

NORTH DAKOTA GEOLOGICAL SURVEY CIRCULAR NO. 6

Summary of the J. H. Kline No. 1 Well

Ward County, North Dakota

By Sidney B. Anderson

J. H. Kline - Price Drilling Co. - J. H. Kline No. 1 Well, Ward County, North Dakota. SE1/4 SE1/4 SE1/4 Section 16, T. 157N. R. 85W. (300' W. of E. line, 60' N. of S. line, Section 16.), Elevation 1679 ground.

The Price Kline No. 1 Well was spudded August 18, 1948, and 10 3/4 inch casing was run at 976 feet. The well was shut down at 5408 feet in January, 1949. Drilling was resumed in May, 1949, and 7 inch casing was set at 6540 feet with 900 sacks in June.

Tests: The well was extensively tested through perforations during the summer with the following results:

<u>Holes</u>	<u>Interval</u>	<u>Recovery</u>	<u>Holes</u>	<u>Interval</u>	<u>Recovery</u>
10	5080-85	Salt Water	16	6070-78	Water
31	5105-20	Water	27	6154-76	"
11	5125-30	"	12	6188-98	"
12	5855-60	"	13	6245-57	"
34	5900-33	"	26	6386-96	"
26	5962-74	"	9	6474-52	"
26	5995-6010	"	17	6489-6500	"
9	6048-51	"			

The upper three tests were in the Charles formation, and the remainder were in the Madison limestone. A drill stem test in the Devonian from 6969 to 7010 feet recovered salt water and mud.

Drilling recommenced at 6540 feet in September and 6 1/8 inch hole was drilled to a total depth of 8435 feet. Drill pipe twisted off in November, and 234 feet of plug was set from 6995 to 7229 feet. Plug was drilled to 7010 feet, and the drill stem test described earlier was made.

Drilling was completed on November 23, 1949, and the well was abandoned. The California Company financed drilling from 7765 feet to total depth.

Formation tops determined from sample, electric, and radioactivity logs follow:

TOPS

	<u>Depth</u>
Tertiary System	
Tongue River Group	95
Ludlow and Cannonball Formation	335
Cretaceous System	
Hell Creek Formation	710
Fox Hills Formation	915

Pierre Formation	1150
Niobrara Formation	2330
Benton Formation	2440
Greenhorn Formation	2735
"Muddy"	3185
Dakota	3395
Jurassic System	
Morrison Formation	3695
Sundance Formation	3770
Piper Formation (Sawtooth)	4430
Triassic System	
Spearfish Formation	4670
Mississippian System	
Kibbey Formation	4945
Charles Formation	5135
Mission Canyon Formation	5785
Lodgepole Formation	6132
Bakken Formation (Englewood)	6705
Devonian System	
Lyleton Formation	6755
Nisku	6930
Woodbend Equivalent	7073
Beaverhill Lake Equivalent	7443
Manitoban Formation	7653
Sample Tops	
Winnipegogan Formation	7872
Elm Point Formation	8335
Total Depth	8435

PRICE KLINE NO. 1 WELL

Sample Descriptions by Sidney B. Anderson

<u>From</u>	<u>To</u>	<u>Formation</u>
40	45	Sand, pale yellow brown, fine to medium quartz, rounded.
45	65	Sand as above; slightly calcareous cement.
65	70	Sand, pale yellow brown, fine to medium quartz, rounded, slightly, coarser.
70	80	Sand, pale yellow brown, fine to medium quartz, rounded, and little lignite.
80	85	Sand, pale yellow brown, fine to medium quartz, rounded, and more lignite.
80	90	Sand, pale yellow brown, fine to medium quartz, rounded, medium to coarse, some lignite.
90	95	Sandstone, fine to coarse, some dark yellow 10YR6/6 orange siltstone.
Tongue River Group 95'		
95	100	Sandstone, fine to coarse; much lignite.
100	105	Sandstone, fine to coarse; little lignite.
105	110	Coarse sand, little lignite.
110	118	Sandstone, fine to coarse, little lignite; calcareous cement.
118	123	Sandstone, fine to medium, little lignite.

<u>From</u>	<u>To</u>	<u>Formation</u>
123	128	Sandstone, medium to coarse sandstone, little lignite.
128	133	Fine sand, much lignite.
133	143	Very fine sand, little lignite.
143	149	Very fine sand, much lignite.
149	154	Fine to medium sandstone, lignite.
154	160	Very fine sand to silty lignite.
160	165	Very fine, to silty, to coarse sand; some lignite.
165	170	Sand, very fine to coarse, silty; some lignite.
170	177	Dark yellow brown 10YR4/2 siltstone to sand; lignite.
177	182	Same as above, much lignite.
182	187	Sandstone, dark yellow brown, fine to coarse; some lignite.
187	195	Sandstone, dusky yellow brown 10YR4/2, fine to coarse, little anhydrite.
195	208	Sandstone as above.
208	221	Sandstone, light olive gray, fine to coarse.
221	240	Same as above, mostly fine sand.
240	250	Sandstone same as above, some lignite.
250	255	Pale yellow brown 10YR6/2 sandstone, fine to coarse, some lignite.
255	260	Missing.
260	265	Sandstone, light olive gray 5Y6/1, fine to coarse, little coal.
265	275	Sandstone, fine to coarse as above, mostly fine, some coal.
275	290	Sandstone, medium to coarse, some fine conglomeratic, some coal.
290	300	Sandstone, medium to coarse, conglomeratic.
300	305	Sandstone, medium coarse, some silty fine grain to light olive gray 5Y6/1, calcareous cement.
305	335	Sandstone, fine grained, medium light gray N6, other coarser materials (probably cave?), calcareous.
Ludlow and	Cannonball	Formation 335'
335	345	Same as above, fine sand and silt.
345	350	Siltstone, light olive gray, not calcareous; some sand.
350	385	Shale, light olive gray 5Y6/1, silty, little sand, calcareous.
385	405	Shale same as above, calcareous.
405	415	Shale, light olive gray 5Y6/1, silty, some fine sand, calcareous.
415	435	Missing.
435	450	Sandstone, light olive gray 5Y6/1, very fine grained, silty, calcareous.
450	455	Sandstone same as above, some lignite.
455	470	Sandstone as above.
470	475	Siltstone, light olive gray 5Y6/1, medium gray shale N5, little sand.
475	490	Siltstone same as above, not calcareous.
490	495	Missing.
495	500	Same as above.
500	520	Sandstone, light olive gray 5Y6/1, silty, fine to medium grained.

<u>From</u>	<u>To</u>	<u>Formation</u>
520	530	Sandstone, same as above, with small amount of gravel.
530	534	Sandstone same as above, silty, fine to medium grained.
534	540	Sandstone same as above, some lignite, slightly calcareous.
540	545	Siltstone and shale, light olive gray, silty, some fine to medium sand.
545	560	Siltstone, light olive gray, some fine sand, little lignite.
560	575	Siltstone, yellow gray 5Y7/2, otherwise same as above.
575	590	Siltstone same as above, some lignite, fine to medium sand.
590	595	Same as above, very little sand.
595	600	Same as above, lignite.
600	605	Siltstone, light olive gray, lignite, little more sand.
605	607	Sandstone same as above, fine sand, silty.
607	610	Sandstone same as above, lignite.
610	617	Sandstone as above, silty.
617	625	Sandstone same as above, silty, lignite.
625	655	Sandstone, mostly silt, some sandstone, lignite.
655	660	Sandstone same as above, some gravel, cave?
660	665	Sandstone same as above, calcareous, some rounded sand.
665	670	Sandstone as above, sand is quite rounded, some lignite.
670	675	Sandstone, light olive gray, hard to fine grained, calcareous, lot of cave?
675	680	Sandstone light olive gray, silty, rounded sand. Siltstone.
680	685	Sandstone same as above, little medium light gray shale. Siltstone.
685	690	Sandstone same as above, little glauconitic, some lignite. Siltstone.
690	695	Sandstone same as above, no glauconitic. Some Siltstone.
695	700	Sandstone same as above, little sand. Some Siltstone.
700	705	Siltstone, little bentonite, otherwise same as above, lignite.
705	710	Siltstone same as above, carbonaceous partings.
Hell Creek Formation 710'		
710	720	Sandstone, yellow gray 5Y8/1, fine grained, silt cement.
720	735	Sandstone as above, some gray siltstone partings.
735	740	Sandstone same as above, some lignite.
740	745	Missing.
745	770	Sandstone same as above.
770	775	Sandstone same as above, some gray siltstone.
775	785	Sandstone same as above, some coal.
785	795	Sandstone as above.
795	800	Sandstone as above, some gray siltstone.
800	900	Missing.
900	905	Shale, light olive gray, silty, soft; some sand.
905	910	Shale same as above, some light gray shale, silty, some sand and lignite.
910	915	Shale same as above, some light gray shale, silty, not calcareous.

