

Report 75-8

COAL RESOURCES,
TOFIELD-DONALDA AREA, ALBERTA

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ERRATA

1. On page 1, line 4 of paragraph 3 should read:
"to 10 miles apart (Fig. 3) . . ."
2. On page 4, line 6 of paragraph 1 should read:
"near Ryley and Tofield (Fig. 4) . . ."
3. On page 4, line 3 of paragraph 2 should read:
"Island Park till upland (Fig. 3, Section A-A¹); . . ."
4. On page 6, line 4 of paragraph 4 should read:
". . . three distinct coal zones; figure 4"
5. On page 6, the title of Table 1 should read:
"Table 1. Proved Reserves of Coal¹"
6. On page 7, lines 3 and 4 of paragraph 1 should read:
". . . vary from about 15 feet per mile to nearly 100 feet per mile . . ."
7. In figure 3A, item 7 should read:
". . . with thickness of mined coal in feet."
8. In figure 3A, item 9 should read:
"Topographic contour (interval 100 feet)"
9. Figure 4 on page 5 should be replaced with the corrected version given below.

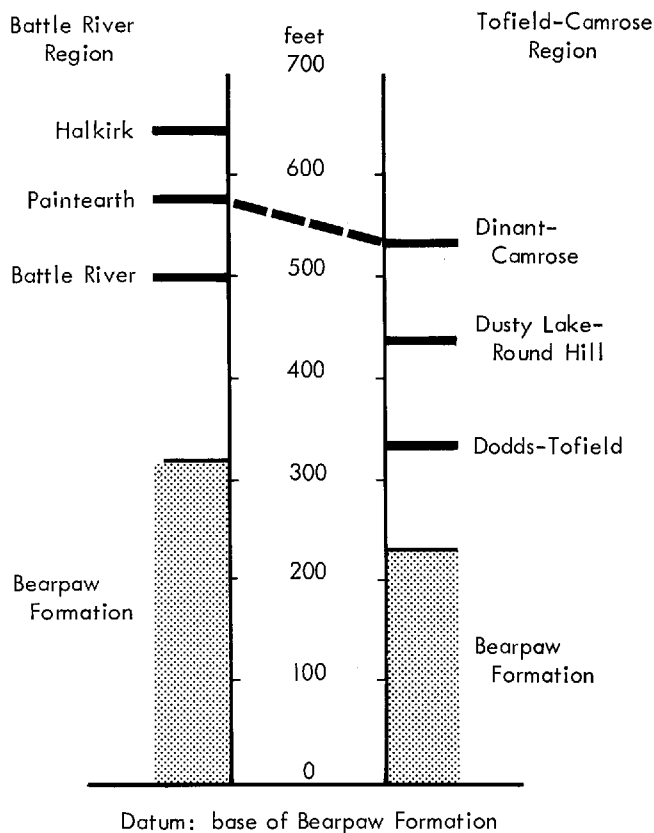


FIGURE 4. Correlation of coal zones, Tofield-Donalds area.

CONTENTS

	Page
Abstract	1
Introduction.....	1
Acknowledgments.....	3
The Tofield-Donalda area.....	3
Geology.....	3
Coal.....	5
Coal quality.....	7
References cited.....	8
Appendix A. Alberta Research Council coal testholes.....	11

ILLUSTRATIONS

Figure 1. Location of study area.....	2
Figure 2. Geology of study area.....	in pocket
Figure 3. Coal occurrences, Tofield-Donalda area.....	in pocket
Figure 4. Correlation of coal zones.....	5

TABLES

Table 1. Proved reserves of coal.....	6
Table 2. Coal in selected deep wells.....	8
Table 3. Proximate analyses of mined coals.....	in pocket

COAL RESOURCES,
TOFIELD-DONALDA AREA, ALBERTA

Abstract

The Tofield-Donalda area lies between longitudes 111° 30' and 113° west and latitudes 52° 15' and 53° 45' north. Within this area, all bedrock strata dip gently toward the west-southwest. At surface, the marine Bearpaw Formation occupies a narrow band across the area from southeast to northwest, separating areas underlain by the older continental Belly River Formation in the northeast from areas underlain by the younger continental Edmonton Formation in the southwest. Economically significant coal deposits are restricted to the lower part of the Edmonton Formation where a series of large bodies, mostly suitable for large-scale strip mining, extend from Halkirk in the southeast to Tofield in the northwest. Several of the coal bodies are glacially disturbed. The area consists of a flat plain bounded on the northeast and on the west by low but rough uplands of till and glacially disturbed bedrock. Locations and logs of 268 shallow coal testholes and one deep testhole are given.

