Y 6/4); brown (10YR 4/3); yellowish-brown mud clasts; small brown clayey spots. Brittle, core cracking like dried mud; hard concretion at 619 ft; poorly to moderately consolidated; clay, some carbonate cementation. Large yellowish-brown mud clasts. Visual grain size estimates are 54% clay and 46% silt. Other constituents include minor carbonaceous material. Trace minerals include microscopic pyrite. Woody plant material.
	619	619.4	Muddy shale and mudstone. Dark olive gray (5Y 3/2) to dark gray (5Y 4/1). Splits easily; moderately consolidated; clay, carbonate cementation. Visual grain size estimates are 53% silt and 47% clay. Other constituents include sparse carbonaceous material. Woody plant material.
	619.4	620.5	Interbedded muddy shale and siltstone. Black (N 1 to 2.5Y 2.5/1) to very dark gray (5Y 3/1) to light olive gray (5Y 6/2) to light olive brown (2.5Y 5/4); few zones with banding, darker shale/clay and lighter silt; yellowish to reddish-brown clayey spots. Hard to brittle; slightly carbonaceous; poorly to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some yellow, brown, and red grains. Visual grain size estimates for entire interbedded interval are 51% silt, 43% clay, and 6% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, sparse dark accessory minerals, and sparse carbonaceous material. Woody plant material.
	620.5	620.7	Mudstone. Light yellowish brown (2.5Y 6/4) to brown (10YR 4/3). Very hard; difficult to get grain size, could be siltstone or claystone; some shells appear to be in cemented layer, some in dark mud packed against cemented layer; moderately consolidated to well cemented; carbonate, clay cementation. Visual grain size estimates are 50% clay and 50% silt. Other constituents include minor fossils. Fossils include shells (bivalve) and shell fragments.
	620.7	622.1	Muddy shale and mudstone. Black (5Y 2.5/1 to N 1) to olive gray (5Y 4/2). Breaks easily; waxy in places when split; waxy when scraped; moderately to well consolidated; clay, some carbonate cementation. Visual grain size estimates are 51% silt and 49% clay. Other constituents include minor fossils and minor carbonaceous material. Fossils include shells (bivalve) and some woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	622.1	623.7	Carbonaceous muddy shale. Black (N 1 to 5Y 2.5/1); sparse light gray sandy streaks. Breaks easily; thin, silty, very fine sand streak on top of very carbonaceous layer at 622.9 ft; presumable coal (unusually very dense) 622.9–623.3 ft; hard with light gray silty sand clasts/streaks below 623.5 ft; moderately to well consolidated; clay cementation. Visual grain size estimates are 53% silt and 47% clay. Woody plant material.
	623.7	624	Sandy siltstone. Olive gray (5Y 5/2) to light gray (5Y 7/1); "salt and pepper" appearance. Moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some gray grains. Visual grain size estimates are 47% very fine sand, 37% silt, and 16% clay. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Woody plant material.
	624	624.5	Mudstone. Black (10YR 2/1) and brown (10YR 5/3); black clay with brown mud clasts; few olive gray clasts; some small brownish yellow clasts. Firm mud clasts in soft, plastic clay; very hard to tell grain size; some clear, angular, very fine sand-sized grains in brown mudstone; some sand and carbonaceous material in black clay; very poorly to moderately consolidated; clay cementation. Visual grain size estimates are 56% clay, 41% silt, and 3% very fine sand. Other constituents include sparse carbonaceous material.
	624.5	626.7	Silty sandstone. Olive gray (5Y 5/2) to gray (5Y 6/1); dark gray to black streaks/spots; yellowish to reddish-brown clayey spots/streaks. Firm but breaks easily; thin clayey/carbonaceous streaks/spots, thicker black streak at top of interval; more streaks 624.5–624.6, 625.4–625.6, 626.1–626.2, and 626.5–626.7 ft; some small (<5 mm [0.20 in.]), round concretions (pyritic?) in upper part; still damp; poorly consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some yellow, brown, green, and red grains. Visual grain size estimates are 64% very fine sand, 23% silt, 11% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include magnetite.
	626.7	629.8	Carbonaceous muddy shale and mudstone. Black (5Y 2.5/2 to N 1) to dark gray (5Y 4/1); yellowish-brown streak at 628.5 ft. Firm to hard, breaks/splits easily; gradational contact with overlying interval; waxy when scraped; more of a mudstone in upper and lower parts of interval; sparse light, very fine sand spots; some carbonaceous material has gypsum and sulfur (?); transition to coal starts at 629.7 ft; moderately to well consolidated; clay cementation. Visual grain size estimates are 51% clay, 48% silt, and 1% very fine sand. Trace minerals include some microscopic pyrite. Woody plant material.
	629.8	630.1	Coal. Black (N 1). Transitional between lithology in overlying and underlying depth intervals. Trace minerals include gypsum and pyrite. Woody plant material.
	630.1	631.7	Carbonaceous muddy shale and mudstone. Black (5Y 2.5/2 to N 1) to dark gray (5Y 4/1). Firm to hard, breaks/splits easily; transitions from coal 630.1–630.2 ft; coal parting at 631 ft; moderately to well consolidated; clay cementation. Visual grain size estimates are 51% silt and 49% clay. Trace minerals include microscopic pyrite, gypsum, sulfur in coal vein, and amber (?). Woody plant material.
	631.7	632	No core was retrieved.
	632	633.5	Carbonaceous muddy shale and coal. Black (N 1) to very dark gray (5Y 3/1); yellowish to reddish-brown clayey spots/streaks. Firm to hard, breaks/splits easily; waxy when scraped; moderately to well consolidated; clay cementation. Visual grain size estimates are 52% clay and 48% silt. Trace minerals include some microscopic pyrite and amber (?). Woody plant material.
	633.5	633.7	Coal. Black (N 1). Transitions from overlying into underlying units.
	633.7	634.5	Carbonaceous muddy shale and coal. Black (N 1) to very dark grayish brown (10YR 3/2). Firm to hard, breaks/splits easily; very fine sand and limonite streaks at bottom of interval; moderately to well consolidated; clay cementation. Visible grains have limonite staining. Visual grain size estimates are 52% silt, 45% clay, and 3% very fine sand. Trace minerals include some microscopic pyrite and amber (?). Woody plant material.
	634.5	636.3	Silty sandstone with muddy shale interbeds. Olive gray (5Y 5/2) to light brownish gray (2.5Y 6/2) and dark olive gray (5Y 3/2) to dark yellowish brown (2.5Y 4/2); dark gray to black clayey/carbonaceous streaks; yellowish to reddish-brown clayey spots/streaks. Firm but breaks easily; layered light silty sand and darker shale; thin clayey/carbonaceous streaks; concretionary (limonite, pyritic?) in upper 0.2 ft; still damp; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; limonite staining; some brown, yellow, gray, red, and green grains. Visual grain size estimates for entire interbedded interval are 42% very fine sand, 27% silt, 17% clay, and 14% fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, minor carbonaceous material, and sparse mica. Trace minerals include magnetite. Woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	636.3	637	No core was retrieved.
	637	640	Silty sandstone with muddy shale interbeds. Olive gray (5Y 5/2) to light brownish gray (2.5Y 6/2) and dark olive gray (5Y 3/2) to dark yellowish brown (2.5Y 4/2); dark gray to black clayey/carbonaceous streaks; yellowish to reddish-brown clayey spots/streaks. Firm but breaks easily below; layered light silty sand and darker shale; thin clayey/carbonaceous streaks; brown clayey spots/streaks, some hard; some fine- to medium-grained sand layers; some siltstone layers near bottom of interval; very poorly to moderately consolidated; clay, carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; limonite staining; some brown, yellow, gray, red, and green grains. Visual grain size estimates for entire interbedded interval are 42% very fine sand, 24% silt, 18% clay, 12% fine sand, and 4% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Trace minerals include magnetite. Woody plant material.
	640	640.5	Interbedded sandy siltstone and mudstone. Gray (5Y 5/1) to light gray (2.5Y 7/1) and dark gray (5Y 4/1) to yellowish brown (10YR 5/4), banded, lighter silt/sand and darker mud/clay. Very hard, very dense; layered siltstone and sandstone with mudstone and claystone; very well consolidated/cemented; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some brown, yellow, gray, red, and green grains. Visual grain size estimates for entire interbedded interval are 49% silt, 36% clay, 14% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material.
	640.5	640.9	Interbedded sandy siltstone, silty sandstone, and muddy shale. Light olive gray (5Y 6/2) to light olive brown (2.5Y 5/4) and very dark gray (5Y 3/1) to dark brown (10YR 3/3); banded, darker shale/clay and lighter silt/sand; yellowish to reddish-brown clayey spots/layers. Hard, splits easily; grades into underlying unit; moderately to well consolidated; clay, carbonate cementation. Visual grain size estimates for entire interbedded interval are 49% silt, 29% clay, and 22% very fine sand. Other constituents include minor carbonaceous material. Woody plant material.
	640.9	643.4	Interbedded muddy shale, mudstone, and siltstone. Black (N 1 to 2.5Y 2.5/1) to very dark gray (5Y 3/1) to dark brown (10YR 3/3) with light olive gray (5Y 6/2) to light olive brown (2.5Y 5/4); some color banding, darker shale/mud and lighter silt; yellowish to reddish-brown clayey spots. Hard, splits easily; some bioturbation (?); moderately to well consolidated; clay cementation. Visual grain size estimates are 56% silt, 43% clay, and 1% very fine sand. Other constituents include minor carbonaceous material. Trace minerals include some gypsum. Woody plant material.
	643.4	646.8	No core was retrieved.
	646.8	649.8	Muddy shale. Black (N 1) to very dark gray (5Y 3/1); yellowish to reddish-brown clayey spots/streaks. Hard to brittle, breaks/splits easily; waxy when scraped; few lighter silt/sand streaks/layers; some presumable bioturbation (tracks?); moderately to well consolidated; clay cementation. Visual grain size estimates are 57% silt and 43% clay. Other constituents include minor fossils and minor carbonaceous material. Trace minerals include abundant microscopic pyrite, some amber (?), and some gray to iridescent botryoidal streaks (unknown constituent). Fossils include woody plant material, shells (bivalve, conical), shell fragments, and shell layers.
	649.8	650.9	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (2.5Y 2.5/1) to dark gray (5Y 4/1) to light olive gray (5Y 6/2) to light olive brown (2.5Y 5/4); banded to mottled, darker shale and lighter silt/sand; yellowish to reddish-brown clayey spots/layers. Hard, splits easily; bioturbation; moderately to well consolidated; clay cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some brown, yellow, red, green grains. Visual grain size estimates for entire interbedded interval are 38% clay, 49% silt, 12% very fine sand, and 1% fine sand. Other constituents include sparse fossils, minor carbonaceous material. Trace minerals include microscopic pyrite and some gray to iridescent botryoidal streaks (unknown constituent). Fossils include woody plant material; some shells, shell fragments.
