

Appendix 1. Lithologic Logs

Well SPMW1

Date well completed: 6/1/2013

[Depth intervals in feet below land surface; mm, millimeters; ft, feet]

Depth	Sample type	Description ¹
0–8	cuttings	Alluvium—Gravel with some sand and cobbles, light brown (5YR 5/6) to moderate brown (5YR 4/4), fine–coarse grained, cobbles up to 100 mm in size, poorly sorted, angular–subrounded, medium dense, dry–damp 0–7.5 ft, saturated 7.5–8 ft.
8–31	cuttings	Weathered Pierre Shale—Clay with little very fine sand, dark yellowish brown (10YR 4/2), becoming olive gray (5Y 4/1) with depth, stiff–hard, dry–damp.
31–44	cuttings	Pierre Shale—Silty sandstone, olive gray (5Y 4/1), very fine–fine grained, well sorted, dense, saturated.
44–194	cuttings	Pierre Shale—Silty claystone, olive gray (5Y 4/1) to medium dark gray (N4), occasional limestone layers up to 3 ft thick, very hard, dry–damp.
194–201.7	cuttings and core (198.5–201.7 ft)	Pierre Shale—Silty sandstone, medium light gray (N6) to medium dark gray (N4), very fine–fine grained, very dense, well cemented, dry–damp

¹Grain size based on the Wentworth classification system (Wentworth, 1922). Proportions defined using the following terms: trace (0–10 percent), little (10–20 percent), some (20–35 percent), and (35–50 percent). Color codes refer to the Munsell color system (Geological Society of America, 1995).

Well SPMW2

Date well completed: 6/2/2013

[Depth intervals in feet below land surface; mm, millimeters; ft, feet]

Depth	Sample type	Description ¹
0–3	surface and cuttings	Top soil—Sand with some silt and clay, dark yellowish brown (10YR 4/2), very fine–fine grained, very loose, damp–moist, organic rich.
3–7	cuttings	Alluvium—Gravel and sand with little clay, dark yellowish brown (10YR 4/2), fine–coarse grained, gravel up to 50 mm in size, poorly sorted, subangular–subrounded, medium dense, saturated.
7–8.9	cuttings	Weathered Pierre Shale—Clay with trace silt, olive gray (5Y 4/1), hard, damp.

¹Grain size based on the Wentworth classification system (Wentworth, 1922). Proportions defined using the following terms: trace (0–10 percent), little (10–20 percent), some (20–35 percent), and (35–50 percent). Color codes refer to the Munsell color system (Geological Society of America, 1995).

Well SPMW3

Date well completed: 6/3/2013

[Depth intervals in feet below land surface; mm, millimeters; ft, feet]

Depth	Sample type	Description ¹
0–2	surface and cuttings	Top soil—Sand with little silt and clay, dark yellowish brown (10YR 4/2), very fine–fine grained, well sorted, very loose, moist, organic rich.
2–19	cuttings	Alluvium—Gravel with some cobbles, little sand, and trace clay, dark yellowish brown (10YR 4/2), gravel is mostly coarse grained to about 15 ft, becoming more fine grained and sandy with depth, cobbles up to 110 mm in size, moderately-well sorted, subangular–subrounded, medium dense, moist, becoming saturated below 7.5 ft.

¹Grain size based on the Wentworth classification system (Wentworth, 1922). Proportions defined using the following terms: trace (0–10 percent), little (10–20 percent), some (20–35 percent), and (35–50 percent). Color codes refer to the Munsell color system (Geological Society of America, 1995).

Well SPMW4

Date well completed: 6/3/2013

[Depth intervals in feet below land surface; mm, millimeters; ft, feet]

Depth	Sample type	Description ¹
0–1	surface	Top soil—Sand with little silt, dusky yellowish brown (10YR 2/2), fine–medium grained, well sorted, subangular–subrounded, very loose, dry, organic rich.
1–6	cuttings	Alluvium—Sand with little gravel and clay, moderate yellowish brown (10YR 5/4) to dark yellowish orange (10YR 6/6), fine–coarse grained, gravel up to 25 mm in size, poorly sorted, angular–subangular, loose, moist.
6–15	cuttings	Alluvium—Clay with trace sand and gravel, olive gray (5Y 4/1) to medium dark gray (N4), sand is fine–coarse, gravel consists of shale fragments up to 20 mm in size, soft, moist–wet, becoming saturated below about 13.5 ft.
15–17	cuttings	Weathered Pierre Shale—Clay, medium dark gray (N4), hard, damp.

¹Grain size based on the Wentworth classification system (Wentworth, 1922). Proportions defined using the following terms: trace (0–10 percent), little (10–20 percent), some (20–35 percent), and (35–50 percent). Color codes refer to the Munsell color system (Geological Society of America, 1995).

Borehole SPMW5

Date drilled: 6/4/2013

[Depth intervals in feet below land surface; mm, millimeters; ft, feet]

Depth	Sample type	Description ¹
0–4	surface and cuttings	Alluvium—Sand with some silt and clay, dark yellowish-orange (10YR 6/6) to moderate yellowish brown (10YR 5/4), very fine–fine grained, well sorted, angular–subrounded, loose, damp.
4–8	cuttings	Alluvium—Sand and gravel with little silt and clay, dark yellowish-orange (10YR 6/6) to moderate yellowish brown (10YR 5/4), fine–coarse grained, gravel up to 50 mm, poorly sorted, angular–subrounded, loose–medium dense, damp.
8–13	cuttings	Alluvium—Sand with little silt, little clay, and trace gravel, dark yellowish-orange (10YR 6/6) to moderate yellowish brown (10YR 5/4), fine–coarse grained, gravel up to 12 mm, poorly sorted, angular–subrounded, loose–medium dense, dry–damp.
13–16	cuttings	Same as 4–8ft
16–28	cuttings	Weathered Pierre Shale—Clay with trace sand, dark yellowish brown (10YR 5/4) to olive gray (5Y 4/1), stiff, damp.
28–33.5	cuttings	Pierre shale—Silty claystone, olive gray (5Y 4/1), hard–very hard, dry–damp.

¹Grain size based on the Wentworth classification system (Wentworth, 1922). Proportions defined using the following terms: trace (0–10 percent), little (10–20 percent), some (20–35 percent), and (35–50 percent). Color codes refer to the Munsell color system (Geological Society of America, 1995).

Borehole SPMW6

Date well completed: 6/4/2013

[Depth intervals in feet below land surface; mm, millimeters; ft, feet]

Depth	Sample type	Description ¹
0–5	cuttings	Alluvium—Sand with some gravel, dark yellowish orange (10YR 6/6) to moderate yellowish brown (10YR 5/4), fine–coarse grained, gravel up to 50 mm, poorly sorted, angular–subrounded, loose–medium dense, dry–damp.
5–12	cuttings	Weathered Pierre Shale—Clay with trace sand, dark yellowish brown (10YR 5/4) to olive gray (5Y 4/1), stiff, damp.
12–13.5	cuttings	Pierre Shale—Silty claystone, olive gray (5Y 4/1), hard–very hard, dry–damp.

¹Grain size based on the Wentworth classification system (Wentworth, 1922). Proportions defined using the following terms: trace (0–10 percent), little (10–20 percent), some (20–35 percent), and (35–50 percent). Color codes refer to the Munsell color system (Geological Society of America, 1995).