INTRODUCTION

In the summer of 1971, Alberta Research Council focused its coal survey activities on a portion of the east-central Alberta Plains bounded by longitudes 111° 30' and 113° west and latitudes 52° 15' and 53° 45' north, designated the Tofield-Donalda area (Fig. 1; Fig. 2). This is a settled area, almost completely cleared for agriculture, with a number of long-known coal deposits such as Tofield, Dodds, Camrose, Forestburg, most of which are already held by mining companies.

The coal companies have devoted a great deal of time to exploration activity here in the past, mostly in relatively small areas of special interest, and oil companies have conducted a number of structure testhole programs, but results of all projects remain confidential. Consequently, Alberta Research Council felt that a drilling program was warranted here to widen its reconnaissance of Alberta Plains thermal coal resources begun in 1958 (Pearson, 1959), and to resolve some of the local problems of coal seam sequence and continuity.

To this end, 268 shallow testholes (mostly 160-195 feet deep; 47 715 feet in total) and one deep testhole (700 feet deep) were drilled at about 2.5-mile intervals, mostly along 10 lines roughly at right angles to the regional strike. Lines were set 8 to 10 miles apart (Fig. 2), with cross lines and, in a few areas of special interest, fill-in locations on a 2-mile grid.

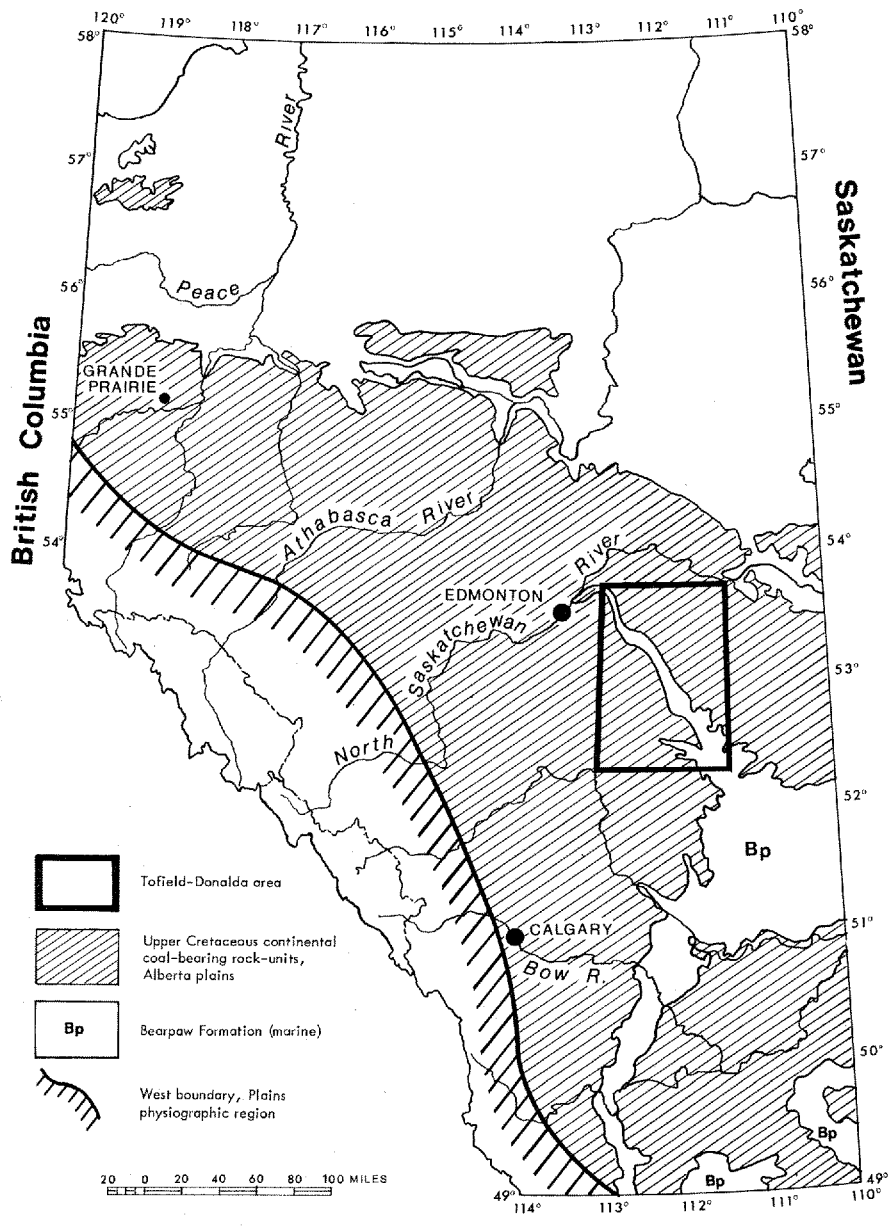


FIGURE 1. Location of study area.

Each hole, drilled with a conventional mud-rotary shothole rig, was described lithologically from mud-stream cuttings, and electrologged for spontaneous potential and single-point resistance. Except in the southwest corner of the area, outcrops are rare and usually disturbed; in consequence, the reconnaissance of the Tofield-Donalda area relied entirely on the drill program.

Testhole locations are shown in figure 3; logs presented in Appendix A are collations of lithologs with single-point electrologs.

Acknowledgments

Coal survey activities in the Tofield-Donalda area were supported by Alberta Power Ltd. and Calgary Power Ltd.; their encouragement and financial assistance are gratefully recognized. Field operations and testhole data collation were supervised by A. Bosman.

Tofield-Donalda Area