<u>From</u>	<u>To</u>	<u>Formation</u>
Fox Hills Formation 915'		
915	920	Sandstone, light gray N7, fine grained sandstone, calcareous.
920	940	Sandstone, light olive gray, fine grained, calcareous.
940	945	Sandstone as above and a little light gray silty shale N7.
945	950	Sandstone as above, not calcareous, little light gray silty shale, carbonaceous partings.
950	955	Shale as above, much sand cave?
955	965	Shale as above, sandstone.
965	980	Sandstone as above, little shale.
980	985	Sandstone, yellow gray 5Y8/1, fine grained, slightly calcareous.
985	990	Light olive gray, mostly siltstone, some sandstone, some carbonaceous partings in siltstone, slightly calcareous.
990	995	Same as above, more sandstone.
995	1000	Light olive gray 5Y6/1 siltstone and sandstone, coal.
1000	1005	Siltstone, light gray N7 and some sandstone cave? Carbonaceous matter.
1005	1020	Light, gray N7 to light olive gray 5Y6/1, shaly, much gravel etc. cave?
1020	1030	Siltstone, poor sample, mostly gravel cave?
1030	1035	Siltstone, poor sample as above, light olive gray siltstone and medium gray shale N5.
1035	1040	Shale and siltstone, poor sample.
1040	1045	Siltstone and shale, medium light gray N6, soft, much gravel cave.
1045	1050	Same as above.
1050	1055	Siltstone, white N9, calcareous, and light gray shale and siltstone.
1055	1065	Siltstone same as above, light olive gray shale and sandstone, some pale red 10R6/2 sandstone, calcareous.
1065	1075	Shale, medium light gray, black carbonaceous partings, some white silty limestone, very poor sample.
1075	1080	Shale same as above, with pale red 10R6/2 sandstone.
1080	1090	Shale, light olive gray, silty, black carbonaceous partings.
1090	1095	Shale, light gray N7 and light olive gray with carbonaceous partings.
1095	1105	Shale same as above, some siltstone.
1105	1110	Shale same as above, some pale red 10R6/2 sandstone.
1110	1115	Shale, green gray 5GY6/1 on fracture, silty, and some white limestone.
1115	1120	Shale same as above, some black carbonaceous partings.
1120	1130	Shale same as above, little sandstone, pale red 10R6/2, little yellow gray sandstone.
1130	1135	Shale same as above, little sandstone with glauconite, some free rounded quartz grains.
1135	1140	Shale same as above, little light olive gray sandstone, some silty shale.
1140	1150	Shale same as above, poor sample.

<u>From</u>	<u>To</u>	<u>Formation</u>
Pierre Formation 1150'		
1150	1155	Shale, light gray on fracture, poor sample.
1155	1160	Shale, silty, green gray 5GY6/1.
1160	1165	Shale same as above, few quartz grains.
1165	1175	Shale same as above.
1175	1190	Shale, green gray 5GY6/1, fairly soft.
1190	1195	Shale, medium gray N5.
1195	1200	Shale, green gray 5GY6/1.
1200	1210	Shale, medium gray N5.
1210	1215	Shale, medium light gray N6.
1215	1220	Shale, green gray 5GY6/1.
1220	1230	Same as above, fairly soft.
1230	1240	Shale, same as above, little pyrite.
1240	1260	Shale same as above, some magnitite.
1260	1265	Missing.
1265	1270	Shale same as above.
1270	1275	Missing.
1275	1290	Shale same as above.
1290	1310	Shale same as above, little pyrite and few rounded quartz grains.
1310	1330	Shale same as above, some sand, pyrite.
1330	1340	Shale same as above, few quartz grains.
1340	1400	Shale, light gray N7, few quartz grains.
1400	1430	Shale, medium light gray N6.
1430	1440	Shale, medium light gray N6, few rounded quartz sand grains.
1440	1450	Shale same as above.
1450	1460	Shale, medium light gray N6.
1460	1470	Shale, medium light gray N6, some sand.
1470	1480	Shale, medium light gray N6.
1480	1490	Shale as above, little sand.
1490	1520	Shale, medium light gray N6.
1520	1530	Shale as above, little sand.
1530	1560	Shale, medium light gray N6.
1560	1570	Missing.
1570	1580	Shale, medium light gray N6, little sand.
1580	1590	Shale, medium light gray N6.
1590	1650	Shale, medium light gray N6, much sand (cave)?
1650	1680	Shale, medium light gray N6, some sand.
1680	1690	Shale, medium light gray N6, little sand.
1690	1700	Shale, medium light gray N6.
1700	1740	Shale, medium light gray N6, much fine sand.
1740	1750	Shale, medium light gray N6, much fine sand,
1750	1760	Shale, medium light gray N6, inoceramus prisim, much fine sand.
1760	1770	Shale, medium light gray N6, annodiscus cretacea.
1770	1780	Shale, medium light gray N6, inoceramus prisim.
1780	1790	Shale, medium light gray N6.
1790	1800	Shale, medium light gray N6, some sand.
1800	1810	Shale, medium light gray N6, ironstones, some sand.
1810	1820	Shale, medium light gray, some sand inoceramus, ironstones, pyrite.

<u>From</u>	<u>To</u>	<u>Formation</u>
1820	1830	Shale, medium light gray, some sand.
1830	1840	Shale, medium light gray.
1840	1850	Shale, medium light gray, some sand.
1850	1870	Shale, medium light gray.
1870	1880	Shale, medium light gray, some sand.
1880	1900	Shale, medium light gray.
1900	1910	Missing.
1910	1920	Shale, medium light gray, some sand.
1920	1930	Shale, medium light gray
1930	1940	Shale, medium light gray, much sand, shell fragments.
1940	1960	Shale, medium light gray, some sand.
1960	1970	Shale, medium light gray.
1970	2020	Shale, medium light gray, some sand.
2020	2030	Shale, medium light gray, much sand.
2030	2040	Shale, medium light gray, some sand.
2040	2050	Shale, medium light gray, some sand, ironstones.
2050	2060	Shale, medium light gray, some sand.
2060	2070	Shale, medium light gray, some sand, ironstones.
2070	2080	Shale, medium light gray, inoceramus prisims, and some sand.
2080	2100	Shale, medium light gray, some sand.
2100	2110	Shale, medium light gray N6 to medium dark gray N4, some sand.
2110	2120	Shale, medium light gray, some white specks in shale, white bentonite.
2120	2140	Shale, medium light gray, some sand, white bentonite.
2140	2150	Shale, medium light gray, ironstones, some sand, white bentonite.
2150	2160	Shale, medium light gray, inoceramus prisims, some quartz, white bentonite.
2160	2170	Shale, medium light gray, some quartz, white bentonite.
2170	2200	Shale, medium light gray, some sand, white bentonite.
2200	2205	Missing.
2205	2215	Shale, medium light gray, some sand, white bentonite.
2215	2220	Shale, medium light gray.
2220	2225	Shale, medium light gray, some sand, white bentonite.
2225	2235	Shale, medium light gray, much fine sand cave? white bentonite.
2235	2240	Shale, medium light gray N6, (cave?, some sand) white bentonite.
2240	2245	Shale, medium light gray N6, pyrite, white bentonite.
2245	2255	Shale, medium light gray N6, white bentonite.
2255	2260	Shale, medium light gray N6, some sands white bentonite.
2260	2265	Shale, medium light gray N6, some sand, inoceramus prisims, white bentonite.
2265	2275	Shale, medium light gray N6.
2275	2280	Shale, medium light gray N6, some sands white bentonite.
2280	2310	Shale, medium light gray N6, inoceramus prisims, white bentonite.
2310	2315	Shale, medium light gray N6, little glauconite and some sand, white bentonite.
2315	2330	Shale, medium light gray N6, some sand, white bentonite.

<u>From</u>	<u>To</u>	<u>Formation</u>
Niobrara Formation 2330'		
2330	2345	Shale, medium light gray N6, some sand, white bentonite.
2345	2350	Shale, medium light gray N6, and some medium gray slightly calcareous.
2350	2360	Shale, medium gray N5 to light medium gray N6, slightly calcareous.
2360	2365	Shale, medium dark gray N4 to medium gray to light medium gray N6, slightly calcareous, white bentonite.
2365	2370	Shale, medium gray N5 to light medium gray N6, calcareous.
2370	2380	Shale, color as above, some white bentonite, white specks.
2380	2385	Shale, same as above.
2385	2390	Missing.
2390	2400	Shale, medium dark gray N4 to light medium gray N6, calcareous.
2400	2410	Shale, medium gray N5 to light medium gray N6, calcareous.
2410	2420	Shale, medium gray and light medium gray.
2420	2430	Shale as above, inoceramus prisims.
2430	2440	Shale same as above.
Benton Formation 2440'		
2440	2450	Shale same as above white bentonite.
2450	2460	Shale same as above white bentonite, pyrite.
2460	2470	Shale same as above, shell fragments.
2470	2480	Shale same as above, some white specks, white bentonite.
2480	2490	Shale same as above, mostly light medium gray, much pyrite, ammodiscus cretecia.
2490	2500	Shale same as above, inoceramus prisims, much pyrite.
2500	2520	Shale same as above, white bentonite.
2520	2540	Shale same as above, inoceramus prisims, white bentonite
2540	2550	Medium gray shale, white bentonite.
2550	2570	Shale, medium dark gray to medium light gray, little white bentonite, not calcareous.
2570	2590	Shale same as above, mostly medium gray N5 to medium gray N6, some white specks.
2590	2600	Shale same as above, some white specks.
2600	2610	Shale same as above, mostly medium gray, some white bentonite.
2610	2630	Shale, medium gray to medium light gray, some light gray, some white bentonite.
2630	2640	Shale same as above, inoceramus prisims.
2640	2650	Shale same as above.
2650	2660	Shale same as above, little limestone.
2660	2670	Shale, medium dark gray N4 to medium gray N5.
2670	2690	Shale same as above, white specks.
2690	2700	Shale, medium dark gray N4.
2700	2710	Shale, medium dark gray N4 to medium gray N5, white bentonite and white specks.
2710	2720	Shale, medium dark gray to medium gray, some light olive gray staining.
2720	2730	Shale, medium dark gray N4 to medium gray N5, some light olive gray staining and white specks.