	650.9	651.6	Muddy shale. Black (N 1 to 5Y 2.5/1) to very dark grayish brown (2.5Y 3/2); yellowish to reddish-brown clayey spots/streaks. Hard to brittle, breaks/splits easily; waxy when scraped; few lighter silt/sand streaks/layers; some presumable bioturbation (tracks?); moderately to well consolidated; clay cementation. Visual grain size estimates are 52% silt and 48% clay. Other constituents include minor carbonaceous material and sparse fossils. Trace minerals include microscopic pyrite (abundant in some areas) and some gray to iridescent botryoidal streaks. Fossils include woody plant material, some shells (bivalve), and shell fragments.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	651.6	652	Carbonaceous mudstone. Dark grayish brown (2.5Y 4/2) to light yellowish brown (2.5Y 6/3) to yellowish brown (10YR 5/4) with dark gray (5Y 4/1) to very dark gray (10YR 3/1) to black (N 1); darker at top and bottom of interval. Hard; waxy when scraped; some larger carbonaceous material; well consolidated/cemented; carbonate, clay cementation. Visual grain size estimates are 53% clay and 47% silt. Other constituents include minor carbonaceous material. Trace minerals include microscopic pyrite. Woody plant material.
	652	652.6	Coal. Black (N 1). Brittle to hard; poorly to moderately consolidated. Trace minerals include some microscopic pyrite and amber (?). Woody plant material. Fossils include a shell fragment.
	652.6	653.1	Carbonaceous muddy shale and coal. Black (N 1) to very dark gray (2.5Y 3/1). Hard to brittle; breaks/splits easily; moderately to well consolidated; clay cementation. Visual grain size estimates are 55% silt and 45% clay. Woody plant material.
	653.1	654.2	Carbonaceous sandy siltstone. Dark gray (2.5Y 4/1) to black (N 1). Hard; splits easily; some coal stringers; some lighter sandy areas; coarsens downward; very carbonaceous silty sand in bottom 0.2 ft with amber (?); moderately to well consolidated; clay, some carbonate cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some brown, yellow, red, and gray grains. Visual grain size estimates are 62% silt, 20% clay, 17% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, major carbonaceous material, sparse coal, and sparse mica. Trace minerals include amber (?) (bottom 0.2 ft). Woody plant material.
	654.2	654.8	Coal. Black (N 1). Hard to brittle; some silty sand spots/streaks; moderately consolidated. Trace minerals include some microscopic pyrite and amber (?). Woody plant material.
	654.8	657	No core was retrieved.
	657	657.6	Mudstone. Black (10YR 2/1) to dark olive gray (5Y 3/2) with pale brown (10YR 6/3); brown mud clasts in black mud and dark olive gray silty zones, becoming layered/banded mudstone of same colors in bottom part. Very poorly to moderately consolidated; clay cementation. Visual grain size estimates are 56% silt, 41% clay, and 3% very fine sand. Other constituents include sparse carbonaceous material.
	657.6	659.8	Interbedded sandy siltstone, muddy sandstone, and muddy shale. Light brownish gray (2.5Y 6/2) to light gray (2.5Y 7/1) to dark gray (5Y 4/1) to black (2.5Y 2.5/1); banded to mottled, lighter silt/sand and darker shale; yellowish to reddish-brown clayey spots/layers. Hard to loose, splits easily; some presumable bioturbation; hard concretion at 659.3 ft, very dense, heavy; some thin coal streaks/stringers in upper part; poorly to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some brown, yellow, green, and red grains. Visual grain size estimates for entire interbedded interval are 45% silt, 29% clay, 23% very fine sand, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include magnetite and some microscopic pyrite. Woody plant material.
	659.8	660.1	Muddy shale and claystone. Olive brown (2.5Y 4/3) to olive gray (5Y 4/2) to black (5Y 2.5/1). Hard, splits/breaks easily; waxy when scraped, some waxy when broken; moderately to well consolidated; clay cementation. Visual grain size estimates are 62% clay and 38% silt. Other constituents include sparse carbonaceous material.
	660.1	660.9	Mudstone. Very dark grayish brown (2.5Y 3/2) to light olive brown (2.5Y 5/3); black carbonaceous and yellowish to reddish-brown clayey spots. Very hard; very well consolidated/cemented; carbonate, clay cementation. Visual grain size estimates are 51% silt and 49% clay. Other constituents include minor carbonaceous material. Trace minerals include some microscopic pyrite. Woody plant material.
	660.9	661.8	Interbedded muddy shale, sandy siltstone, and muddy sandstone. Black (2.5Y 2.5/1) to very dark gray (2.5Y 3/1) and olive gray (5Y 5/2) to gray (5Y 5/1 to 5Y 6/1); some banded to mottled, darker shale and lighter silt/sand; yellowish to reddish-brown clayey spots/layers. Hard, splits easily; moderately to well consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some brown, yellow, green, and red grains. Visual grain size estimates for entire interbedded interval are 53% silt, 27% clay, 19% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Woody plant material.
	661.8	662.7	Carbonaceous muddy shale and mudstone. Black (N 1 to 5Y 2.5/1) to very dark grayish brown (10YR 3/2); some reddish to yellowish brown clayey spots. Firm to hard, breaks/splits easily; moderately to well consolidated; clay cementation. Visual grain size estimates are 53% silt and 47% clay. Trace minerals include microscopic pyrite. Woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	662.7	663	Interbedded sandy siltstone, muddy sandstone, and muddy shale. Black (2.5Y 2.5/1) to very dark grayish brown (2.5Y 3/2) to dark grayish brown (2.5Y 4/2) to gray (2.5Y 6/1); yellowish-brown concretions at top of interval; reddish to yellowish-brown clayey spots. Transitional zone from mostly shale to mostly sand; very hard concretions at top of interval, claystone (?); poorly to moderately consolidated; clay cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some brown, yellow, gray, and red grains. Visual grain size estimates for entire interbedded interval are 43% silt, 27% clay, 23% very fine sand, and 7% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Woody plant material.
	663	665.5	Muddy sandstone. Light olive gray (5Y 6/2) to light brownish gray (2.5Y 6/2) to gray (5Y 6/1); "salt and pepper" appearance; thin dark gray to black clayey/carbonaceous streaks; yellowish to reddish-brown clayey spots/streaks. Loose to firm; unconsolidated to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some brown, yellow, gray, red, and green grains. Visual grain size estimates are 31% fine sand, 29% very fine sand, 19% silt, 14% clay, and 7% medium sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include magnetite. Woody plant material.
	665.5	666.5	Interbedded muddy shale, sandy siltstone, and muddy sandstone. Black (N 1) to very dark brown (10YR 2/2) to olive (5Y 5/3) to dark brown (10YR 3/3) to yellowish brown (10YR 5/6); banded, darker shale/mud with lighter silt/sand; yellowish to reddish-brown clayey spots. Layered shale/mud with thin siltstone/sand; dark plastic clay/mud squeezed out (?) and coating core; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some brown, yellow, gray, red, and green grains. Visual grain size estimates for entire interbedded interval are 42% silt, 36% clay, 21% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Woody plant material.
	666.5	669.5	Interbedded sandy siltstone, muddy sandstone, and muddy shale. Light gray (2.5Y 7/2 to 5Y 7/1) to grayish brown (2.5Y 5/2) with dark yellowish brown (10YR 4/4) to very dark grayish brown (2.5Y 3/2) to black (2.5Y 2.5/1); banded to mottled, lighter silt/sand and darker shale/clay; yellowish to reddish-brown clayey spots/layers. Hard to brittle, splits/breaks easily; layered siltstone/silty sand and shale/clay; some bioturbation; hard layer at 662.7 ft, very dense, heavy; poorly to moderately consolidated; carbonate, clay cementation. Visible grains angular to subrounded; subprismoidal to subdiscoidal; some brown, yellow, orange, red, and green grains. Visual grain size estimates for entire interbedded interval are 46% silt, 27% very fine sand, 21% clay, and 6% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include magnetite.
	669.5	672	No core was retrieved.
	672	674.7	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (N 1) to dark brown (10YR 3/3) to olive (5Y 4/3) to light olive brown (2.5Y 5/4) to light olive gray (5Y 6/2) to light gray (5Y 7/1); banded with thinly layered darker shale/clay and lighter silt/sand; yellowish to reddish-brown clayey spots/layers; some presumable bioturbation; some dark, plastic clay/mud coats core in places; moderately consolidated; clay, carbonate (in upper part) cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some brown, yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 49% silt, 31% clay, and 20% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, sparse fossils, and sparse carbonaceous material. Fossils include some shells and shell fragments.
	674.7	675.8	Carbonaceous muddy shale and coal. Black (N 1 to 5Y 2.5/1). Hard; very carbonaceous at top of interval, decreases with depth; silt increases with depth; gradational change to underlying interval; some dark, plastic clay/mud coats core in places; moderately to well consolidated; clay cementation. Visual grain size estimates are 52% silt and 48% clay. Trace minerals include some microscopic pyrite. Woody plant material.
	675.8	677.6	Siltstone. Dark gray (5Y 4/1) to olive gray (5Y 4/2); some lighter areas of sandy silt; some yellowish to reddish-brown clayey spots. Hard; some waxy layers of dark clay; moderately to well consolidated; carbonate, clay cementation. Visible grains subrounded to subangular; subprismoidal to subdiscoidal. Visual grain size estimates are 72% silt, 24% clay, and 4% very fine sand. Other constituents include minor mica, sparse dark accessory minerals, and sparse carbonaceous material. Trace minerals include some microscopic iridescent (gold to purple) mineral.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	677.6	678	Interbedded muddy shale and sandy siltstone. Olive (5Y 4/3) to olive brown (2.5Y 4/3) to light olive brown (2.5Y 5/4) to dark brown (7.5YR 3/2); banded to mottled, lighter siltstone and darker shale; yellowish to reddish-brown clayey spots/layers. Hard, splits easily; some presumable bioturbation; moderately to well consolidated; carbonate, clay cementation. Visible grains subrounded to subangular; subprismoidal to subdiscoidal. Visual grain size estimates for entire interbedded interval are 61% silt, 27% clay, and 12% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, sparse dark accessory minerals, and sparse carbonaceous material. Woody plant material.
	678	678.7	Sandy mudstone. Dark gray (5Y 4/1) to dark grayish brown (2.5Y 4/2) to light yellowish brown (2.5Y 6/4); somewhat mottled, darker and lighter areas. Hard, splits easily; yellowish zones have more clay, some lighter zones are sandy siltstone; very thin coal stringer near top of interval; moderately to well consolidated; carbonate, clay cementation. Visible grains subrounded to subangular; subprismoidal to subdiscoidal. Visual grain size estimates are 51% silt, 38% clay, and 11% very fine sand. Other constituents include major quartz, minor feldspar, sparse mica, sparse dark accessory minerals, sparse coal, and sparse carbonaceous material. Woody plant material.
	678.7	680	Interbedded siltstone, silty sandstone, and muddy shale. Light gray (2.5Y 7/2) to light olive brown (2.5Y 5/3) with dark olive gray (5Y 3/2) to very dark grayish brown (10YR 3/2) to black (2.5Y 2.5/1); banded to mottled with layered lighter silt/sand and darker shale/clay; yellowish to reddish-brown clayey spots. Hard to brittle, splits/breaks easily; disturbed bedding, some presumable bioturbation; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subrounded to subangular; subprismoidal to subdiscoidal; some brown, yellow, green, and red grains. Visual grain size estimates for entire interbedded interval are 56% silt, 23% very fine sand, and 21% clay. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Woody plant material.
	680	681.9	Interbedded silty sandstone, carbonaceous muddy shale, and clay. Gray (2.5Y 6/1) to very dark grayish brown (2.5Y 3/2), with black (2.5Y 2.5/1); banded with thinly layered gray silt/sand and dark shale/clay, very few layers around 0.1 ft thick; yellowish to reddish-brown clayey spots. Some disturbed bedding; very plastic clay squeezed out coating firmer sand and shale core; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; orange, brown, yellow, and red grains. Visual grain size estimates for entire interbedded interval are 34% silt, 32% very fine sand, 31% clay, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.