The Tofield-Donalda area (Fig. 1; Fig. 2) covers 6 368 square miles or about 178 townships, and adjoins the Central Red Deer River coal study area (Campbell, 1967) and the Hussar-Hanna coal study area (Campbell, 1974). It consists of an extensive flatland, limited in the northeast (east of Vegreville) and west (from Elk Island Park to Miquelon Lakes, and around Buffalo Lake) by low but rough uplands of till and glacially disturbed bedrock (Fig. 2). Relief is small; elevation varies from 1 960 feet on the Vermilion River in Sec. 11, Tp. 54, R. 11¹ to 2 800 feet in Sec. 8, Tp. 39, R. 21. In the southern six townships, badlands topography is developed along several incised stream valleys. Except in the uplands and in a few buried préglaial valleys, drift cover is thin and bedrock lies close to the present surface.

The area is almost completely cleared for agriculture, the dominant economic enterprise. It is served by a good country road network and by numerous settlements, three of which, Camrose, Stettler and Vegreville, are among the larger country centers of Alberta.

GEOLOGY

The Tofield-Donalda area forms part of the Plains physiographic region of Alberta (Fig. 1); within it, bedrock strata dip gently to the west-southwest.

The marine Bearpaw Formation occupies a narrow band diagonally across the area from southeast to northwest (Fig. 2). The underlying, mostly continental Belly River Formation outcrops east and northeast of the Bearpaw, while the overlying, continental, coal-bearing Edmonton Formation outcrops west and southwest of it.

The general geology of the area is discussed by Crickmay *et al.* (1942), Green (1972), Lang (1965), Rutherford (1939a,b) and Warren and Hume (1937).

¹All locations given in this report are west of the fourth meridian.

Rutherford (1939a,b), on the basis of rare outcrops near Wavy Lake (Tp. 45, R. 15) mapped the Bearpaw Formation north as far as Tp. 55. Bearpaw-type sediments (dark grey shales and shaly siltstones, low electrolog resistance trace) were encountered in testholes east of Tofield and near Holden. The formation thins gradually northward from nearly 300 feet on the Battle River to about 150 feet near Ryley and Tofield (Fig. 2); since the Bearpaw base is relatively synchronous (Given and Wall, 1971) the Edmonton-Bearpaw boundary is probably diachronous and the lowermost Edmonton strata at Tofield older than the lowermost on the Battle River.