<u>From</u>	<u>To</u>	<u>Formation</u>
Greenhorn Formation 2735'		
2730	2740	Shale, medium dark gray N4, some pale yellow brown 10YR6/2.
2740	2750	Shale, medium dark gray N4, lumpy, some slightly calcareous bits.
2750	2760	Shale, medium dark gray N4, some pale yellow brown 10YR6/2.
2760	2770	Shale, medium dark gray N4.
2770	2790	Shale, medium dark gray N4, some pale yellow brown 10YR6/2.
2790	2800	Shale, medium gray N5, medium dark gray N4, slightly calcareous, slightly bentonitic.
2800	2810	Shale, medium gray N5, some white limestone, white specks.
2810	2820	Shale, medium gray N5, slightly calcareous.
2820	2830	Shale, slightly calcareous, white specks.
2830	2840	Shale, medium dark gray N4, slightly calcareous, white specks.
2840	2850	Shale, dark gray N3 and medium gray N5, white specks, white bentonite, slightly calcareous.
2850	2865	Shale same as above.
2865	2870	Shale, same as above, with some light gray shale N7.
2870	2880	Shale, same as above, and dark gray shale N3, slightly calcareous.
2880	2885	Shale, medium dark gray N4 and medium gray N5, white speck shell fragments.
2885	2890	Shale same as above.
2890	2900	Shale, medium dark gray N4, medium gray N5, medium dark gray, calcareous.
2900	2915	Shale, medium dark gray N4, to dark gray N3, mostly medium dark gray, some light blue gray 5B7/1, bentonitic.
2915	2925	Shale, same as above, little white bentonite.
2925	2940	Shale same as above, much white bentonite.
2940	2945	Shale same as above, some light blue gray and white bentonite.
2945	2950	Missing.
2950	2965	Shale, medium dark gray N4 and medium gray N5, some white bentonite.
2965	2975	Shale same as above, shell fragments.
2975	2980	Shale, medium dark gray N4 and light gray N7.
2980	2985	Shale, dark gray N3 and light gray N7, shell fragments.
2985	2990	Shale, dark gray, and light gray N7, shell fragments.
2990	2995	Shale same as above, some white bentonite.
2995	3000	Shale same as above, some white bentonite, pyrite.
3000	3005	Missing.
3005	3010	Shale, dark gray N3 and medium gray N5, white bentonite.
3010	3015	Shale same as above, white bentonite, inoceramus prisims.
3015	3020	Missing.
3020	3025	Shale, dark gray N3 and medium gray N5, white bentonite, inoceramus prisims.
3025	3030	Shale, dark gray N3 and medium light gray N6 white bentonite.

<u>From</u>	<u>To</u>	<u>Formation</u>
3030	3045	Shale same as above, Fishbones? Inoceramus prisims, little sand.
3045	3050	Shale same as above, little sand, shell fragments.
3050	3060	Shale same as above, little sand.
3060	3070	Shale, dark gray N3, medium dark gray N3, light gray N7, white bentonite.
3070	3075	Shale same as above, fish scale?
3075	3095	Shale same as above, white bentonite.
3095	3110	Shale, dark gray N3, little quartz sand, white bentonite.
3110	3115	Shale, medium dark gray N4.
3115	3125	Shale, dark gray N3, white bentonite.
3125	3135	Shale, dark gray N3 and medium dark gray, white bentonite.
3135	3140	Shale, dark gray N3, white bentonite.
3140	3145	Shale, dark gray N3, little white bentonite.
3145	3165	Shale, dark gray N3.
3165	3170	Shale, dark gray N3, few pieces of light olive gray 5Y6/1.
3170	3180	Shale, dark gray N3.
3180	3185	Shale, dark gray N3, little white bentonite.
Muddy	3185'	
3185	3190	Shale, dark gray N3.
3190	3195	Shale, dark gray N3 and little white limestone.
3195	3200	Shale, dark gray N3, little white bentonite.
3200	3220	Shale same as above.
3220	3225	Shale, dark gray N3, some sand.
3225	3310	Shale dark gray N3.
3310	3320	Shale, N5, slightly fissile, some pyrite.
3320	3325	Shale as above, some sand grains.
3325	3335	Shale as above.
3335	3340	Shale as above, few sand grains, euhedral.
3340	3360	Shale as above, micaceous.
3360	3365	Shale as above, slightly calcareous.
3365	3380	Shale as above, few sand grains.
3380	3385	Missing.
3385	3395	Shale as above.
Dakota	3395'	
3395	3405	Missing.
3405	3410	Shale as above.
3410	3415	Shale N5, splintery.
3415	3420	Shale as above, large round sand grains.
3420	3425	Shale as above, few frosted sand grains.
3425	3430	Shale as above, sandstone, medium grained.
3430	3435	Shale as above, sandstone as above in very small amounts.
3435	3440	Sandstone as above, micaceous, dirty, much shale.
3440	3450	Sandstone as above, much shale.
3450	3455	Shale N4, sandstone as above.
3455	3460	Sandstone N7, dirty, with pyrite, much shale as above.
3460	3465	Sandstone as above, much shale as above.
3465	3470	Shale as above, some sandstone as above.
3470	3475	Shale as above, little sandstone as above.
3475	3485	Sandstone, as above, much shale.

<u>From</u>	<u>To</u>	<u>Formation</u>
3485	3490	Shale as above, little sandstone as above,
3490	3505	Shale as above, sandstone as above.
3505	3510	Sandstone and shale as above.
3510	3515	Sandstone and shale as above, much pyrite.
3515	3520	Shale and sandstone as above, dolomite, pale yellowish brown 10YR6/2.
3520	3525	Shale N4, fissile.
3525	3530	Shale ditto, sandstone, medium to fine grained, dirty.
3530	3535	Shale and sandstone; sandstone is glauconitic and more abundant.
3535	3540	Shale as above, shell fragmental.
3540	3550	Shale and sandstone as above.
3550	3555	Sandstone, medium to coarse grained, much shale as above.
3555	3560	Shale N4, shell fragments.
3560	3565	Shale as above, sandstone, medium grained, much pyrite.
3565	3570	Shale as above, sandstone as above, also micaceous.
3570	3580	Shale as above, much pyrite.
3580	3585	Shale as above, much medium grained sand.
3585	3595	Shale as above, little sand.
3595	3605	Sandstone, coarse grained, white, pyrite, crystalline.
3605	3610	Sandstone as above, much shale.
3610	3625	Sandstone as above, much shale.
3625	3645	Sandstone, medium to coarse sand, dirty, much shale.
3645	3655	Sandstone as above, limestone, dense pale brown 5YR5/2 rare, much shale.
3655	3660	Shale N5, little sandstone as above.
3660	3665	Shale as above, more sandstone as above,
3665	3680	Sandstone, very coarse grained, subangular, first good, sand seen.
3680	3685	Sandstone as above, conglomeratic.
3685	3690	Sandstone, fine to medium grained, dirty.
3690	3695	Sandstone as above, much shale N4.
Morrison Formation 3695'		
3695	3700	Shale, N4, sandstone as above.
3700	3705	Shale as above; sandstone as above, spicule.
3705	3710	Missing.
3710	3715	Shale as above; sandstone, fine grained glauconitic.
3715	3720	Sandstone, coarse grained, subangular.
3720	3730	Missing.
3730	3735	Sandstone, medium to coarse grained, large subround euhedral quartz crystals.
3735	3740	Missing.
3740	3755	Sandstone as above.
3755	3760	Sandstone as above; sandstone N6, very fine grained, shaly.
3760	3765	Sandstone, coarse grained, subangular crystals.
3765	3770	Sandstone as above, good sample (compared to those above).
Sundance Formation 3770'		
3770	3775	Sandstone as above.
3775	3780	Missing.
3780	3785	Sandstone, coarse grained sandstone fine grained, shaly.