	681.9	684.5	Interbedded silty sandstone, carbonaceous muddy shale, and clay. Gray (2.5Y 6/1) to very dark grayish brown (2.5Y 3/2), with black (2.5Y 2.5/1) and very dark brown (7.5YR 2.5/3); thinly banded with layered gray silt/sand and dark shale/clay; yellowish to reddish-brown clayey clasts/layers. Very plastic clay squeezed out coating firmer sand and shale core; poorly to well consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; orange, brown, yellow, and red grains; some mudstone (?) pebbles. Visual grain size estimates for entire interbedded interval are 40% silt, 30% clay, and 30% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.
	681.9	684.5	Interbedded carbonaceous muddy shale and silty sandstone. Very dark grayish brown (2.5Y 6/1) to black (2.5Y 2.5/1) with gray (2.5Y 3/2); thinly banded with layered gray silt/sand and dark shale/clay, very few layers around 0.1 ft thick. Very plastic clay squeezed out coating firmer sand and shale core; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; orange, brown, yellow, and red grains. Visual grain size estimates for entire interbedded interval are 45% silt, 35% clay, and 20% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.
	684.5	685.1	Coal. Black (2.5N 2.5/1). Brittle; moderately to well consolidated. Woody plant material.
	685.1	685.3	Carbonaceous muddy shale and coal. Black (2.5N 2.5/1) to dark gray (2.5Y 4/1). Brittle, fissile, transitional from coal to carbonaceous shale; moderately to well consolidated. Visual grain size estimates are 50% silt, 45% clay, and 5% very fine sand. Woody plant material.
	685.3	686.6	No core was retrieved.
	686.6	687.2	Carbonaceous muddy shale. Black (2.5N 2.5/1) to dark gray (2.5Y 4/1). Hard, waxy when scraped, fissile; some small bits of coal; moderately to well consolidated. Visible grains subangular to rounded; subprismoidal to subdiscoidal. Visual grain size estimates are 51% silt, 47% clay, and 2% very fine sand. Other constituents include minor dark accessory minerals and sparse mica.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	687.2	687.6	Sandy siltstone. Grayish brown (2.5Y 5/2) to black (2.5N 2.5/1). Hard; moderately to well consolidated. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some yellow, brown, red, and green grains. Visual grain size estimates are 40% very fine sand, 30% silt, 23% clay, and 7% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.
	687.6	687.7	Carbonaceous sandy mudstone. Black (N 2.5/1) to grayish brown (2.5Y 5/2). Firm; moderately to well consolidated. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some yellow, brown, red, and green grains. Visual grain size estimates are 35% very fine sand, 30% silt, 25% clay, and 10% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Woody plant material.
	687.7	689	Interbedded silty sandstone and carbonaceous muddy shale. Light olive gray (5Y 6/2) and very dark gray (2.5Y 3/1) to dark greenish gray (10Y 4/1); banded layers of lighter sand with dark shale/clay; few yellowish to reddish-brown clayey spots. Silty sandstone with carbonaceous muddy shale (waxy when scraped) or clay (very plastic, rolls well) interbeds (most very thin, <0.05 in.; few as much as 0.05 ft thick); poorly to moderately consolidated; clay cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; yellow, red, orange, and green grains. Visual grain size estimates for entire interbedded interval are 50% very fine sand, 25% silt, 15% clay, and 10% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Woody plant material.
	689	692.8	Silty sandstone. Light olive gray (5Y 6/2); “salt and pepper” appearance; some color banding, dark shale/clay and dark yellowish brown laminae; banding more frequent 689.8–690.2 and 692.8–693.6 ft. Some zones are finer, more silt; hard to determine what material may be carbonaceous; poorly to moderately consolidated. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; yellow, red, orange, and green grains. Visual grain size estimates are 70% very fine sand, 15% silt, 10% fine sand, and 5% clay. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.
	692.8	695.1	Silty sandstone. Light olive gray (5Y 6/2) with dark gray (2.5Y 4/1), dark yellowish brown (10YR 4/6), and black (2.5N 2.5/1); “salt and pepper” appearance; banded with dark laminae, carbonaceous, shale, and clay laminae; some zones are finer, more silt; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; yellow, red, orange, and green grains. Visual grain size estimates are 65% very fine sand, 17% silt, 10% fine sand, and 8% clay. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.
	695.1	695.5	Interbedded silty sandstone, carbonaceous muddy shale, and clay. Light gray (2.5Y 7/2), dark olive brown (2.5Y 3/3), gray (2.5Y 6/1), very dark gray (2.5Y 3/1), yellowish brown (10YR 5/8), dusky red (10R 3/4). Hard zones, somewhat brittle, soft to plastic clay zones that squeezed out to coat core; layered silty sandstone, carbonaceous sandstone, carbonaceous muddy shale, and clay; poorly to well consolidated; clay, carbonate cementation. Visible grains subangular to rounded; subprismoidal to subdiscoidal; some limonite staining; yellow, red, orange, and green grains. Visual grain size estimates for entire interbedded interval are 45% silt, 30% very fine sand, 23% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.
	695.5	696.2	Carbonaceous gravelly clay. Black (N 2.5/1), very dark gray (2.5Y 3/1), dark reddish brown (5YR 3/3), grayish brown (2.5Y 5/2); some color banding. Very plastic; contains lighter colored clasts, pebbles, and black coal, most clasts are in lower half; poorly consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some limonite staining; yellow, red, orange, and green grains; mudstone, siltstone, and sandstone (as much as 30-mm [1.18-in.]) clasts. Visual grain size estimates are 60% clay, 26% silt, 8% very fine sand, 3% medium pebbles, and 3% coarse pebbles. Other constituents include minor feldspar, minor carbonaceous material, and sparse coal. Trace minerals include feldspar pebbles (as much as 15 mm [0.59 in.]). Woody plant material.
	696.2	696.8	Interbedded carbonaceous muddy shale and silty sandstone. Light gray (2.5Y 7/1) to very dark grayish brown (2.5Y 3/2) to light olive brown (2.5Y 5/3); banded with layered light silt/sand and dark shale. Poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; yellow, red, orange, and some green grains. Visual grain size estimates for entire interbedded interval are 38% silt, 35% very fine sand, and 27% clay. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	696.8	696.9	Muddy sandstone. Light brownish gray (2.5Y 6/2). Poorly consolidated; some clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; yellow, red, orange, and some green grains. Visual grain size estimates are 47% very fine sand, 27% silt, 14% clay, and 12% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material.
	696.9	699.2	Carbonaceous muddy shale. Black (N 2.5/1) to very dark grayish brown (2.5Y 3/2) to light olive brown (2.5Y 5/3) to light brownish gray (2.5Y 6/2); some thin bands/partings, lighter and darker. Some thin sandy siltstone layers, decreasing with depth; some thin partings of carbonaceous clay (plastic); fissile, waxy when scraped; poorly to moderately consolidated; clay, some carbonate cementation in upper part. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; yellow, red, orange, and some green grains. Visual grain size estimates are 52% silt, 34% clay, and 14% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, minor carbonaceous material, and sparse fossils. Trace minerals include microscopic pyrite and gypsum (?), increasing with depth. Fossils include woody plant material and shells.
	699.2	701.1	Interbedded carbonaceous muddy shale and sandy siltstone. Black (N 2.5/1) to very dark grayish brown (2.5Y 3/2); some lighter sandy zones near bottom of interval; some dark plastic clay coating core. Some presumable bioturbation; moderately to well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; yellow, red, orange, and some green grains. Visual grain size estimates for entire interbedded interval are 53% silt, 35% clay, and 12% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, minor carbonaceous material, sparse coal, and sparse fossils. Trace minerals include microscopic pyrite. Fossils include woody plant material and some shells.
	701.1	701.4	Sandy siltstone. Light gray (5Y 7/1) to olive gray (5Y 4/2) with dark olive gray (5Y 3/2); streaks of dark clay/mud/carbonaceous material. Poorly consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and green grains. Visual grain size estimates are 46% very fine sand, 41% silt, 12% clay, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include magnetite. Woody plant material.
	701.4	702.2	Carbonaceous muddy shale. Black (N 2.5/1) to very dark gray (10YR 3/2). Some silty sand spots/streaks (presumable bioturbation); less clay in bottom half; moderately to well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and green grains. Visual grain size estimates are 51% silt, 47% clay, and 2% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include microscopic pyrite. Woody plant material.
	702.2	704.2	Interbedded muddy shale and sandy siltstone. Black (N 1) to very dark gray (2.5Y 3/1) and dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1); mottled to banded, dark shale and lighter sand/silt; yellowish to reddish-brown clayey spots; light olive brown (2.5Y5/4) to pale yellow (2.5Y7/4) mudstone. Disturbed bedding (presumable bioturbation); slightly to very carbonaceous muddy shale with sandy siltstone; very hard mudstone zone/clast at 702.8 ft; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and green grains. Visual grain size estimates for entire interbedded interval are 57% silt, 31% clay, and 12% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse coal. Trace minerals include microscopic pyrite. Woody plant material.
	704.2	704.7	Interbedded sandy siltstone, silty sandstone, and muddy shale. Dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1) and black (N 1) to very dark gray (2.5Y 3/1); thinly banded, lighter silt/sand and darker shale/clay/mud (varves?); yellowish to reddish-brown clayey spots. Thinly layered silt and sand with slightly carbonaceous muddy shale and some plastic clay/mud (some squeezed out and coated core); poorly to well consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates for entire interbedded interval are 52% silt, 27% clay, and 21% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include some magnetite. Woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	704.7	704.9	Silty sandstone. Light gray (5Y 7/1). Poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some yellow, red, green, and gray grains. Visual grain size estimates are 56% very fine sand, 32% silt, and 12% clay. Other constituents include major quartz, minor mica, sparse feldspar, sparse dark accessory minerals, and sparse carbonaceous material. Trace minerals include magnetite.
	704.9	705.5	Interbedded sandy siltstone, silty sandstone, and muddy shale. Very dark gray (2.5Y 3/1) to dark yellowish brown (10YR 4/4) to light gray (5Y 7/1); some very thin banding. Some disturbed bedding (presumable bioturbation); well consolidated/cemented; carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow and orange grains. Visual grain size estimates for entire interbedded interval are 51% silt, 27% clay, and 22% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include some magnetite.
	705.5	705.9	Interbedded silty sandstone, sandy siltstone, and muddy shale. Light gray (5Y 7/1) to dark grayish brown (2.5Y 4/2) and black (N 1) to very dark gray (2.5Y 3/1); lighter silt/sand layered with darker shale/clay/mud; yellowish to reddish-brown clayey spots. Very poorly to moderately consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; some yellow, red, green, and gray grains. Visual grain size estimates for entire interbedded interval are 41% very fine sand, 37% silt, 12% clay, and 10% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include magnetite.
	705.9	707	No core was retrieved.
	707	708.7	Interbedded muddy shale and sandy siltstone. Black (N 1) to very dark gray (10YR 3/1) and dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1); thinly banded to mottled, dark shale and lighter silt/sand; yellowish to reddish-brown clayey spots. Layered slightly to very carbonaceous muddy shale and sandy siltstone (few silty sand stringers); disturbed bedding (presumable bioturbation); moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and green grains. Visual grain size estimates for entire interbedded interval are 52% silt, 39% clay, and 9% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Woody plant material.