North of Tofield and west of Beaverhill Lake, the Bearpaw Formation is difficult to trace in the glacially disturbed bedrock on the east flank of the Elk Island Park till upland (Fig. 3, section A-A'); the formation is believed to thin abruptly to 15-30 feet in this region.

Neither marker beds nor true coal seams were observed in the Belly River Formation within the study area.

The lower Edmonton Formation, however, especially in the Tofield-Dodds-Camrose region and along the Battle River, contains many moderately thick coal seams which are usable locally as markers.

Three distinguishable coaly zones are evident in the Tofield-Dodds-Camrose region, and three in the Battle River region (Fig. 2), each consisting of one or a very few well-marked coal seams. However, the uppermost zone at Camrose appears to be equivalent to the middle zone or seam (Paintearth) on the Battle River (Fig. 4). The uppermost coaly zone (Halkirk) on the Battle River is believed to correlate with the seams at Castor, Sullivan Lake and Garden Plain, and approximately with seams numbered 5, 6 and 7 at Drumheller (Allan and Sanderson, 1949; Campbell, 1974).

Upper Edmonton Formation strata (Carbon-Thompson coal zone and Kneehills Member) are found in disturbed bedrock hills at Nevis in the southwest corner of the area.

Several large buried preglacial bedrock valleys cut across the area (Farvolden, 1963; Stalker, 1960; Carlson and Topp, 1971); the largest of these, 6 miles wide in places, is the preglacial Red Deer valley running east across the Battle River at Driedmeat Lake toward Daysland and Killam (Fig. 2).

The hummocky moraine uplands at Elk Island Park, Buffalo Lake and east of Vegreville, formed by ice action in Pleistocene time, are believed from testhole evidence to consist in large part of disturbed bedrock. Glacial bedrock disturbance is evident also in the flatlands; many coal deposits, especially those near Dinant, Round Hill and Tofield, are considerably contorted.

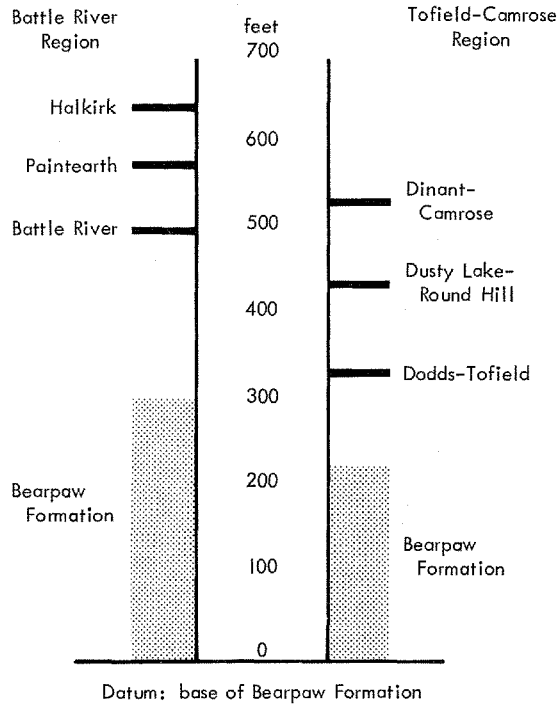


FIGURE 4. Correlation of coal zones.

COAL

The Tofield-Donalda area is one of the most active regions in the Alberta Plains in both coal exploration and coal mining. About 200 mines have been licensed for operation within the area, beginning in 1907 at Tofield and in 1909 at Camrose and at Halkirk; five mines are still producing (1973) including two of the largest stripmines in Alberta. Figure 3 shows locations of all mines licensed to 1963 while Campbell (1964) gives further information on each.

Near Forestburg (Tp. 40, R. 15) one large coal-fired electric power plant is operating with a present capacity of 212 MW² and a projected total capacity of

²MW - megawatts

587 MW by 1979; a second power plant is planned for the Dodds-Round Hill region with a total capacity of 1250 MW by 1983 (Electric Utility Planning Council, 1974).

The coal survey program in this area confirms that in the settled plains regions of Alberta, strippable coal deposits are to be found only in and around localities that have been known for many years to bear coal.

No significant coal deposits were observed within rocks of the Belly River formation.