<u>From</u>	<u>To</u>	<u>Formation</u>
3785	3790	Sandstone as above, much pyrite.
3790	3795	Sandstone as above.
	1/9/51	Predominant part of sample from 3300 to here which dolomite run is medium gray shale. I don't know what should be called on this. I have called mainly the smaller fraction the rock being cut on the theory that the shale is float.
3795	3800	Shale N4; sandstone as above.
3800	3805	Shale N4; sandstone less abundant.
3805	3810	Shale as above, sandstone in small amounts.
3810	3815	Shale as above; sandstone fine grained, glauconitic.
3815	3820	Shale as above; sandstone, coarse grained, rusty colored N6.
3820	3830	Shale as above; sandstone as above; pyrite.
3830	3845	Sandstone as above, shale as above.
3845	3850	Sandstone 5YR6/1, medium grained; shale as above, sandstone, coarse grained.
3850	3855	Missing.
3855	3860	Shale N5; some sandstone as above.
3860	3865	Missing.
3865	3875	Shale as above; sandstone, fine grained silty, light olive gray 5Y6/1.
3875	3880	Shale as above; sandstone as above, glauconitic.
3880	3890	Shale as above; sandstone as above and more abundant.
3890	3900	Sandstone as above; shale as above to N3.
3900	3905	Sandstone, 5YR6/1 fine grained, fairly glauconitic, much shale as above.
3905	3910	Sandstone as, above; shale as above, much pyrite.
3910	3915	Shale as above; sandstone, N8 fine grained, glauconitic.
3915	3930	Sandstone; light olive gray 5Y6/1, fine to medium grained, glauconitic.
3930	3935	Sandstone N7, medium grained, intergranular, porous, glauconitic.
3935	3940	Sandstone as above, sandstone has black chert, fragment intergranular porosity.
3940	3950	Sandstone as above, much glauconite, intergranular porosity, partly filled with CaCO ₃ .
3950	3955	Sandstone, medium and fine grained N7.
3955	3960	Missing.
3960	3965	Shale, greenish gray (5G6/1) sandstone as above.
3965	3980	Shale as above, sandstone as above, one fragment shows thin lense of sandstone in shale.
3980	3990	Sandstone N7, fine to medium grained, glauconitic, dirty, calcareous cement, shale as above.
3990	3995	Sandstone as above.
3995	4000	Sandstone as above; sandstone, large rounded quartz grains.
4000	4005	Sandstone as above, interbedded with shale 5G6/1.
4005	4020	Sandstone as above, dirty.
4020	4030	Sandstone as above, calcareous cement.
4030	4035	Shale 5Y6/1 and 5GY6/1; sandstone as above.
4035	4040	Sandstone, 5YR6/1, fine grained, glauconitic, dirty.

<u>From</u>	<u>To</u>	<u>Formation</u>
4040	4050	Sandstone, 5Y6/1, very fine grained, glauconitic.
4050	4055	Sandstone, fine to medium grained, 5Y6/1.
4055	4065	Sandstone, fine grained 5Y6/1, dirty.
4065	4075	Sandstone as above, micaceous.
4075	4085	Shale N5, sandstone as above.
4085	4090	Shale, greenish gray 5GY6/1, some with fish scales.
4090	4095	Missing.
4095	4105	Shale N5, splintery.
4105	4110	Shale as above, limestone dense, pale brown 5YR5/2 in small fragments.
4110	4115	Shale as above; limestone as above, only slightly more abundant.
4115	4120	Shale N4 to N6; some sandstone as above.
4120	4125	Shale as above; sandstone, fine grained 5YR6/1.
4125	4130	Missing.
4130	4240	Shale as above.
4140	4150	Shale as above, sandstone 5YR6/1 fine grained, glauconitic.
4150	4155	Shale as above; fragments of white, coarse crystalline limestone with black spots.
4155	4160	Shale as above; some sandstone 5YR6/1 as above.
4160	4165	Shale as above; some sandstone 5YR6/1 to N8.
4165	4370	Shale N5, splintery.
4170	4175	Shale as above, fragments of limestone N7, dense to fragmental.
4175	4185	Shale as above; limestone as above in very small amounts.
4185	4200	Shale, N6.
4200	4205	Shale as above, some coarse sand grains.
4205	4210	Shale as above, sand as above.
4210	4215	Shale as above, very fissile and dirty; dirty sample.
4215	4220	Shale as above; shale grayish red 5R4/2; limestone dense, argillaceous pale red 5R6/2 in small fragments.
4220	4225	Shale, greenish gray 5GY6/1; shale, grayish red 5R4/2; mottles of this red on the green gray.
4225	4230	Shale as above, calcareous, greasy looking.
4230	4235	Shale as above; shale 5R4/2 calcareous; siltstone (?) 5GY6/1, large frosted quartz grains.
4235	4240	Shale, medium gray N5, large chunks, not in place (?)
4240	4250	Shale N6; sandstone fine grained N7, rare.
4250	4255	Shale as above; shale, 5R4/2; sandstone as above more common.
4255	4260	Shale N6, sandstone as above, fairly common, dirty sample.
4260	4265	Shale as above, little sandstone, dirty sample.
4265	4270	Shale N5, siltstone N5; limestone, white dense, (not in place rare.)
4270	4280	Missing.
4280	4285	Shale N5, shale, brownish gray 5YR4/1; shale, light olive gray 5Y6/1.
4285	4295	Shale N5, 5YR4/1; some sandstone fine grained, dirty shale.
4295	4300	Shale as above, some sandstone fine grained.

<u>From</u>	<u>To</u>	<u>Formation</u>
4300	4305	Shale N5, large chunks, probably cave.
4305	4310	Shale N5, 5YR4/1, 5Y6/1; sandstone, fine grained 5YR6/1 rare.
4310	4315	Shale as above, sandstone, 5YR6/1, fine grained, pyrite.
4315	4320	Shale as above; sandstone, light olive gray 5Y6/1, fine grained.
4320	4325	Shale as above, sandstone as above, more rare.
4325	4335	Shale as above, 5YR4/1 more common; limestone, light brownish gray fragmental, rare.
4335	4340	Shale N6, 5YR4/1.
4340	4345	Sandstone N6, fine grained, shale as above, sand grains coarse, subhedral crystalline.
4345	4350	Sandstone as above; shale mottled N6 and 5YR4/1; some sand grains as above.
4350	4355	Sandstone as above; shale as above; limestone, dense to saccharoidal N6.
4355	4360	Shale N6 and 5YR6/1; sandstone as above; limestone, dense 5YR8/1, rare.
4360	4365	Sandstone, fine grained N6, glauconitic (?); shale as above; limestone as above.
4365	4370	Sandstone as above; limestone N8, dense; shale as above.
4370	4375	Sandstone, fine grained N7, glauconitic, shale as above.
4375	4380	Sandstone as above; shale as above; limestone, saccharoidal 5YR8/1 rare.
4380	4385	Shale as above; sandstone fine to medium grained N7, some limestone, dense to fine saccharoidal N7, with black streaks.
4385	4390	Sandstone as above; shale as above.
4390	4395	Sandstone medium grained 5YR6/1, to 5GY6/1 glauconitic, much shale as above.
4395	4400	Sandstone as above; much shale as above; shell fragments.
4400	4415	Missing.
4415	4420	Sandstone as above; much shale as above plus some N3 shale, Sample contaminated badly.
4420	4425	Shale N6, micaceous, splintery, limestone N8, dense, rare.
4425	4430	Limestone N8, dolomite dense, some secondary calcite, much shale as above, some sandstone as above.
Piper Formation (Sawtooth)	4430'	
4430	4435	Limestone N8, dense, much shale as above; some sandstone as above.
4435	4440	Shale fissile, 5GY6/1; sandstone, medium to fine grained N5.
4440	4445	Shale fissile medium dark gray N4.
4445	4450	Shale as above, sandstone N7, fine grained.
4450	4455	Shale N5; sandstone N7 fine grained, glauconitic, limestone dense N8, rare,
4455	4460	Shale as above; sandstone as above; limestone as above, but fairly common.

<u>From</u>	<u>To</u>	<u>Formation</u>
4460	4465	Limestone; dense 5YR6/1 to N7; much shale as above.
4465	4470	Limestone, dense N8 to 5YR8/1; much shale, same large sand grains.
4470	4475	Limestone as above; anhydrite rare.
4475	4480	Shale N5; limestone as above, dirty sample.
4480	4485	Shale as above, fissile; sandstone dirty, shaly N6 fine grained; limestone as above, dirty sample.
4485	4490	Shale as above; sandstone as above; limestone dense, N8 more abundant.
4490	4495	Limestone as above; shale as above, very abundant.
4495	4505	Limestone N9, dense.
4505	4510	Limestone ditto, dense to slightly crystalline.
4510	4515	Limestone as above; fossil, fragmental?
4515	4520	Limestone; 5YR8/1, dense.
4520	4525	Limestone as above, trace anhydrite.
4525	4530	Missing.
4530	4535	Shale N7, calcareous limestone as above.
4535	4540	Limestone 5YR8/1, dense, secondary calcite.
4540	4545	Limestone as above 5YR8/1, 5YR6/1; shale N6 calcareous.
4545	4550	Limestone as above, shale as. above 50-50?
4550	4555	Limestone as above 5YR8/1; shale as above.
4555	4560	Limestone as above; shale as above, shale 5YR4/1, trace.
4560	4565	Shale N4, Chunky.
4565	4570	Shale N5, non-calcareous.
4570	4575	Shale N5,, 5YR6/1; limestone dense 5YR8/1.
4575	4580	Shale N5, limestone 5YR8/1 dense.
4580	4585	Shale N5, 5YR4/1; limestone as above.
4585	4590	Shale N5; 5YR4/1; limestone as above in minority.
4590	4595	Shale N5, limestone as above with a little black stain.
4595	4600	Shale as above; limestone as above.
4600	4605	Shale N5, 5YR6/1; limestone 5YR8/1 dense, ostraed; little anhydrite, white.
4605	4610	Shale N5, 5YR4/1; white anhydrite.
4610	4615	Shale N5, sandstone fine grained N7; limestone as above, some anhydrite; chert, gray, rare.
4615	4620	Shale N5, anhydrite white, sandstone as above; limestone as above.
4620	4625	Shale N5; anhydrite as above; sandstone as, above; limestone as above, glauconitic sandstone.
4625	4630	Shale N5, 5YR4/1; anhydrite white; limestone N8 dense and saacharoidal.
4630	4635	Shale N5, 5YR4/1, greenish gray 5G6/1; anhydrite, Limestone as above.
4635	4640	Shale N5, 5YR4/1; limestone 5YR6/1 - 5YR8/1, limestone as above, dense and saccharoidal, white anhydrite.
4640	4645	Shale N5 5YR4/1, white anhydrite, limestone as above.
4645	4650	Shale N5 5YR4/1, white chert.
4650	4655	Shale as above, some chert as above; limestone 5YR6/1 dense, some white anhydrite.