	708.7	710.5	Coal. Black (N 1 to 2.5N 2.5/1). Brittle; few spots of light silt or clay; moderately to well consolidated. Woody plant material.
	710.5	711.1	Interbedded carbonaceous muddy shale, sandy siltstone, and silty sandstone. Black (N 1) to dark brown (7.5YR 3/3) and dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1); thinly banded to mottled, dark shale/clay/mud with lighter silt/sand. Layered carbonaceous muddy shale and plastic clay/mud with silt and sand; disturbed bedding (presumable bioturbation); moderately to well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; brown, gray; some yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 38% silt, 29% very fine sand, 26% clay, and 7% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse coal. Woody plant material.
	711.1	713.5	Interbedded muddy shale, sandy siltstone, and silty sandstone. Very dark gray (10YR 3/1) to black (N 1) and dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1); banded to mottled, dark shale/clay/mud with lighter silt/sand; some yellowish to reddish-brown clayey spots. Layered slightly to very carbonaceous muddy shale and plastic clay/mud with silt and sand; disturbed bedding (presumable bioturbation); more silt/sand 712.6–713 ft; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; brown, gray; some yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 48% silt, 31% very fine sand, and 21% clay. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material.
	713.5	716.6	No core was retrieved.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	716.6	721.7	Interbedded muddy shale, sandy siltstone, and silty sandstone. Very dark gray (10YR 3/1) to black (N 1) and dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1); banded to mottled, dark shale/clay/mud with lighter silt/sand; some yellowish to reddish-brown clayey spots; brown (10YR 4/3) mudstone nodules. Layered slightly carbonaceous muddy shale and plastic clay/mud (coats core in places) with silt and sand; disturbed bedding (presumable bioturbation); hard to brittle; some fine sand near base; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, brown, red, and green grains; hard mudstone nodules (40+ mm [1.58+ in.]) at 717.6, 718.7, and 719.7 ft. Visual grain size estimates for entire interbedded interval are 55% silt, 25% clay, and 20% very fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, sparse feldspar, sparse fossils, and sparse carbonaceous material. Fossils include small shell at 721.6 ft.
	721.7	722.1	Muddy sandstone. Gray (5Y 6/1) to light olive gray (5Y 6/2); “salt and pepper” appearance; some yellowish to reddish-brown clayey spots. Some clay/mud streaks, more in bottom 0.1 ft (transitional, very fine sand only); slight petroleum-like odor when scraped; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; brown, yellow, green, and red grains. Visual grain size estimates are 30% very fine sand, 29% fine sand, 21% silt, 11% clay, and 9% medium sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include some clear flakes greater than 1 mm (0.04 in.) (mica?) and some magnetite. Woody plant material.
	722.1	723.2	Interbedded muddy shale, sandy siltstone, and silty sandstone. Very dark gray (10YR 3/1) to black (N 1) and dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1); banded to mottled, dark shale/clay/mud with lighter silt/sand; some yellowish to reddish-brown clayey spots. Layered slightly carbonaceous muddy shale and plastic clay/mud (coats core in places) with silt and sand; disturbed bedding (presumable bioturbation); poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; yellow, brown, red, and green grains. Visual grain size estimates for entire interbedded interval are 54% silt, 27% clay, and 19% very fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, sparse feldspar, and sparse carbonaceous material. Woody plant material.
	723.2	723.3	Mudstone. Dark brown (10YR 3/3) to yellowish brown (10YR 5/6) to pale brown (10YR 6/3) to dark reddish brown (5YR 3/3). Very hard, dense; oxidized; well consolidated/cemented; clay, carbonate cementation. Visual grain size estimates are 63% silt and 37% clay.
	723.3	725	Interbedded muddy shale, sandy siltstone, and silty sandstone. Very dark gray (10YR 3/1) to black (N 1) and dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1); banded to mottled, dark shale/clay/mud with lighter silt/sand; some yellowish to reddish-brown clayey spots. Layered slightly carbonaceous muddy shale and plastic clay/mud (coats core in places) with silt and sand; disturbed bedding (presumable bioturbation); poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; yellow, brown, red, and green grains. Visual grain size estimates for entire interbedded interval are 51% silt, 32% clay, and 17% very fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, minor carbonaceous material, and sparse feldspar. Trace minerals include some microscopic pyrite. Woody plant material.
	725	725.9	Carbonaceous muddy shale. Black (N 1) to dark olive gray (5Y 3/2); some lighter silt partings; some dark clay coating core. Waxy when scraped; some bioturbation; some soft to plastic clay coating core; poorly to moderately consolidated; clay, some carbonate cementation. Visual grain size estimates are 56% silt, 42% clay, and 2% very fine sand. Trace minerals include microscopic pyrite and some amber (?). Woody plant material.
	725.9	726	Carbonaceous clay. Black (N 1). Plastic; poorly consolidated; clay cementation. Visual grain size estimates are 76% clay and 24% silt.
	726	727.1	Coal. Black (N 1). Brittle, hard to soft; some shale/mud zones; poorly to moderately consolidated. Visual grain size estimates of shale/mud zones are 51% silt and 49% clay. Trace minerals include gypsum and microscopic pyrite. Woody plant material.
	727.1	727.6	Carbonaceous muddy shale. Black (N 1) to dark brown (10YR 3/3). Waxy, hard; moderately to well consolidated. Visual grain size estimates are 57% clay and 43% silt. Other constituents include major carbonaceous material. Trace minerals include some microscopic pyrite and amber (?). Woody plant material.
	727.6	730	No core was retrieved.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	730	731.3	Carbonaceous muddy shale. Black (N 1 to 5Y 2.1/1); black clay coating parts of core. Waxy, hard; some silty spots; moderately to well consolidated. Visual grain size estimates are 55% clay and 45% silt. Other constituents include major carbonaceous material. Trace minerals include some microscopic pyrite. Woody plant material.
	731.3	732.4	Carbonaceous muddy shale and coal. Black (N 1 to 5Y 2.1/1); black clay coating core. Brittle (coal/lignite) and plastic to waxy muddy shale; some silty spots; very poorly to moderately consolidated. Visual grain size estimates are 54% clay and 46% silt. Other constituents include major coal and major carbonaceous material. Trace minerals include gypsum, some microscopic pyrite, and amber (?). Woody plant material.
	732.4	733.7	Carbonaceous muddy shale and coal. Black (N 1 to 5Y 2.1/1); black clay coating core. Brittle to fissile, plastic to waxy; some silty spots; very poorly to moderately consolidated. Visual grain size estimates are 53% clay and 47% silt. Other constituents include minor coal, major fossils, and major carbonaceous material. Trace minerals include gypsum, bottom part has microscopic pyrite and yellow powder (sulfur?). Fossils include shells (bivalves, broken) and woody plant material.
	733.7	736.2	Interbedded muddy shale, sandy siltstone, and silty sandstone. Very dark gray (10YR 3/1) to black (N 1) and dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1); banded (some very thin) to mottled, dark shale/clay/mud with lighter silt/sand; some yellowish to reddish-brown clayey spots. Some very thin layers (varves?), slightly carbonaceous muddy shale and plastic clay/mud with silt and sand; disturbed bedding (presumable bioturbation); poorly to moderately consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; yellow, brown, red, and green grains. Visual grain size estimates for entire interbedded interval are 52% silt, 32% clay, and 16% very fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, sparse feldspar, sparse fossils, and sparse carbonaceous material. Trace minerals include blue-green streak in shale at 734 ft (botryoidal), some yellow powder, and gypsum. Fossils include woody plant material and few shell fragments.
	736.2	737	No core was retrieved.
	737	737.3	Muddy shale. Very dark gray (10YR 3/1) to black (10YR 2/1); some color banding with lighter silt; some reddish-brown mud. Very sticky; muck from hole (?); very poorly consolidated; clay, carbonate cementation. Visual grain size estimates are 52% clay and 48% silt. Other constituents include sparse carbonaceous material.
	737.3	740.3	Interbedded sandy siltstone, silty sandstone, and muddy shale. Dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1) and very dark gray (10YR 3/1) to black (10YR 2.5/1); banded, lighter silt/sand with dark shale/clay/mud; some yellowish to reddish-brown clayey spots; dark yellowish-brown concretionary zones/layer. Some very thin layers (varves?), silt and sand with slightly carbonaceous muddy shale and plastic clay/mud; disturbed bedding (presumable bioturbation); concretionary zone 738.3–738.4 ft, another firm layer at 740.2 ft; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; yellow, brown, red, and green grains. Visual grain size estimates for entire interbedded interval are 47% silt, 29% clay, and 24% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, sparse fossils, and sparse carbonaceous material. Trace minerals include some microscopic magnetite. Fossils include few shell fragments.
	740.3	742	Interbedded muddy shale and sandy siltstone. Black (N 1) to very dark gray (10YR 3/1) and dark grayish brown (2.5Y 4/2) to light gray (5Y 7/1); banding, dark shale/clay with lighter siltstone. Transitional; layered slightly to very carbonaceous muddy shale/clay with siltstone (decreasing with depth); some scattered lenses of sand; very thin coal/lignite stringer at 741.6 ft; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, and orange grains. Visual grain size estimates for entire interbedded interval are 46% silt, 43% clay, 10% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, minor carbonaceous material, and sparse fossils. Trace minerals include microscopic pyrite; gypsum and amber (?) in coal stringer. Woody plant material. Fossils include shells (bivalves, scattered and in layers).

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	742	744	Interbedded sandy siltstone, silty sandstone, and muddy shale. Grayish brown (2.5Y 5/2) to light gray (5Y 7/1) and very dark gray (10YR 3/1) to dark brown (10YR 3/3); faint banding, layered lighter silt and sand with dark slightly carbonaceous muddy shale/clay; yellowish to reddish-brown clayey spots. Hard; some disturbed bedding; moderately to well consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and gray grains. Visual grain size estimates for entire interbedded interval are 45% silt, 27% clay, 25% very fine sand, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite and some magnetite. Woody plant material.
	744	744.6	Muddy sandstone. Light brownish gray (2.5Y 6/2). Hard to friable; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and gray grains. Visual grain size estimates are 50% very fine sand, 27% silt, 17% clay, and 6% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include magnetite.
	744.6	746	Interbedded sandy siltstone, silty sandstone, and muddy shale. Grayish brown (2.5Y 5/2) to light gray (5Y 7/1) and very dark gray (10YR 3/1) to dark brown (10YR 3/3); banded, layered lighter silt/sand with darker slightly carbonaceous shale/clay; yellowish to reddish-brown clayey spots/lenses. Hard; some disturbed bedding (some presumable bioturbation); some clayey spots/lenses very hard; moderately to well consolidated; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and gray grains. Visual grain size estimates for entire interbedded interval are 47% silt, 31% clay, 21% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite and some magnetite. Woody plant material.
	746	746.7	Interbedded muddy shale and sandy siltstone. Very dark gray (10YR 3/1) to dark brown (10YR 3/3) and grayish brown (2.5Y 5/2) to light gray (5Y 7/1); banded, layered darker slightly carbonaceous muddy shale/clay with lighter silt; yellowish to reddish-brown clayey spots/lenses. Hard; some clayey spots/lenses very hard; some disturbed bedding (some presumable bioturbation); some sand in bioturbated areas; moderately to well consolidated/cemented; carbonate, clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and gray grains. Visual grain size estimates for entire interbedded interval are 52% silt, 36% clay, 11% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, sparse fossils, and sparse carbonaceous material. Woody plant material. Fossils include a few shell fragments.