Within the lower Edmonton Formation, coal occurs in two broad regions, separated approximately by the buried preglacial Red Deer valley (Fig. 2) - a northern region (Tofield-Dodds-Camrose) and a southern region (Battle River). As noted above, in each region there appear to be three distinct coal zones; figure 3 shows the probable stratigraphic relationships among these, with names indicating the main location at which each is found, while figure 2 shows approximate distributions.

Mines have exploited all the coal zones noted above.

Coal thicknesses and numbers of seams at selected datum points are indicated in figure 3; conspicuous concentrations of mines mark locally thickened lenses, for example, in the Battle River seam about Tp. 40, R. 15, and in the Paintearth zone in Tp. 42, R. 17. The thick Dodds-Tofield and Battle River seams, traceable along strike for about 24 and 9 miles respectively, probably are relatively isolated lenses of coal.

Table 1. Proved Reserves of Coal

Field	Remaining in place ² (MM tons)	Recoverable by strip mining ³ (MM tons)	Recoverable by underground mining ³ (MM tons)
Battle River:			
Heisler-Donalda	414	117	16
Central Battle River	344	271	-
Dodds-Tofield			
Tofield	57	49	-
Dusty Lake	323	251	-
Dinant	13	3	-
	1151	691	16

¹From Energy Resources Conservation Board Report 73-31.

²Coal in seams > 2 feet thick.

³Coal in seams > 4.5 feet thick.

Much of the coal, especially in the north of the area, is glacially deformed. At Round Hill (Tp. 48, R. 18), the seam lies probably 100 feet higher than expected; its dip away from the outcrop appears to vary from less than 10 feet per mile to more than 40 feet per mile (Fig. 3, section B-B') in an area where regional dip is uniformly about 20 feet per mile. Deposits at Tofield, east of Dodds (Tp. 49, R. 17) and at Dinant (Tp. 48, R. 19) may be similarly deformed. The small strip pit west of Elk Island Park (Sec. 2, Tp. 53, R. 21), the only mine known within the till uplands, exploited a 12-foot thick body of coal which extends laterally no more than 100 or 200 yards and doubtless has been glacially disturbed; probably it is only part of a large glacial erratic.

Coal deposits recoverable by strip mining within the Tofield-Donalda area are very large, but since most lie within properties and leaseholds of established mining companies and are being actively explored in detail, tonnage estimates at the present time are subject to constant upward revision.

The Alberta Energy Resources Conservation Board has undertaken to monitor exploration results in the various coalfields of the province, and has already published a first inventory, based on information available to the end of 1972, including data from the 1971 Research Council testhole program (Energy Resources Conservation Board, 1973). Table 1 summarizes Board estimates of coal resources of the five arbitrary fields that lie within the Tofield-Donalda area.

Further coal resources lie downdip southwestward from the known near-surface deposits at depths requiring underground mining methods. Coal indications from five selected deep wells, presented in table 2 (including single seams 10 and 14 feet thick), show that these likely represent a significant resource for future development, but information at present is inadequate to delineate them, especially in view of the lency nature of the near-surface deposits.

COAL QUALITY

Since most of the coal in the Tofield-Donalda area occurs in the well-marked seams with relatively sharp floors and roofs and only a very few thin partings, it is usually extracted at moderately low ash levels.

Numerous samples of coals from mines in the area have been analyzed in the Alberta Research Council coal analytical laboratories; proximate analyses of 42 of these are shown, on a capacity moisture, ash-free basis, in table 3. Of the tabulated coals, 40 are Subbituminous C in rank according to the ASTM classification and 2 (in Sec. 8, Tp. 43, R. 17 and in Tp. 46, R. 20) are marginally Subbituminous B.