<u>From</u>	<u>To</u>	<u>Formation</u>
4655	4660	Shale N5 5YR4/1; limestone 5Y6/1.
4660	4665	Shale N4, N5.
4665	4670	Shale N5, 5YR4/1; limestone dense 5YR8/1.
4670	' top of Spearfish Formation	
4670	4675	Shale, N4, 5YR4/1.
4675	4680	Shale, N5, anhydrite, white abundant.
4680	4685	Shale N6 and limestone dense 5YR8/1.
4685	4690	Sandstone, pale reddish brown, fine grained in minority, shale N5 as above.
4690	4695	Sandstone as above, shale as above (more abundant).
4695	4700	Sandstone as above, very clayey; with red clay.
4700	4705	Sandstone as above; sample mostly gray N5 shale.
4705	4710	Sandstone as above, shale N5, 5YR4/1 anhydrite, badly contaminated.
4710	4715	Sandstone 10R5/4, fine grained, clayey; shale N5 in majority as cave.
4715	4725	Sandstone as above, shale N5 in majority.
4725	4730	Sandstone, as above, shale pale brown 5YR5/2, shale N5 contaminated.
4730	4735	Sandstone moderate reddish orange 10R6/2, fine grained, some clayey material in sand, calcareous, much shale N6.
4735	4740	Sandstone as above, pale reddish brown 10R5/4, shale pale red 10R6/2.
4740	4745	Sandstone, and shale as above. Shale is mottled, slightly with yellowish brown.
4745	4755	Sandstone and shale as above, shale is dark reddish brown 10R3/4.
4755	4760	Sandstone and shale as above, anhydrite, white, crystalline.
4760	4765	Sandstone and shale as above, anhydrite as above, some shale 10R6/2 in anhydrite.
4765	4770	Sandstone 10R5/4, sandstone grayish orange pink 10R8/2, fine grained.
4770	4775	Sandstone 10R5/4, shale grayish red 5R4/2, splintery.
4775	4780	Sandstone as above, anhydrite, white crystalline.
4780	4785	Sandstone 10R5/4, shale 5R4/2.
4785	4795	Sandstone as above, micaceous; some shale as above.
4795	4800	Sandstone and shale as above, shale N8 (in place.)
4800	4805	Sandstone and shale as above, light greenish gray 5YR8/1 sandstone, fine grained, glauconitic (?) dolomite, yellowish gray 5Y8/1, anhydrite white to pink crystalline.
4805	4810	Sandstone pale reddish brown 10R5/4, medium grained, mica dirty, shale grayish red 10R4/2.
4810	4815	Sandstone and shale as above, shale calcareous.
4815	4820	Sandstone and shale as above, sandstone medium grained very light gray N8.
4820	4825	Sandstone and shale as above, sandstone medium grained very light gray N8, mica.
4825	4830	Sandstone and shale as above, some large sand grains with rusty coating.

<u>From</u>	<u>To</u>	<u>Formation</u>
4830	4835	Shale, pale yellowish brown 10YR6/2, silty; shale grayish red 10R4/2; limestone white, dense.
4835	4840	Shale 10YR6/2, shale 10R4/2, mostly cave gray shale.
4840	4845	Anhydrite, light bluish gray 5B7/1 (?) mostly cave.
4845	4855	Sandstone ? pale reddish brown 10R5/4; mostly cave.
4855	4860	Sandstone (?) mostly cave.
4860	4865	Sandstone, medium grained angular, 10R5/4 friable, sandstone light olive gray 5Y6/1, medium grained.
4865	4870	Sandstone 10R5/4 as above, shale.
4870	4875	Sandstone, as above, anhydrite, white.
4875	4885	Sandstone as above; lost of shale cave gray.
4885	4890	Sandstone as above, calcareous, pyrite.
4890	4895	Sandstone, 10R5/4, coarse grained, slightly calcareous, very little cave.
4895	4900	Missing.
4900	4905	Sandstone, medium grained, 10R5/4, friable.
4905	4915	Sandstone as above, very little cave.
4915	4920	Sandstone as above, but coarser, some mica.
4920	4930	Sandstone as above.
4930	4935	Sandstone as above, shale, grayish red 10R4/2, small amounts.
4935	4940	Sandstone as above, shale pale red 5R6/2
4940	4945	Sandstone 10R5/4, medium to coarse grained, larger grains rounded and frosted, friable.
Kibbey Formation	4945	
4945	4950	Sandstone as above, shale grayish red 10R4/2.
4950	4955	Sandstone as above; anhydrite, white crystalline.
4955	4960	Sandstone as above.
4960	4965	Sandstone as above; anhydrite, white crystalline abundant.
4965	4970	Sandstone as above, much cave.
4970	4975	Sandstone as above, anhydrite, white, crystalline, limestone, dense, white.
4975	4980	Sandstone as above, anhydrite as above.
4985	4990	Limestone grayish orange pink 10R8/2, dense, oolitic, sandstone as above.
4990	4995	Missing.
4995	5000	Sandstone light red 5R6/6 to 10R5/4, medium grained angular to rounded; anhydrite white crystalline.
5000	5005	Sandstone 10R5/4 medium grained, anhydrite, white crystalline, sandstone, white medium gained, pyrite cemented.
5005	5010	Sandstone as above 10R5/4.
5010	5015	Sandstone as above, some sandstone, yellowish gray 5Y8/1.
5015	5020	Sandstone as above, sandstone, fine grained, moderate orange pink 10R7/4, anhydrite, white crystalline.
5020	5025	Sandstone as above; sandstone, fine grained, moderate orange pink 10R7/4, anhydrite, white crystalline. Sandstone fine to medium grained, 10R5/4 to grayish red, 10R4/2, limestone, white dense, anhydrite, white crystalline.

<u>From</u>	<u>To</u>	<u>Formation</u>
5025	5030	Sandstone 10R5/4 as above, limestone as above.
5030	5035	Sandstone as above, anhydrite, white crystalline to dense.
5035	5045	Sandstone as above, anhydrite as above.
5045	5050	Sandstone as above, anhydrite as above, some large round quartz grains.
5050	5055	Sandstone as above, anhydrite, crystalline and dense; some large quartz grains.
5055	5060	Missing.
5060	5065	Sandstone as above but very clayey; anhydrite as above, large rounded quartz grains.
5065	5070	Sandstone as above, anhydrite as above, much cave.
5070	5075	Contaminated.
5075	5080	Sandstone as above, contaminated.
5080	5085	Missing.
5085	5090	Anhydrite, white dense; sandstone as above, large quartz grains.
5095	5100	Anhydrite as above, sandstone as above.
5100	5105	Sandstone 10R5/4 fine to medium grained; anhydrite, white, crystalline to dense.
5105	5120	Anhydrite and sandstone as above.
5120	5125	Sandstone, 10R5/4 to grayish orange pink 10R8/2; anhydrite as above.
5125	5130	Sandstone 10R5/4 to white, medium to fine grained; some large quartz grains, anhydrite, white, dense.
5130	5135	Sandstone and anhydrite as above, limestone, light brownish gray 5YR6/1, dense.
Charles Formation	5135	
5135	5140	Anhydrite, limestone and sandstone as above.
5140	5145	Anhydrite and limestone as above.
5145	5150	Anhydrite, limestone and sandstone as above; large sand grains as above.
5150	5155	Missing.
5155	5160	Siltstone, 10R5/4, clayey.
5160	5165	Missing.
5165	5170	Sandstone 10R5/4, medium grained, subangular, limestone, white, dense.
5170	5175	Limestone, pinkish gray 5YR8/1, oolitic and dense, some intergranular porosity.
5175	5180	Limestone as above, somewhat chalky appearance.
5180	5185	Sandstone, grayish pink 5R8/2, fine grained, shale, pale red 10R6/2, limestone as above.
5185	5190	Anhydrite, white, crystalline, limestone as above non-porous, sandstone as above.
5190	5195	Limestone, grayish orange pink 10R8/2, oolitic, oolites round and ellystrial floating large quartz grains, little porosity.
5195	5210	Limestone and anhydrite as above.
5210	5215	Limestone and anhydrite as above, less abundant.
5215	5220	Anhydrite, dense, grayish pink 5R8/2, some crystalline, some limestone as above.
5220	5225	Limestone, grayish orange pink 10R8/2, oolitic to dense anhydrite as above.