	746.7	749	Muddy shale. Black (N 1) to dark gray (5Y 4/1) to dark grayish brown (2.5Y 4/2); some color banding. Hard; some thin streaks of siltstone; some disturbed bedding (presumable bioturbation); moderately to well consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal. Visual grain size estimates are 52% silt, 47% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, minor carbonaceous material, and sparse fossils. Trace minerals include microscopic pyrite. Woody plant material. Fossils include some shell fragments (bivalve, gastropods).
	749	751.8	Sandy mudstone. Black (N 1) to very dark grayish brown (2.5Y 3/2) to gray (5Y 5/1); some black clay. Hard to friable; some plastic clay; some hydrogen sulfide (?) odor; some small pieces of coal; gradational change at bottom of interval, fining with depth; moderately consolidated; clay, little carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; some yellow, red, brown, and green grains. Visual grain size estimates are 34% very fine sand, 28% silt, 26% clay, and 12% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include gypsum, microscopic pyrite, and some magnetite; some yellow powder on outside of core (sulfur?). Fossils include oyster beds (749.3–749.4, 750, 750.6, and 751.5 ft) and scattered shells.
	751.8	754.1	Sandy mudstone. Black (N 1) to very dark grayish brown (2.5Y 3/2) to gray (5Y 5/1); some black plastic clay. Hard to firm; some hydrogen sulfide (?) odor; some small pieces of coal near bottom of interval; moderately consolidated; clay, little carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some black staining; some yellow, red, brown, and green grains. Visual grain size estimates are 40% silt, 37% clay, 22% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, minor fossils, minor carbonaceous material. Trace minerals include gypsum and microscopic pyrite. Fossils include shells and oyster beds.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	754.1	754.7	Carbonaceous muddy shale. Black (N 1) to very dark grayish brown (2.5Y 3/2) to gray (5Y 5/1). Hard to fissile; some hydrogen sulfide (?) odor; moderately consolidated; clay, little carbonate cementation. Visual grain size estimates are 51% silt, 44% clay, and 5% very fine sand. Trace minerals include gypsum, microscopic pyrite, and some yellow powder on outside of core (sulfur?). Woody plant material.
	754.7	757.7	Interbedded sandy siltstone, silty sandstone, and muddy shale. Gray (5Y 5/1) to light gray (5Y 7/1) and very dark gray (10YR 3/1) to dark brown (10YR 3/3); banded, layered lighter silt/sand with darker slightly carbonaceous muddy shale and plastic clay; some yellowish to reddish-brown clayey spots. Hard; some disturbed bedding (some presumable bioturbation); more fine sand layers near 757 ft; poorly to moderately consolidated; clay, some carbonate (more near bottom) cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; yellow, red, orange, and brown grains. Visual grain size estimates for entire interbedded interval are 48% silt, 25% clay, 23% very fine sand, and 4% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include microscopic pyrite, some magnetite, and some gypsum. Some woody plant material. Fossils include a few shells.
	757.7	758.8	Sandy siltstone. Gray (5Y 6/1) to light gray (2.5Y 7/1) when scraped, black (5Y 2.5/1) to dark gray (5Y 4/1) when broken; light banding; yellowish to reddish-brown zone at 758.7 ft. Very hard; appears to be similar to layers above and below, just very well cemented, size estimates very rough; very well consolidated/cemented; carbonate, clay cementation. Visual grain size estimates are 51% silt, 24% clay, 24% very fine sand, and 1% fine sand. Minor carbonaceous material. Woody plant material. Fossils include shells (758.6–758.75 ft).
	758.8	760.1	Interbedded muddy shale and siltstone. Dark gray (5Y 4/1) to light brownish gray (2.5Y 6/2), some black (5Y 2.5/1); banded, layered darker slightly carbonaceous muddy shale/clay with lighter silt; yellowish to reddish-brown clayey spots. Hard to brittle; some very fine to fine sand layers at bottom of interval; moderately to well consolidated/cemented; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and gray grains. Visual grain size estimates for entire interbedded interval are 51% silt, 46% clay, 2% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Some woody plant material. Fossils include a few shell fragments.
	760.1	760.2	Mudstone. Brown (10YR 4/3). Very hard; size estimates very rough; very well consolidated/cemented; carbonate, clay cementation. Visual grain size estimates are 51% clay, 47% silt, and 2% very fine sand.
	760.2	763.2	Interbedded muddy shale and siltstone. Very dark gray (10YR 3/1) to dark brown (10YR 3/3) and grayish brown (2.5Y 5/2) to light gray (5Y 7/1); banded, layered darker slightly carbonaceous muddy shale and plastic clay with lighter silt/sand; yellowish to reddish-brown clayey spots. Hard to brittle; clay coats core in places; moderately to well consolidated/cemented; clay, carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some yellow, red, orange, and gray grains. Visual grain size estimates for entire interbedded interval are 52% silt, 38% clay, and 10% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Some woody plant material. Fossils include shells (scattered).
	763.2	765	Carbonaceous muddy shale with interbedded siltstone. Black (2.5Y 2.5/1) to light gray (2.5Y 7/1) with some dark brown (10YR 3/3); thinly banded/layered black muddy shale/clay with some gray silt at top to silty sand at bottom. Some plastic clay layers (swelling?); parts preferentially on silt/sand layers; poorly to well consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some black staining; some brown, and few green grains. Visual grain size estimates are 52% silt, 33% clay, and 15% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, sparse fossils, and sparse carbonaceous material. Some woody plant material. Fossils include a few shells.
	765	767	Interbedded carbonaceous muddy shale and silty sandstone. Black (2.5Y 2.5/1) to light gray (2.5Y 7/1); thinly banded with layered black muddy shale/clay and gray silt/silty sand. Some plastic clay layers; parts preferentially on silt/sand layers; poorly to well consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some black staining; some brown, yellow, and few green grains. Visual grain size estimates for entire interbedded interval are 50% silt, 28% clay, and 22% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, sparse fossils, and sparse carbonaceous material. Trace minerals include some micaceous zones and few areas of microscopic pyrite. Some woody plant material. Fossils include a few shells.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation	767	768.6	Interbedded carbonaceous mudstone and silty sandstone. Black (2.5Y 2.5/1) to light gray (2.5Y 7/1); thinly banded with layered black plastic clay and mudstone and gray silty sand. Parts preferentially on sand layers; poorly to well consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some black staining; some brown, yellow, and few green grains. Visual grain size estimates for entire interbedded interval are 45% silt, 30% clay, 24% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include some micaceous zones and few areas of microscopic pyrite. Some woody plant material. Fossils include a few shells or shell fragments.
	768.6	770.7	Interbedded carbonaceous muddy shale and silty sandstone. Black (2.5Y 2.5/1) to light gray (2.5Y 7/1); thinly banded with layered black muddy shale/clay and gray silt to silty sand. Some plastic clay layers; parts preferentially on silt/sand layers; poorly to well consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some black staining; some brown, yellow, and few green grains. Visual grain size estimates for entire interbedded interval are 48% silt, 30% clay, 21% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, sparse fossils, and sparse carbonaceous material. Trace minerals include some micaceous zones and few areas of microscopic pyrite. Some woody plant material. Fossils include a few small shells or shell fragments.
	770.7	770.9	Siltstone. Light olive brown (2.5Y 5/4) to dark brown (7.5YR 3/2). Very hard; very well cemented. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; orange grains. Visual grain size estimates are 67% silt, 32% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and sparse dark accessory minerals.
	770.9	771.5	Interbedded carbonaceous muddy shale and silty sandstone. Black (2.5Y 2.5/1) to light gray (2.5Y 7/1), grayish brown (2.5Y 5/2); thinly banded, black muddy shale/clay and gray silt to silty sand. Some plastic clay layers; parts preferentially on silt/sand layers; poorly to well consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some black staining; some brown, yellow, and few green grains. Visual grain size estimates for entire interbedded interval are 48% silt, 30% clay, 21% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, sparse fossils, and sparse carbonaceous material. Trace minerals include some micaceous zones and few areas of microscopic pyrite. Some woody plant material. Fossils include a few shells or shell fragments.
	771.5	772.9	Carbonaceous sandy muddy shale. Black (2.5Y 2.5/1) with light gray (2.5Y 7/1), grayish brown (2.5Y 5/2); black carbonaceous muddy shale with some thin bands of lighter silt and silty sand. Moderately to well consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; some black staining; some brown, yellow, and few green grains. Visual grain size estimates are 52% silt, 38% clay, and 10% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor fossils. Trace minerals include some microscopic pyrite. Woody plant material. Fossils include shells (bivalves, gastropods [bumpy conical spiral, example at 772.3 ft]).
	772.9	775.6	Carbonaceous muddy shale. Black (N 1) with grayish brown (2.5Y 5/2); white to tan shells. Fossiliferous, shells larger and more abundant in bottom part (probable oyster bed); brittle, almost a coal; some silty sand lenses in upper part; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal. Visual grain size estimates are 51% silt, 42% clay, and 7% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite, gypsum (crystals and clusters), and sulfur near bottom of interval. Fossils include shells (bivalves, some with iridescence), some gastropods (flat coil, smooth conical spiral, examples at 773 ft).
	775.6	776.6	Coal. Black (N 1). Very brittle; very poorly consolidated. Trace minerals include microscopic pyrite, gypsum (crystals and clusters), and sulfur near top of interval (secondary?), more apparent when core uncovered for examination).
	776.6	777	No core was retrieved.
	777	779	Carbonaceous muddy shale. Black (N 1) with grayish brown (2.5Y 5/2); a few very thin light gray silt bands/laminations. Parts easily, some intervals almost coal; poorly to well consolidated; clay cementation. Visual grain size estimates are 57% silt, 42% clay, and 1% very fine sand. Other constituents include minor dark accessory minerals, and sparse mica. Woody plant material.
	779	779.7	Coal. Black (N 1). Hard, light weight; well consolidated. Trace minerals include microscopic pyrite and gypsum.

Unit	Depth below land surface (in feet)		Description
	From	To	
Fox Hills Sandstone	779.7	783.4	Muddy sandstone. Olive gray (5Y 4/2) to gray (5Y 6/1); “salt and pepper” appearance. Few very thin carbonaceous or muddy streaks; unconsolidated to poorly consolidated. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; red, brown, yellow, and green grains. Visual grain size estimates are 47% very fine sand, 33% fine sand, 11% silt, and 9% clay. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Top of depth interval interpreted as top of first of two sandstone beds (“upper bed”; 779.7–794.4 ft) composing the “upper” Fox Hills Sandstone.
	783.4	784	No core was retrieved.
	784	794.4	Muddy sandstone. Olive gray (5Y 4/2) to gray (5Y 6/1); “salt and pepper” appearance; some very thin black to very dark brown streaks; grains turn bright greenish yellow with HCl; turned yellowish brown above coal; some very thin carbonaceous streaks (examples 788.9, 790.5, and 792.2 ft), increasing with depth; unconsolidated to poorly consolidated. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; red, brown, yellow, and green grains. Visual grain size estimates are 44% very fine sand, 30% fine sand, 14% silt, and 12% clay. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Trace minerals include mica in carbonaceous streaks (black, bronze, gold, green, silver). Woody plant material. Bottom of depth interval interpreted as bottom of “upper bed” (779.7–794.4 ft) of the “upper” Fox Hills Sandstone.
Lance Formation (tongue between two sandstone beds of the Fox Hills Sandstone)	794.4	796	Coal. Black (N 1). Hard to slightly brittle, lightweight, splits easily; well consolidated. Trace minerals include pyrite and gypsum in partings. Top of depth interval is top of Lance Formation tongue (794.4–808.4 ft) located between “upper” and “lower” sandstone beds composing the “upper” Fox Hills Sandstone.
	796	796.6	Carbonaceous sandy muddy shale. Black (N 1) to dark brown (10YR 3/3); banded. Firm to hard; splits easily; gradational with intervals above and below; moderately to well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal. Visual grain size estimates are 55% silt, 33% clay, and 12% very fine sand. Other constituents include major quartz, major carbonaceous material, minor dark accessory minerals, sparse feldspar, sparse mica, and sparse coal. Trace minerals include gypsum. Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.
	796.6	797.3	Interbedded carbonaceous muddy shale and silty sandstone. Black (5Y 2.5/1) to dark gray (5Y 4/1) to light gray (5Y 7/1); banded with layered dark carbonaceous muddy shale and light silty sand. Disturbed bedding; one thin layer of fine sand separating two distinct disturbed zones at 797.1 ft; lower part has more silty sand; moderately to well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; brown, yellow, and green grains. Visual grain size estimates for entire interbedded interval are 42% silt, 32% very fine sand, 24% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, and sparse mica. Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.
	797.3	797.8	Muddy sandstone. Olive gray (5Y 4/2) to gray (5Y 6/1); “salt and pepper” appearance; some very thin, dark gray carbonaceous clay streaks. Unconsolidated to poorly consolidated. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; red, brown, yellow, and green grains. Visual grain size estimates are 51% very fine sand, 29% silt, 17% clay, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.
	797.8	798.1	Interbedded carbonaceous muddy shale and silty sandstone. Black (5Y 2.5/1) to dark gray (5Y 4/1) to light gray (5Y 7/1); banded, dark carbonaceous muddy shale and light silty sand. Moderately to well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; brown, yellow, and green grains. Visual grain size estimates for entire interbedded interval are 43% silt, 31% very fine sand, and 26% clay. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation (tongue between two sandstone beds of the Fox Hills Sandstone)	798.1	798.4	Muddy sandstone. Olive gray (5Y 4/2) to gray (5Y 6/1); “salt and pepper” appearance; some very thin, dark gray carbonaceous clay streaks. Unconsolidated to poorly consolidated. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; red, brown, yellow, and green grains. Visual grain size estimates are 42% very fine sand, 25% fine sand, 21% silt, and 12% clay. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.
	798.4	799	Interbedded carbonaceous muddy shale and sandy siltstone. Black (5Y 2.5/1) to dark gray (5Y 4/1) to light gray (5Y 7/1); banded, dark carbonaceous clay/shale and gray sandy silt. Moderately to well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; red, brown, yellow, and green grains. Visual grain size estimates for entire interbedded interval are 46% silt, 32% clay, and 22% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.
	799	800.6	Interbedded carbonaceous muddy shale and siltstone. Black (5Y 2.5/1) to dark gray (5Y 4/1) to very dark grayish brown (2.5Y 3/2) and light gray (5Y 7/1) to gray (2.5Y 5/1); thinly banded, dark carbonaceous muddy shale and plastic clay with light silt. Moderately to well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; yellow and brown grains. Visual grain size estimates for entire interbedded interval are 57% silt, 42% clay, and 1% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.
	800.6	802	Carbonaceous muddy shale. Black (5Y 2.5/1) to dark gray (5Y 4/1) to very dark grayish brown (2.5Y 3/2) with light gray (5Y 7/1) to gray (2.5Y 5/1); some thin bands, dark carbonaceous muddy shale with light very thin silty lenses; waxy when scraped; well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; yellow and brown grains. Visual grain size estimates are 56% silt and 44% clay. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.
	802	802.4	Carbonaceous muddy shale. Black (5Y 2.5/1) to dark gray (5Y 4/1) to very dark grayish brown (2.5Y 3/2) with light gray (5Y 7/1) to gray (2.5Y 5/1); some thin bands, dark carbonaceous muddy shale and light very thin silty lenses. Waxy when scraped; almost brittle; well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; yellow and brown grains. Visual grain size estimates are 54% silt and 46% clay. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.
	802.4	804	No core was retrieved.
	804	805.4	Carbonaceous muddy shale. Black (N 1) to very dark gray (5Y 3/1) with olive gray (5Y 4/2) to light gray (5Y 7/1); few thin bands, dark carbonaceous muddy shale with few very thin lighter silt and (or) sand lenses/spots. Some larger bits of carbonaceous material appear to be coal; waxy when scraped; well consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; yellow and brown grains. Visual grain size estimates are 51% silt, 47% clay, 1% very fine sand, and 1% fine sand. Other constituents include major quartz, minor dark accessory minerals, minor carbonaceous material, sparse feldspar, sparse mica, and sparse coal. Trace minerals include some gypsum and amber (?). Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.
	805.4	805.7	Carbonaceous muddy shale and coal. Black (N 1). Soft (almost "spongy") to brittle; fissile carbonaceous muddy shale, plastic carbonaceous clay, lignite (?); poorly consolidated; clay cementation. Visible grains angular to subrounded; prismoidal to subdiscoidal. Visual grain size estimates are 48% silt, 47% clay, 2% very fine sand, 1% fine sand, 1% medium sand, and 1% coarse sand. Other constituents include major carbonaceous material, minor quartz, minor coal, sparse feldspar, sparse mica, and sparse dark accessory minerals. Trace minerals include gypsum (as much as 1 mm [0.04 in.] in length) and some microscopic pyrite. Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between “upper” and “lower” sandstone beds of the “upper” Fox Hills Sandstone.

Unit	Depth below land surface (in feet)		Description
	From	To	
Lance Formation (tongue between two sandstone beds of the Fox Hills Sandstone)	805.7	807.6	Interbedded carbonaceous muddy shale and siltstone. Black (N 1) to olive gray (5Y 4/2) and gray (5Y 6/1) to light gray (5Y 7/1); banded, dark shale/clay/coal and light silt/sand; yellow (5Y 8/6) oxidation around 806.8 ft. Layered, carbonaceous muddy shale, plastic clay, silt, and some silty sand; some thin lignite/coal layers; poorly consolidated; clay cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal; black staining; yellow, brown, and orange grains. Visual grain size estimates for entire interbedded interval are 47% silt, 45% clay, 7% very fine sand, and 1% fine sand. Other constituents include major quartz, minor mica, minor dark accessory minerals, minor carbonaceous material, sparse feldspar, and sparse coal. Trace minerals include gypsum, microscopic pyrite, and a micaceous zone at 807.2 ft (50%). Woody plant material. Depth interval composes part of Lance Formation tongue between "upper" and "lower" sandstone beds of the "upper" Fox Hills Sandstone.
	807.6	807.7	Silty sandstone. Dark gray (5Y 4/1) to olive (5Y 4/3); yellow (5Y 8/6) oxidation (not present when collected). Very heavy, dense; well cemented; unknown (not carbonate) cementation. Visible grains subangular to subrounded; subprismoidal to subdiscoidal. Visual grain size estimates are 61% very fine sand, 20% silt, 10% fine sand, and 9% clay. Other constituents include major quartz, minor mica, minor dark accessory minerals, minor carbonaceous material, and sparse feldspar. Trace minerals include gypsum, pyrite, and amber (?). Woody plant material. Depth interval composes part of Lance Formation tongue (794.4–808.4 ft) between "upper" and "lower" sandstone beds of the "upper" Fox Hills Sandstone.
	807.7	808.4	Coal. Black (N 1 to 5Y 2.5/1). Brittle, once a joint is opened, it starts to fall apart; some stray sand grains (very fine to fine); moderately consolidated. Bottom of depth interval is bottom of Lance Formation tongue (794.4–808.4 ft) between "upper" and "lower" sandstone beds of the "upper" Fox Hills Sandstone.
Fox Hills Sandstone	808.4	809.3	Carbonaceous silty sandstone. Black (10YR 2/1) to dark brown (10YR 3/3) to olive brown (2.5Y 4/3). Gradational—darker and firmer at top, lighter and soft at base; poorly to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; black staining; brown, red, yellow, and some green grains. Visual grain size estimates are 61% very fine sand, 21% fine sand, 12% silt, and 6% clay. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, minor carbonaceous material, and sparse mica. Woody plant material. Top of depth interval is top of "lower" sandstone bed (808.4–846.3 ft) of the "upper" Fox Hills Sandstone.
	809.3	817	Muddy sandstone. Grayish brown (2.5Y 5/2 to 2.5Y 5/1); "salt and pepper" appearance; some thin dark streaks; thin carbonaceous streaks and scattered carbonaceous material; some siltier zones; unconsolidated to poorly consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; black staining; yellow, red, and green grains. Visual grain size estimates are 60% very fine sand, 21% fine sand, 12% silt, and 7% clay. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, minor carbonaceous material, and sparse mica. Trace minerals include magnetite. Depth interval is within "lower" sandstone bed (808.4–846.3 ft) of the "upper" Fox Hills Sandstone.
	817	824	Muddy sandstone. Olive gray (5Y 5/2) to gray (5Y 5/1); "salt and pepper" appearance; a few thin dark streaks. Few thin carbonaceous/mud streaks and scattered carbonaceous material; unconsolidated to poorly consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates are 58% very fine sand, 24% fine sand, 11% silt, 6% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, minor carbonaceous material, and sparse mica. Depth interval is within "lower" sandstone bed (808.4–846.3 ft) of the "upper" Fox Hills Sandstone.
	824	829.6	Muddy sandstone. Olive gray (5Y 5/2) to gray (5Y 5/1); "salt and pepper" appearance; a few thin dark streaks. Few thin carbonaceous/micaceous/mud streaks and scattered carbonaceous material; 3-mm (0.12-in.) concretionary ball at 827.5 ft, pyritic (?) (bagged); unconsolidated to poorly consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates are 57% very fine sand, 25% fine sand, 11% silt, 6% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, minor carbonaceous material, and sparse mica. Depth interval is within "lower" sandstone bed (808.4–846.3 ft) of the "upper" Fox Hills Sandstone.

Unit	Depth below land surface (in feet)		Description
	From	To	
Fox Hills Sandstone	829.6	831.3	Muddy sandstone. Olive gray (5Y 5/2) to gray (5Y 5/1); “salt and pepper” appearance. Unconsolidated to poorly consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, green, red, and gray grains. Visual grain size estimates are 57% very fine sand, 27% fine sand, 9% silt, 5% clay, and 2% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse carbonaceous material, and sparse mica. Depth interval is within “lower” sandstone bed (808.4–846.3 ft) of the “upper” Fox Hills Sandstone.
	831.3	837.5	Muddy sandstone. Olive gray (5Y 5/2) to gray (5Y 5/1); “salt and pepper” appearance; a few thin gray to black streaks. Few thin carbonaceous/micaceous/mud streaks and scattered carbonaceous material; unconsolidated to poorly consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, green, red, and gray grains. Visual grain size estimates are 59% very fine sand, 21% fine sand, 12% silt, 7% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse carbonaceous material, and sparse mica. Trace minerals include pyritic spot (cluster of <1-mm [0.04-in.] nodules) at 832.8 ft. Depth interval is within “lower” sandstone bed (808.4–846.3 ft) of the “upper” Fox Hills Sandstone.