<u>From</u>	<u>To</u>	<u>Formation</u>
5225	5230	Limestone as above, but some coarsely oolitic, anhydrite as above.
5230	5235	Anhydrite, white dense, some limestone as above.
5235	5240	Anhydrite and limestone as above.
5240	5245	Anhydrite as above, very little limestone dense, 10R8/2.
5245	5255	Anhydrite as above.
5255	5260	Anhydrite as above, limestone, oolitic to dense 10R8/2, less common.
5260	5265	Limestone, pinkish gray 5YR8/1, dense, earthy, some anhydrite.
5265	5270	Limestone as above.
5270	5275	Limestone as above, anhydrite, dense, white.
5275	5280	Limestone as above with darker calcite and limestone, anhydrite as above
5280	5285	Limestone as above, less dark crystals, anhydrite as above, abundant.
Mission Canyon	5785	Lodgepole 6132
5285	6545	Mission. Doubt if we ever had this section.
6545	6550	Limestone N7, dense, flaky, white N9, earthy looking, dirty samples.
6550	6555	Limestone as above, chert gray.
6555	6560	Limestone; N6, dense, chert gray N7 or 8.
6560	6570	Limestone, N6, dense, translucent in flakes of small size.
6570	6575	Limestone N6, N9 earthy.
6575	6580	Limestone N6, white with pale red 10R6/2 coating about 50/50.
6580	6590	Limestone as above.
6590	6595	Limestone N7 dense conchoidal fracture.
6595	6600	Limestone as above, dolomite, dense, moderate reddish orange. 10R6/6, very minor amount; N7 limestone badly stained with iron, lots of bit (?) fragments in sample.
6600	6610	Limestone, N7 dense.
6610	6620	Limestone as above, large subangular quartz grains, ls. white earthy.
6620	6625	Limestone as above, white earthy oolitic.
6625	6630	Limestone as above, less oolitic.
6630	6635	Limestone N7 dense; flaky, glauconitic slightly.
6635	6640	Limestone as above badly iron stained, lots of bit fragments.
6640	6645	Limestone as above, N8 ls., earthy glauconitic; large quartzgrain, subangular.
6645	6650	Limestone; white, earthy, dark speckled; chert, gray; iron stained.
6650	6660	Limestone, dense N7 very dirty sample. Might be in gray shale.
6660	6665	Limestone as above.
6665	6670	Limestone as above sample very clayey - may be gray shale.
6670	6675	Limestone as above, badly stained with bit iron.
6675	6680	Limestone as above, dirty sample - may be gray shale.

<u>From</u>	<u>To</u>	<u>Formation</u>
6680	6685	Limestone as above, dirty sample.
6685	6695	Shale N7; I give up - maybe its in place.
6695	6700	Limestone, pinkish gray 5YR8/1, earthy, dense. Limestone N7, dense, iron stained.
Bakken 6705		
6700	6705	Limestone N7, dense, flaky; limestone as above.
6705	6710	Limestone as above, ls, white, earthy, oolitic.
6710	6715	Limestone N7, dense.
6715 Kinder- hook	6720	Limestone N8, dense; pyrite; limestone pinkish gray 5YR8/1, dense earthy.
6720 Break	6725	Limestone as above shale, medium dark gray N4.
6725	6730	Shale, dark gray N3, fissile.
6730	6735	Limestone, white, dense, earthy; dirty sample.
6735	6740	Limestone as and N7, shale N3 present (probably belongs in this interval.)
6740	6745	Sandstone, medium to coarse grained, N8, glauconitic, limy grains subrounded.
6745	6750	Sandstone as above but N7, pyrite, grains subrounded to subangular.
Lyleton 6755		
6750 Break	6755	Sandstone as above, fine grained, dirty sample.
6755	6760	Dolomite, fine saccharoidal, pinkish gray 5YR8/1.
6760	6770	Dolomite as above, lots of iron stain from bit (?)
6770	6780	Dolomite as above, lot of calcareous clay of same color, dirty sample (?).
6780 Break	6785	Dolomite as above, some shale light greenish gray 5GY8/1 interbedded.
6785	6790	Dolomite, 5YR8/1 weathering to light brown 5YR6/4, color very pronounced.
6790	6795	Dolomite as above but 5YR6/4 color goes thru fragments; light greenish gray 5GY8/1 dolomite:
6795	6800	Dolomite as above, fine saccharoidal.
6800	6805	Dolomite as above, fine saccharoidal, and light brown 5YR6/2.
6805	6810	Dolomite as above, much of light brown color appears to be secondary weathering.
6810	6815	Dolomite moderate orange pink 5YR8/4, fine saccharoidal.
6815	6820	Dolomite, gray orange pink 5YR7/2, medium saccharoidal.
6820	6825	Dolomite, light brown 5YR6/4, dense to medium saccharoidal.
6825	6830	Shale 5YR6/4, clayey; dolomite as above.
6830	6835	Shale as above.
6835	6840	Dolomite, pinkish gray 5YR8/1, medium saccharoidal with 5YR6/4 coating.
6840	6845	Shale, moderate reddish orange 10R6/6, dolomitic, laminated.
6845	6850	Dolomite, light greenish gray 5GY8/1 weathering to pale red, clayey.
6850	6855	Dolomite as above, weathers moderate red orange 10R6/6, clayey.

<u>From</u>	<u>To</u>	<u>Formation</u>
6855	6860	Dolomite as above; weathers gray orange pink 10R8/2, clayey.
6860	6865	Dolomite as above, weathers 10R6/6.
6865	6875	Dolomite as above; shale (?) 10R6/6, very clayey. Probably this whole sequence is interbedded 10R6/6 shale and light greenish gray 5GY8/1 dolomite.
6875	6880	Shale 10R6/6.
6880	6885	Dolomite, N5, dense.
6885	6890	Limestone pinkish gray 5YR8/1, fine saccharoidal.
6890	6895	Limestone as above, much shale gray contaminated (?)
6895	6905	Dolomite, white, medium saccharoidal weathered pale red 10R6/2.
6905	6910	Dolomite, pale red 10R6/2, fine saccharoidal, light green gray 5GY8/1 fine saccharoidal dolomite.
6910	6915	Dolomite, white fine saccharoidal, dirty sample.
6915	6920	Dolomite as above; dolomite 10R6/2, earthy, saccharoidal, dirty sample.
6920	6925	Shale, pale reddish brown 10R5/4 calcareous; dolomite as above.
6925	6935	Shale as above.
Nisku 6930		
6935	6940	Dolomite, light green gray 5GY8/1 dense to fine saccharoidal.
6940	6945	Dolomite as above to white saccharoidal.
6945	6950	Dolomite as above and pale red 10R6/2 saccharoidal dolomite.
6950	6955	Dolomite, very pale orange 10YR8/2 with pyrite inclusions, dense to coarsely saccharoidal to coarsely crystalline.
6955	6960	Limestone as above; dense to slightly fragmental.
6960	6965	Limestone as above, dolomite 10YR8/2, saccharoidal, contaminated sample.
6965	6970	Limestone, pale brown 5YR5/2, dense; anhydrite (?) white crystalline.
6970	6975	Limestone and anhydrite as above.
6975	6980	Limestone, light brownish gray 5YR6/1, dense to fragmental.
	6980	1 hour circulation. Limestone nearest to grayish orange pink 5YR7/2, very coarse saccharoidal, excellent intergranular porosity. Some fluorescence on stuff similar to that below.
	6980	1 1/2 hr. circulation. Limestone 5YR7/2, dense to fragmental fluoresces.
	6980	2 hr. circulation. Limestone similar to that in 1 and 1 1/2 hr. cir. periods. Stuff that fluoresces in each case is dense. Saccharoidal stuff doesn't seem to fluoresce well.
6980	6985	Limestone 5YR7/2, very coarse saccharoidal, excellent vugular and intergranular porosity.
6985	6990	Limestone, very coarse saccharoidal, excellent vugular and intergranular porosity.

<u>From</u>	<u>To</u>	<u>Formation</u>
6990	6995	Limestone as above, porosity as above; fluorescences. Limestone has black stain.
6995	7000	Limestone, pinkish gray 5YR8/1, dense.
7000	7005	Limestone as above dense to fine saccharoidal.
7005	7010	Limestone, light brownish gray 5YR6/1, fine saccharoidal. Fine pinpoint and intergranular porosity.
7010	7015	Limestone as above, pinpoint, porosity.
7015	7020	Limestone, 5YR8/1, dense to slightly fragmental, fossiliferous.
7020	7025	Limestone as above, some small vugular porosity.
7025	7030	Limestone, light brownish gray 5YR6/1, dense to slightly fragmental.
7030	7035	Limestone, same as above; some intergranular porosity.
7035	7040	Limestone 5YR8/1, dense to fine saccharoidal.
7040	7045	Limestone as above f some intergranular porosity.
7045	7050	Limestone, 5YR6/1, dense dark stain (?)
7050 Break	7055	Dolomite, light brownish gray 5YR6/1, dense to fine saccharoidal, some dark stain but does not fluoresce.
7055 Break	7060	Dolomite, light brown 5YR6/4, fine saccharoidal color quite noticeable.
7060	7065	Dolomite, pinkish gray 5YR8/1, dense to fine saccharoidal; little anhydrite
7065 Break	7070	Dolomite as above.
Woodbend Equivalent	7073	
7070	7075	Limestone 5YR8/1, dense to very fine saccharoidal.
7075	7095	Limestone, light gray N7 dense, dark stained.
7095	7100	Limestone N6, contaminated sample.
7100	7105	Limestone N7, dense, dark stained.
7105	7110	Limestone N7, dense, anhydrite, white, crystalline.
7110	7115	Anhydrite, white finely crystalline.
7115	7120	Dolomite N7, dense to fine saccharoidal.
7120	7125	Dolomite pinkish gray 5YR8/1, fine saccharoidal.
7125	7130	Limestone, light brownish gray 5YR6/1, dense.
7130	7135	Anhydrite, white, finely crystalline.
7135	7140	Limestone 5YR6/1, dense.
	7140	30 min. circulating. Limestone 5YR8/1, fine saccharoidal to dense.
	7140	1 hr. circulating. Limestone 5YR6/1, dense.
	7140	1 1/2 hr. circulating. Limestone 5YR8/1, dense, slightly oolitic (?)
	7140	2 hr. circulating. Limestone 5YR6/1, dense.
7140	7160	Limestone as above, dense to slightly fragmental.
7160	7165	Dolomite N6, dense anhydritic?
	7165	1 hr. circulating. Limestone, pinkish gray 5YR8/1, dense to finely saccharoidal, slightly oolitic.
7165	7170	Limestone, dense 5YR8/1.
7170	7175	Limestone, pinkish gray 5YR8/1, dense.
7175	7180	Limestone, pale yellow brown, finely crystalline, dense.
7180	7185	Limestone and dolomite, pale yellow brown, finely crystalline some grayish brachiopod fragment.

<u>From</u>	<u>To</u>	<u>Formation</u>
7185	7190	Limestone, pale yellow brown, finely crystalline, dense grayish. (cave ?) lots of iron stains.
7190	7195	Limestone, pale yellow brown, finely crystalline, lots of white anhydrite.
7195	7200	Limestone, pale yellow brown, finely crystalline white anhydrite, iron stain.
7200	7205	Limestone, pale yellow brown, finely crystalline, few vugs.
7205	7210	Limestone, pale yellow brown, finely crystalline, vuggy.
7210	7215	Limestone and dolomite, mostly pale yellow brown, Limestone and light gray N7. Dolomite, crystalline, slightly vuggy iron stain.
7215	7220	Limestone as above, some anhydrite.
7220	7230	Limestone and dolomite, pale yellow brown, finely crystalline, dense.
7230	7235	Limestone, pale pale yellow brown and light olive gray 5Y6/1, finely crystalline, dense.
7235	7240	Limestone and dolomite, pale yellow brown to yellow gray 5Y18/1, finely crystalline, dense.
7240	7250	Limestone, light olive gray, finely crystalline, pinpoint vugs.
7250	7255	Limestone, light olive gray to yellow gray, fine crystalline to yellow gray slightly saccharoidal.
7255	7260	Limestone, very pale orange, finely crystalline, dense.
7260	7265	Limestone, very pale orange, finely crystalline to crystalline.
7265	7270	Limestone, very pale orange 10YR8/2 to pale yellow brown 10YR6/2 crystalline to saccharoidal.
7270	7275	Limestone and dolomite, very pale orange to light gray N7, finely crystalline, platy. Some iron staining?
7275	7280	Limestone and dolomite, pale yellow brown, crystalline to saccharoidal, much iron staining.
7280	7285	Limestone and dolomite, pale yellow brown to very pale orange, crystalline to saccharoidal.
7285	7295	Limestone and dolomite, pale yellow brown, finely crystalline, dense.
7295	7300	Limestone, pale yellow brown 10YR6/2 saccharoidal, light olive gray 5Y6/1 anhydrite and some gypsum. 2 hrs. circulating at 7300, same as above. Saccharoidal, vuggy.
7300	7305	Limestone, same as above, light gray and white vuggy, some saccharoidal, anhydrite, dolomitic, limestone.
7305	7310	Limestone as above, dolomitic.
7310	7315	Limestone and dolomite, pale yellow brown, (limestone crystalline) dolomite, saccharoidal shell fragments.
7315	7320	Limestone and dolomite, same as above, mainly limestone platy.
7320	7325	Limestone, pale yellow brown crystalline to saccharoidal.
7325	7330	Dolomite, pale yellow brown, saccharoidal, anhydrite.

<u>From</u>	<u>To</u>	<u>Formation</u>
7330	7335	Dolomite, pale yellow brown saccharoidal, anhydrite, limestone dolomitic.
7335	7340	Limestone, pale yellow brown to olive gray 5Y2/1, finely crystalline to crystalline.
7340	7350	Limestone, olive gray 5Y2/1, finely crystalline.
7350	7355	Limestone, olive gray, finely crystalline, shell fragments, white anhydrite.
7355	7360	Limestone, olive gray, finely crystalline to coarsely crystalline, white anhydrite.
7360	7365	Limestone as above, platy.
7365	7370	Limestone, light gray N7 to light gray yellow brown texture as above.
7370	7375	Limestone, light gr N7, crystalline.
7375	7380	Limestone, yellow gray to light, gray N7, crystalline, slightly saccharoidal anhydrite, few vugs.
7380	7385	Limestone; yellow gray to light gray N7, crystalline.
7385	7390	Limestone as above, much shale cave? shale pebbles, iron stain.
	7390	30 min. circulation. Limestone, yellow gray anhydrite to crystalline 5Y8/1 to light gray N7.
	7390	2 hrs. circulation. Limestone as above, shale pebbles, cave?
7390	7395	Limestone as above, much cave.
	7395	90 min. circulation. Limestone as above, yellow gray.
7395	7400	Yellow gray to light gray, finely crystalline to crystalline.
7400	7405	Limestone, yellow gray crystalline to slightly saccharoidal.
7405	7410	Limestone, yellow gray crystalline, much cave.
7410	7415	Dolomite, mosly yellow gray, some bright gray, 5YR4/1, crystalline and dense.
7415	7420	Limestone, light gray NT, finely crystalline.
7420	7430	Limestone, light gray N7, yellow gray 5Y8/1, finely crystalline, lithographic and dense.
7430	7435	Limestone, light gray N7, yellow gray to light olive gray, finely crystalline, lithographic to slightly saccharoidal.
	7435	90 min. circulation. Limestone, yellow gray, finely crystalline.
7435	7445	Limestone, yellow gray, finely crystalline.
Beaverhill Lake Equiv.	7443	
7445	7450	Limestone, mainly yellow gray, coarsely crystalline, vary colored, vary texture limestone or calcite.
7450	7455	Limestone, medium light gray N6 and some yellow gray finely crystalline to crystalline, pink calcite.
7455	7460	Limestone, light gray N7, finely crystalline.
7460	7465	Limestone, medium light gray N6, yellow gray, finely crystalline to monotographic, dense.
7465	7470	Limestone, yellow gray, some light gray, finely crystalline.

<u>From</u>	<u>To</u>	<u>Formation</u>
7470	7475	Limestone, finely crystalline, dense, white anhydrite, yellow gray and some light gray.
7475	7480	Limestone, yellow gray and medium light gray N5, finely crystalline to crystalline.
7480	7485	Limestone color as above, finely crystalline to coarsely crystalline.
7485	7490	Limestone, medium light gray, finely crystalline.
7490	7495	Limestone, medium light gray and some yellow gray, fine to coarsely crystalline.
	7495	2 hrs. circulation. Limestone, pale yellow brown saccharoidal.
7495	7500	Limestone, pale yellow brown and light gray N7, finely crystalline to saccharoidal.
7500	7505	Dolomite, pinkish gray, some yellow gray, (medium light gray N6 limestone, pink anhydrite dense.)
7505	7510	Dolomite, light gray N7 and medium lt. gray N6, few pink gray 5YR8/1, finely crystalline.
7510	7515	Limestone, light gray N7, finely crystalline, dense.
7515	7520	Limestone and dolomite, medium light gray N6 limestone, finely crystalline very light gray N8 dol. crystalline.
7520	7525	Limestone and dolomite, light gray N6 ls., medium light brown gray dolomite, shell fragments.
7525	7530	Dolomite, light gray N7, slightly saccharoidal.
7530	7535	Dolomite, medium light gray N6, light, gray N7 crystalline to slightly saccharoidal.
7535	7540	Medium light gray N6, light gray N7 coarsely crystalline; to slightly saccharoidal.
7540	7545	Dolomite and limestone, light gray N7 coarsely crystallite to slightly saccharoidal.
	7545	Limestone as above, yellow gray to medium light gray.
7545	7555	Limestone as above.
7555	7560	Limestone, light olive gray 5Y6/1 crystalline to slightly saccharoidal.
7560	7565	Limestone, light gray N7, coarsely crystalline to saccharoidal.
7565	7575	Limestone, yellow gray, coarse crystalline to slightly saccharoidal, brown gray 5YR4/1, shell fragments, finely crystalline, dense.
	7575	30 min. circulation. Limestone as above, mostly brown gray.
7575	7580	Limestone, olive gray 5Y4/1, dense.
7580	7585	Limestone, olive gray as above, finely crystalline, dense.
7585	7590	Limestone and dolomite, olive gray ls. dense, yellow gray, coarsely crystalline to saccharoidal.
7590	7595	Dolomite, yellow gray as above and limestone as above.
7595	7600	Dolomite light olive gray, saccharoidal, much white anhydrite.
7600	7605	Dolomite, light olive gray, saccharoidal and other vary colored and vary textured white anhydrite, dolomite and limestone.