	837.5	837.7	Muddy sandstone. Olive gray (5Y 5/2) to gray (5Y 5/1) to yellowish brown (10YR 5/6); “salt and pepper” appearance; thin yellowish-brown mud streaks; thin mud streaks with scattered carbonaceous material, gradual appearance and disappearance of mud; unconsolidated to poorly consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, green, red, and gray grains. Visual grain size estimates are 45% very fine sand, 28% silt, 15% clay, and 12% fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse carbonaceous material, and sparse mica. Depth interval is within “lower” sandstone bed (808.4–846.3 ft) of the “upper” Fox Hills Sandstone.
	837.7	841.9	Silty sandstone. Olive gray (5Y 5/2) to gray (5Y 5/1); “salt and pepper” appearance; a few thin gray to black carbonaceous/micaceous/mud streaks; scattered carbonaceous material; unconsolidated to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, green, red, and gray grains. Visual grain size estimates are 55% very fine sand, 19% fine sand, 17% silt, 8% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse carbonaceous material, and sparse mica. Depth interval is within “lower” sandstone bed (808.4–846.3 ft) of the “upper” Fox Hills Sandstone.
	841.9	846.3	Muddy sandstone. Olive gray (5Y 5/2) to gray (5Y 5/1); “salt and pepper” appearance; thin gray to black carbonaceous and yellowish brown mud streaks; some scattered carbonaceous material, finer grained near streaks; unconsolidated to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, green, red, and gray grains. Visual grain size estimates are 51% very fine sand, 19% fine sand, 18% silt, 11% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, minor carbonaceous material, and sparse mica. Woody plant material. Bottom of depth interval is bottom of “lower” sandstone bed (808.4–846.3 ft) of the “upper” Fox Hills Sandstone.
Upper transition member of the Pierre Shale	846.3	847.6	Interbedded silty sandstone and carbonaceous muddy shale. Olive gray (5Y 4/2), black (5Y 2.5/1), and yellowish brown (10YR 5/6); banded, gray silty sand and black muddy shale, some yellowish-brown mud. Unconsolidated to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, green, red, and gray grains. Visual grain size estimates for entire interbedded interval are 34% silt, 32% very fine sand, 27% clay, and 7% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Woody plant material. Top of depth interval is top of the upper transition member of the Pierre Shale.
	847.6	849.1	Interbedded muddy shale and sandy siltstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to light gray (5Y 7/2); banded, dark slightly carbonaceous muddy shale and light silt with some silty very fine sand; some yellowish-brown spots. Poorly to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow and red grains. Visual grain size estimates for entire interbedded interval are 52% silt, 38% clay, and 10% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and minor carbonaceous material. Trace minerals include microscopic pyrite. Woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Upper transition member of the Pierre Shale	849.1	854.1	Interbedded muddy shale, sandy siltstone, and muddy sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 6/1); banded, dark slightly carbonaceous muddy shale and black plastic clay with light silt and sand; some yellowish-brown clayey spots. Poorly to well consolidated; clay, some carbonate (near base) cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow and red grains. Visual grain size estimates for entire interbedded interval are 50% silt, 31% clay, and 19% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite and calcite (small void fill [?] at 853 ft, crystals about 0.1 mm [0.004 in.]). Woody plant material.
	854.1	856	No core was retrieved.
	856	856.9	Interbedded sandy siltstone, silty sandstone, and muddy shale. Olive gray (5Y 4/2) to light gray (5Y 7/1) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded, light silt/sand and dark slightly carbonaceous muddy shale; some yellowish-brown clayey spots. Moderately to well consolidated; clay, carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow and red grains. Visual grain size estimates for entire interbedded interval are 44% silt, 34% very fine sand, 22% clay. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Woody plant material.
	856.9	860.9	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 6/1); banded, dark slightly carbonaceous muddy shale and black plastic clay with light silt/sand; some yellowish-brown clayey spots. Poorly to well consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow and red grains. Visual grain size estimates for entire interbedded interval are 51% silt, 29% clay, 19% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite. Woody plant material.
	860.9	862	No core was retrieved.
	862	863	Silty sandstone. Light olive gray (5Y 6/2) and light olive brown (2.5Y 5/3) to olive gray (5Y 4/2); banded light olive (gray and brown) for most of interval, olive gray below dark mud parting; brown layers in upper part have yellowish-brown clay. Dark mud parting, very plastic, rolls well; brown layers in upper part have clay, more mica, and carbonaceous particles; poorly to moderately consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates are 55% very fine sand, 30% silt, 14% clay, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, sparse dark accessory minerals, and sparse carbonaceous material. Woody plant material.
	863	864.1	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 6/1); banded, dark slightly carbonaceous muddy shale, black plastic clay/mud, and light silt/sand; some yellowish-brown clayey spots. Poorly to well consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow and red grains. Visual grain size estimates for entire interbedded interval are 53% silt, 32% clay, and 15% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some microscopic pyrite. Woody plant material.
	864.1	864.6	Silty sandstone. Olive gray (5Y 5/2); some yellowish-brown clayey spots. Unconsolidated to poorly consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates are 60% very fine sand, 26% silt, 12% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material.
	864.6	865.1	Muddy shale. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) to olive gray (5Y 4/2); banded, dark slightly carbonaceous muddy shale and black plastic clay/mud; some yellowish-brown clayey spots. Poorly to well consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal. Visual grain size estimates are 56% silt, 42% clay, and 2% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals.

Unit	Depth below land surface (in feet)		Description
	From	To	
Upper transition member of the Pierre Shale	865.1	877	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 6/1); banded, dark slightly carbonaceous muddy shale and black plastic clay/mud with light silt and sand (increasing with depth); some yellowish-brown clayey spots. Some disturbed bedding, presumable bioturbation; poorly to well consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 52% silt, 27% clay, 20% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some microscopic pyrite. Woody plant material.
	877	879.1	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 6/1); banded, dark slightly to very carbonaceous muddy shale and black plastic clay/mud with light silt/sand; some yellowish-brown clayey spots. Some disturbed bedding; poorly to well consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 54% silt, 29% clay, and 17% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite. Woody plant material.
	879.1	883.2	Interbedded sandy siltstone, silty sandstone, and muddy shale. Olive gray (5Y 4/2) to gray (5Y 6/1) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded, light silt/sand with dark slightly to very carbonaceous muddy shale; some yellowish to reddish-brown clayey spots. Some disturbed banding, presumable bioturbation; poorly to well consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green grains. Visual grain size estimates for entire interbedded interval are 52% silt, 33% very fine sand, 12% clay, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include microscopic pyrite and amber (?) at 883.6 ft. Fossils include woody plant material, small iridescent shell fragment (<0.5 mm [0.02 in.]) at 879.3 ft, and shells and bioturbation at 880.9 ft.
	883.2	883.4	Silty sandstone. Light olive gray (5Y 6/2); some light banding; some yellowish to reddish-brown clayey spots. Moist (11/19/13); unconsolidated to poorly consolidated; clay, carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, brown, red, green, and gray grains. Visual grain size estimates are 58% very fine sand, 27% silt, 10% clay, and 5% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material.
	883.4	886.5	Interbedded sandy siltstone, silty sandstone, and muddy shale. Olive gray (5Y 4/2) to gray (5Y 6/1) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded, light silt/sand with dark slightly to very carbonaceous muddy shale and black plastic clay/mud; some yellowish to reddish-brown clayey spots. Disturbed bedding, presumable bioturbation; poorly to well consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 54% silt, 30% very fine sand, 14% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite. Woody plant material.
	886.5	887	No core was retrieved.
	887	887.7	Interbedded sandy siltstone, silty sandstone, and muddy shale. Olive gray (5Y 4/2) to gray (5Y 5/1) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded, lighter silt/sand with darker slightly carbonaceous muddy shale and black plastic clay/mud; yellowish to reddish-brown clayey spots (increasing with depth). Disturbed bedding, presumable bioturbation; poorly to well consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 55% silt, 25% very fine sand, 17% clay, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and sparse dark accessory minerals. Trace minerals include microscopic pyrite. Woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Upper transition member of the Pierre Shale	887.7	889	Interbedded sandy siltstone, silty sandstone, and muddy shale. Olive gray (5Y 4/2) to gray (5Y 5/1) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded, lighter silt/sand with darker slightly carbonaceous muddy shale and black plastic clay/mud; yellowish to reddish-brown clayey spots. Disturbed bedding, presumable bioturbation; moderately to well consolidated; carbonate, clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 37% very fine sand, 35% silt, 15% fine sand, 12% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, sparse fossils, and sparse carbonaceous material. Trace minerals include microscopic pyrite. Fossils include woody plant material and some small shells (<0.5 mm [0.02 in.]).
	889	891.7	Muddy sandstone. Olive gray (5Y 5/2); dark yellowish-brown clay clast at 891.5 ft. Dark clay/mud and few carbonaceous streaks; unconsolidated to poorly consolidated; clay, some carbonate cementation. Visible grains subrounded to subangular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates are 52% very fine sand, 19% fine sand, 17% silt, 11% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Trace minerals include magnetite.
	891.7	893	No core was retrieved.
Fox Hills Sandstone	893	897	Muddy sandstone. Olive gray (5Y 5/2); somewhat “salt and pepper” appearance; yellowish-brown to dark streaks/spots; yellowish-brown mud clast at 893.8 ft. Clay/mud and few carbonaceous streaks/spots; unconsolidated to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates are 53% very fine sand, 20% silt, 15% fine sand, 11% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, sparse fossils, and sparse carbonaceous material. Trace minerals include magnetite. Fossils include shells. Top of depth interval is top of “uppermost” sandstone bed (893–905.6 ft) of the “lower” Fox Hills Sandstone.
	897	905.6	Muddy sandstone. Olive gray (5Y 5/2); “salt and pepper” appearance; yellowish-brown to dark streaks/spots. Clay/mud and few carbonaceous streaks/spots; poorly to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates are 54% very fine sand, 20% silt, 13% fine sand, 12% clay, and 1% medium sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Trace minerals include magnetite. Bottom of depth interval is bottom of “uppermost” sandstone bed (893–905.6 ft) of the “lower” Fox Hills Sandstone.
Upper transition member of the Pierre Shale	905.6	906	Interbedded silty sandstone, sandy siltstone, and muddy shale. Gray (5Y 5/1) to olive gray (5Y 5/2) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); dark yellowish brown (10YR 4/4); banding, lighter silt/sand with darker slightly to very carbonaceous muddy shale; yellowish to reddish-brown clayey spots, more in upper part of unit. Disturbed bedding, presumable bioturbation; poorly to well consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 62% silt, 24% clay, 12% very fine sand, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include microscopic pyrite. Fossils include woody plant material, few small shells (<0.5 mm [0.02 in.]), and root cast (?) at 905.7 ft.
	906	907.8	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 6/1); banded, dark slightly carbonaceous muddy shale and black plastic clay/mud with lighter silt/sand; some yellowish-brown clayey spots. Some disturbed bedding, presumable bioturbation (?); poorly to well consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 61% silt, 27% clay, 11% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include microscopic pyrite. Fossils include woody plant material and shell at 907.3 ft.