<u>From</u>	<u>To</u>	<u>Formation</u>
7605	7610	Dolomite, light olive gray, saccharoidal.
7610	7615	Limestone, yellow gray, coarsely crystalline to saccharoidal.
7615	7620	Dolomite, yellow gray, light brown gray, (vary texture) white anhydrite.
7620	7625	Missing.
7625	7630	Dolomite, gray orange pink, pink gray; limestone light brown gray; dolomite yellow gray, vuggy, crystalline to saccharoidal.
7630	7635	Dolomite and limestone, medium gray N5, dolomite, yellow gray ls, light brown gray limestone, white anhydrite, vary texture to saccharoidal.
7635	7640	Dolomite as above.
7640	7645	Dolomite and limestone as above (light brown gray limestone).
7645	7650	Limestone, light olive gray, saccharoidal.
Manitoban Formation 7653		
7650	7655	Limestone as above, crystalline to saccharoidal.
7660	7665	Limestone, yellow gray 5Y8/1, saccharoidal.
7665	7670	Limestone, yellow gray, slightly dolomitic and brown gray 5YR4/1, flaky, crystalline.
7670	7675	Limestone, brown gray, flaky crystalline. Some yellow brown as above.
7675	7680	Limestone, brown, gray 5YR4/1 flaky crystalline, dense.
7680	7685	Limestone and dolomite, brown gray 5YR4/1 crystalline; yellow gray dolomite.
7685	7690	Limestone same as above.
7690	7695	Limestone, light gray N7 to light olive gray 5Y6/1 to olive gray 5Y4/1, finely crystalline to crystalline, few vugs.
7695	7700	Limestone same as above, crystalline to slightly saccharoidal.
7700	7705	Dolomite, yellow brown 5Y8/1 and light gray N7, saccharoidal; some limestone as above.
7705	7710	Dolomite and limestone; dolomite, very light gray; limestone, medium light gray N5. Mostly dolomite saccharoidal.
7710	7715	Dolomite, very light gray saccharoidal.
7715	7720	Dolomite, very light gray, yellow gray 5Y8/1, some pinkish material.
7720	7725	Dolomite, yellow gray 5Y8/1, crystalline to slightly saccharoidal, little brown gray limestone.
7725	7730	Dolomite, yellow gray 5Y8/1 crystalline to slightly saccharoidal.
7730	7735	Dolomite; yellow gray saccharoidal brown gray 5YR4/1 limestone
7735	7765	Missing.
7765	7770	Dolomite, light brown gray, extremely saccharoidal, vuggy, much gray and red. Shale cave?
7770	7780	Dolomite, light brown gray 5YR6/1, extremely saccharoidal, vuggy, shale cave?

<u>From</u>	<u>To</u>	<u>Formation</u>
7780	7790	Dolomite as above, slight iron stain?
7790	7800	Dolomite as above, little chalky calcite.
7800	7805	Dolomite, light olive gray 5GY6/1, coarsely crystalline to saccharoidal, vuggy.
7805	7815	Dolomite, light olive gray, saccharoidal, vuggy.
7815	7825	Dolomite as above, coarsely crystalline.
7825	7830	Missing.
7830	7835	Dolomite. light olive 5Y6/1, coarsely crystalline.
7835	7845	Limestone, light olive gray, coarsely crystalline to saccharoidal, brown gray limestone 5YR4/1, crystalline.
7845	7865	Limestone, brown gray, crystalline, dense; some light gray dense.
7865	7870	Limestone, brown gray, light gray N7, yellow gray, crystalline pink anhydrite.
Winnipegogan	7872	
7870	7873	Trip. Limestone; mostly brown gray, crystalline.
7873	7875	Limestone, dolomite, brown gray, crystalline, little, light olive gray dolomite, saccharoidal.
7875	7885	Limestone, brown gray, crystalline, some light olive gray, saccharoidal dolomite, lot of cave.
7885	7890	Limestone, much light olive gray, crystalline to slightly saccharoidal; otherwise same as above dolomite.
7890	7895	Dolomite, pale red, crystalline, some brown gray limestone, finely crystalline.
7895	7900	Dolomite, pale red, crystalline to slightly saccharoidal, some brown gray, finely crystalline, limestone; some very light gray crystalline to slightly saccharoidal dolomite. Much gray shale cave?
7900	7905	Shale, dolomite and limestone as above, pale red shale.
7905	7910	Shale as above, some yellow gray, very sugary vuggy dolomite.
7910	7915	Shale, pale red brown, white specks, few vugs (rest as above. some v. sugary dolomite, vuggy).
7915	7920	Shale, pale red brown.
7920	7925	Shale, as above. Some limestone and dolomite, probably cave?
7925	7930	Shale as above with some dark gray shale.
7930	7945	Shale as above with some medium gray and dark gray shale.
7945	7980	Shale as above, some, white specks in red shale.
7980	7995	Shale as above, little yellow gray crystalline dolomite.
7995	8005	Shale as above little pale yellow brown dolomite.
8005	8015	Shale as above.
8015	8020	Shale as above, little quartz.
8020	8060	Shale as above.
8060	8065	Shale as above, some pyrite.
8065	8110	Shale as above.
8110	8125	Shale as above, little yellow gray fine grained dolomite.

<u>From</u>	<u>To</u>	<u>Formation</u>
8125	8155	Shale, same as above.
8155	8175	Shale as above, yellow gray, fine grained, dolomites, few vugs.
8175	8190	Shale as above, light olive gray, fine grain dolomite, yellow gray, vuggy, fine grained. Cave? at 85.
8190	8195	Shale, red, some pale red fine grained dolomite and light olive gray.
8195	8205	Red shale, light olive gray, yellow gray dolomite, vuggy, silica at 8205.
8205	8210	Shale and dolomite as above, solution cavities.
8210	8220	Shale and dolomite as above, vuggy.
8220	8225	Shale and dolomite as above.
8225	8235	Shale and dolomite, light olive gray, fine grained dolomite, some yellow gray dolomite, vuggy.
8235	8240	Shale as above; light olive gray, fine to coarsely crystalline, vuggy dolomite, yellow gray, fine grain dolomite.
8240	8245	Shale and dolomite as above. Yellow gray and pale yellow brown dolomite, vuggy.
8245	8255	Shale as above, pale yellow brown dolomite, vuggy.
8255	8260	Shale as above, pale yellow brown dolomite, some gray orange pink dolomite.
8260	8265	Shale as above, pale yellow brown dolomite, some very light gray N8 dolomite.
8265	8275	Shale as above. Pale yellow brown dolomite stain. silty dolomite.
8275	8280	Shale as above, pale yellow brown dolomite, slight stain, some gray orange pink dolomite.
8280	8285	Shale and dolomite as above, slight stain.
8285	8290	Shale and dolomite as above, some saccharoidal, stain.
8290	8295	Red shale cave? very pale orange, fine grain dolomite and pale yellow brown dolomite, slight stain.
8295	8300	Red shale cave? pale yellow brown dolomite, slight stain, white anhydrite.
8300	8315	Red shale cave? pale yellow brown dolomite, fine grained, much white anhydrite.
8315	8330	Anhydrite and dolomite as above.
Elm Point	8335	
8330	8335	Dolomite, white and gray mottled; crystalline, dense.
8335	8350	Limestone, mottled olive gray, and pale yellow brown, fine grain, dense.
8350	8380	Limestone, mottled olive gray, extra fine grained dense.
8380	8400	Limestone as above, some anhydrite.
8400	8405	Limestone as above, some white limestone.
8405	8415	Limestone, mottled olive gray, fine grain, dense to yellow gray fine grain, dense.
8415	8420	Limestone as above, much red shale cave.
8420	8430	Limestone as above, Poor sample.
8430	8435	Limestone, mottled olive gray. Yellow gray dolomite, dense, much red shale cave, some gray shale cave.
Total Depth		