Unit	Depth below land surface (in feet)		Description
	From	To	
Upper transition member of the Pierre Shale	907.8	908.8	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 6/1); banded, dark slightly carbonaceous muddy shale with lighter silt/sand; some yellowish-brown clayey spots. Disturbed bedding, presumable bioturbation; very hard; well consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; limonite staining; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 60% silt, 29% clay, 10% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite and magnetite. Woody plant material.
	908.8	911.2	Interbedded sandy siltstone, silty sandstone, and muddy shale. Gray (5Y 5/1) to olive gray (5Y 5/2) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); dark yellowish brown (10YR 4/4); banded, lighter silt/sand and darker slightly to very carbonaceous muddy shale, with black plastic clay/mud at bottom of interval; some yellowish-brown clayey spots. Some disturbed bedding, presumable bioturbation; poorly to well consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 57% silt, 21% clay, 21% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite and magnetite. Woody plant material.
Fox Hills Sandstone	911.2	915.2	Silty sandstone. Olive brown (2.5Y 4/4) at top, olive gray (5Y 5/2); somewhat “salt and pepper” appearance; yellowish-brown to dark streaks/spots. Clay/mud and few carbonaceous streaks/spots; siltier in middle of interval; unconsolidated to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates are 62% very fine sand, 22% silt, 11% clay, and 5% fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Trace minerals include magnetite. “Middle” sandstone bed of the “lower” Fox Hills Sandstone.
Upper transition member of the Pierre Shale	915.2	916.4	Interbedded sandy siltstone, silty sandstone, and muddy shale. Gray (5Y 5/1) to olive gray (5Y 5/2) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded, lighter silt/sand with darker slightly carbonaceous muddy shale and black plastic clay/mud; some yellowish-brown clayey spots. Some disturbed bedding, presumable bioturbation; poorly to well consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; black staining; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 54% silt, 24% clay, and 22% very fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic magnetite and pyrite. Woody plant material.
	916.4	916.8	No core was retrieved.
	916.8	917.4	Interbedded sandy siltstone, silty sandstone, and muddy shale. Gray (5Y 5/1) to olive gray (5Y 5/2) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded, lighter silt/sand with black plastic clay/mud and dark slightly to very carbonaceous muddy shale; some yellowish-brown clayey spots. Poorly to moderately consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; black staining; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 43% silt, 31% clay, 25% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic magnetite and pyrite. Woody plant material.
	917.4	919	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 5/1); banded, dark slightly to very carbonaceous muddy shale, black plastic clay/mud, and lighter silt/sand; some yellowish-brown clayey spots. Some very thin layers, varves (?); poorly to well consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 51% silt, 31% clay, 17% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite and some magnetite. Woody plant material.

Unit	Depth below land surface (in feet)		Description
	From	To	
Fox Hills Sandstone	919	922.8	Silty sandstone. Olive gray (5Y 5/2) to olive (5Y 5/4); somewhat "salt and pepper" appearance; faint banding, yellowish-brown to dark streaks. Clay/mud and few carbonaceous streaks; poorly to well consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates are 63% very fine sand, 9% fine sand, 21% silt, and 7% clay. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Trace minerals include magnetite. Top of depth interval is top of "lowermost" sandstone bed (919–929.4 ft) of the "lower" Fox Hills Sandstone.
	922.8	923.5	No core was retrieved.
	923.5	924	Siltstone. Gray (2.5Y 5/1) to grayish brown (2.5Y 5/2); somewhat "salt and pepper" appearance; scrapes white; yellowish-brown to dark streaks. Clay/mud and few carbonaceous streaks; very well cemented; carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates are 65% silt, 28% clay, and 7% very fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Depth interval is a fine-grained interbed within "lowermost" sandstone bed (919–929.4 ft) of the "lower" Fox Hills Sandstone.
	924	925.6	Silty sandstone. Olive gray (5Y 5/2); somewhat "salt and pepper" appearance; yellowish-brown to dark streaks. Transitional at top 0.5 ft, sandy silt to silty sandstone; clay/mud and few carbonaceous streaks; poorly to moderately consolidated; clay, some carbonate (decreasing with depth) cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates are 72% very fine sand, 19% silt, 7% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Trace minerals include magnetite. Depth interval is within "lowermost" sandstone bed (919–929.4 ft) of the Fox Hills Sandstone.
	925.6	926.5	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 5/1); banded, dark slightly to very carbonaceous muddy shale and plastic clay/mud with lighter silt and sand (increasing with depth); some yellowish-brown clayey spots. Poorly to well consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 43% silt, 29% very fine sand, 26% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some microscopic pyrite and magnetite. Woody plant material. Depth interval is a fine-grained interbed within "lowermost" sandstone bed (919–929.4 ft) of the "lower" Fox Hills Sandstone.
	926.5	929.4	Silty sandstone. Olive gray (5Y 5/2); "salt and pepper" appearance; yellowish-brown to dark streaks near top of interval. Clay/mud and few carbonaceous streaks near top of interval; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates are 67% very fine sand, 21% silt, 9% clay, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor dark accessory minerals, sparse mica, and sparse carbonaceous material. Trace minerals include magnetite. Bottom of depth interval is bottom of "lowermost" sandstone bed (919–929.4 ft) of the "lower" Fox Hills Sandstone.
Upper transition member of the Pierre Shale	929.4	931.3	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 5/1); banded, dark slightly to very carbonaceous muddy shale and some plastic clay/mud with lighter silt and sand (increasing with depth); some yellowish-brown clayey spots. Some areas of disturbed bedding (presumable bioturbation); poorly to well consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 47% silt, 26% clay, 26% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some microscopic pyrite and magnetite. Woody plant material.
	931.3	932	No core was retrieved.
	932	932.2	Silty sandstone. Olive gray (5Y 5/2); "salt and pepper" appearance; yellowish-brown to dark clay/mud streaks. Poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates are 69% very fine sand, 20% silt, 7% clay, and 4% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include magnetite.

Unit	Depth below land surface (in feet)		Description
	From	To	
Upper transition member of the Pierre Shale	932.2	933.6	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 5/1); banded, dark slightly to very carbonaceous muddy shale and plastic clay/mud with lighter silt and sand (increasing with depth); some yellowish-brown clayey spots. Some areas of disturbed bedding (presumable bioturbation); poorly to well consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 46% silt, 28% very fine sand, 24% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some microscopic pyrite and magnetite. Woody plant material.
	933.6	934.2	Interbedded silty sandstone, sandy siltstone, and muddy shale. Olive gray (5Y 5/2) to light gray (5Y 7/1) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded; lighter silt/sand with darker slightly to very carbonaceous muddy shale and clay/mud; yellowish to reddish-brown clayey spots. Some disturbed bedding; some very thin carbonaceous layers; poorly to well consolidated; clay cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 52% very fine sand, 31% silt, 14% clay, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include microscopic pyrite and magnetite; 5-mm (0.2-in.) concretion at 933.9 ft. Woody plant material.
	934.2	935	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 5/1); banded, dark slightly to very carbonaceous muddy shale and plastic clay/mud with lighter silt/sand; some yellowish-brown clayey spots. Some areas of disturbed bedding; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 51% silt, 27% clay, 21% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, and minor dark accessory minerals. Trace minerals include some microscopic pyrite and magnetite. Woody plant material.
	935	936.1	Silty sandstone. Olive gray (5Y 5/2); “salt and pepper” appearance; thinly banded with yellowish-brown to dark clay/mud streaks. Poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates are 50% very fine sand, 32% silt, 15% clay, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse carbonaceous material. Trace minerals include magnetite.
	936.1	938.6	Interbedded silty sandstone, sandy siltstone, and muddy shale. Olive gray (5Y 4/2) to light gray (5Y 7/1) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded to mottled, lighter silt/sand with darker slightly carbonaceous muddy shale and clay/mud; yellowish to reddish-brown clayey spots. Disturbed bedding, presumable bioturbation; poorly to well consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, and green grains. Visual grain size estimates for entire interbedded interval are 40% very fine sand, 37% silt, 21% clay, and 2% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include some microscopic pyrite and magnetite. Woody plant material. Fossils include a few small shells in lower part of depth interval.
	938.6	946.1	Interbedded muddy shale, sandy siltstone, and silty sandstone. Black (5Y 2.5/1) to dark olive gray (5Y 3/2) and olive gray (5Y 4/2) to gray (5Y 6/1); banded to mottled, dark slightly to very carbonaceous muddy shale and plastic clay/mud with lighter silt/sand; some yellowish to reddish-brown clayey spots. Disturbed bedding, presumable bioturbation; petroleum-like odor when scraped (noticed starting at 944 ft); poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates for entire interbedded interval are 41% silt, 31% very fine sand, 27% clay, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include some microscopic pyrite (sometimes appear as brown streaks) and magnetite; 2-mm (0.08-in.) concretion at 941.1 ft; blue-green streaks at 944.2 and 944.9 ft; some swelling clay (?). Woody plant material. Fossils include a few small shells and straight-coned cephalopods (?) at 942 and 943.1 ft.

Unit	Depth below land surface (in feet)		Description
	From	To	
Upper transition member of the Pierre Shale	946.1	954	Interbedded sandy siltstone, silty sandstone, and muddy shale. Olive gray (5Y 4/2) to light gray (5Y 7/1) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); banded to mottled, lighter silt/sand with darker slightly carbonaceous muddy shale and some plastic clay/mud; yellowish to reddish-brown clayey spots. Disturbed bedding, presumable bioturbation; petroleum-like odor when scraped; poorly to well consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates for entire interbedded interval are 44% silt, 36% very fine sand, 17% clay, and 3% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include some microscopic pyrite and magnetite; pyritic concretion at 951.3 ft (<1 mm [0.04 in.]); blue-green streaks at 952 and 953.2 ft; some swelling clay (?). Woody plant material. Fossils include a few small shells, shell fragments, and straight cone at 953.1 ft.
	954	955.3	Muddy shale and sandy siltstone. Dark olive gray (5Y 3/2) to black (5Y 2.5/1) and olive gray (5Y 4/2) to gray (5Y 6/1); banded to mottled, dark slightly to very carbonaceous muddy shale and plastic clay/mud with lighter sandy silt; some yellowish to reddish-brown clayey spots. Disturbed bedding, presumable bioturbation; petroleum-like odor when scraped; more brittle than previous intervals; poorly to moderately consolidated; clay, some carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates are 61% silt, 27% clay, 11% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include microscopic pyrite (sometimes appear as brown streaks), blue-green streaks more frequent, some magnetite, and some swelling clay (?). Woody plant material. Fossils include some small shells and shell fragments.
	955.3	957	Sandy siltstone and mudstone. Dark to light gray (5Y 4/1 to 5Y 7/1) and black (5Y 2.5/1) to dark olive gray (5Y 3/2); mottled to banded, lighter sandy silt and darker slightly carbonaceous, plastic clay/mud/shale; yellowish to reddish-brown clayey spots. Plastic clay coating core in many areas; disturbed bedding, presumable bioturbation; slight petroleum-like odor when scraped; poorly to moderately consolidated; clay, carbonate cementation. Visible grains subrounded to angular; subprismoidal to subdiscoidal; yellow, red, green, and gray grains. Visual grain size estimates are 62% silt, 25% clay, 12% very fine sand, and 1% fine sand. Other constituents include major quartz, minor feldspar, minor mica, minor dark accessory minerals, and sparse fossils. Trace minerals include some microscopic pyrite and magnetite; some swelling clay (?). Woody plant material. Fossils include a few small shells and shell fragments.
	957	960	No core was retrieved.