Within the Alberta Plains, rank of near-surface coal decreases regularly with increasing distance from the Rocky Mountain Foothills. All the coals of table 3 derive from a narrow band lying roughly parallel to the Foothills front; thus, should

Table 2. Coal in Selected Deep Wells

Lsd	Well			Depth Top of Coal (feet)	Seam Thickness Seams > 5 ft (feet)	Cumulative Thickness (feet)	Coal-bearing Zone Thickness (feet)
	Sec (W. 4th Mer)	Tp	R				
S. & A. Woods HB Gadsby 10-8							
10	8	39	17	386	7	-	-
				480	6	-	-
				517	8	21	160
Cordasun Casagama 2							
6	7	39	19	661	7	-	-
				724	6	-	-
				770	9	-	-
				836	7	29	190
W. Canadian Dome Erskine 11							
11	12	39	21	794	6	-	-
				906	10	16	210
Hewitt et al. Ferintosh							
8	12	44	21	747	7	7	170
Anglo Home C & E Camrose 16-8							
8	16	47	20	254	14	-	-
				274	6	-	-
				358	7	-	-
				405	6	-	-
				415	5	38	210

coals be obtained from the region southwest of this band, they would be expected to be unmistakably Subbituminous B in rank, while any coals from the region underlain by Belly River rocks in the northeast portion of the area would be Lignite A in rank.

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APPENDIX A

ALBERTA RESEARCH COUNCIL COAL TESTHOLES,
TOFIELD-DONALDA AREA

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	Lsd 8-32-38-15 2695; September 3, 1971	140-160	Bluish grey and dark grey shale
0-10	Brown silty clay; few pebbles	160-174	Grey coarse siltstone; grey silty shale
10-20	Brown weathered shale (el. bedrock 2685)	174-185	Chocolate brown carbonaceous shale; trace coal
20-35	Brown weathered and blue grey sandstone	185-195	Light grey argillaceous sandstone
35-40	Chocolate brown carbonaceous shale		
40-45	Grey shale		NE cor. 32-39-14 2398; September 3, 1971
45-52	Light grey fine sandstone		
52-55	Coal (el. top coal 2643)	0-2	Soil
55-60	Brown carbonaceous shale	2-15	Brown weathered shale (el. bedrock 2396)
60-80	Grey shale	15-45	Grey shale
80-85	Light grey argillaceous sandstone	45-75	Grey fine to medium sandstone
85-95	Brown carbonaceous shale; some creamy white bentonite	75-128	Uniform grey silty shale (marine)
95-105	Grey fine sandstone	128-150	Bluish grey argillaceous sandstone (continental)
105-157	Dark grey and grey shale; some grey siltstone	150-175	Uniform grey to slightly dark grey shale (marine)
157-161	Coal (el. top coal 2538)	175-195	Bluish grey fine sandstone (continental)
161-165	Brown carbonaceous shale		
165-170	Grey shale		
170-180	Chocolate brown carbonaceous shale; trace coal		
180-195	Grey silty shale		NE cor. 10-39-15 2550; September 3, 1971
	NE cor. 34-38-15 2600; September 3, 1971	0-5	Light brown clay; few pebbles
0-22	Brown clay; many pebbles and boulders	5-10	Chocolate brown carbonaceous shale (el. bedrock 2545)
22-30	Brown grey slightly weathered shale (el. bedrock 2578)	10-13	Weathered coal (el. top coal 2540)
30-45	Grey silty shale	13-15	Chocolate brown carbonaceous shale
45-55	Light grey argillaceous sandstone	15-45	Grey argillaceous sandstone
55-59	Dark brown carbonaceous shale	45-65	Grey silty shale
59-61	Coal (el. top coal 2541)	65-75	Grey fine sandstone
61-70	Dark brown carbonaceous shale	75-110	Grey shale with one thin shell bed
70-100	Grey argillaceous sandstone; some grey coarse siltstone	110-117	Blue grey fine sandstone
100-135	Grey shale; grey coarse siltstone	117-120	Coal (el. top coal 2433)
135-140	Chocolate brown carbonaceous shale	120-125	Brown carbonaceous shale
		125-130	Dark grey shale
		130-155	Light grey sandstone; grey siltstone
		155-195	Uniform grey bentonitic shale (marine)

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 36-39-15 2452; September 3, 1971	10-20	Grey shale
		20-30	Light grey sandstone
0-10	Sandy clay; many boulders	30-70	Grey silty shale; grey siltstone
10-15	Grey shale (el. bedrock 2442)	70-80	Brown hard siltstone; thin coal seam
15-25	Light grey argillaceous sandstone	80-85	Light grey bentonitic sandstone
25-50	Grey bentonitic shale	85-112	Grey shale; some grey siltstone
50-55	Black and dark brown carbonaceous shale	112-114	Coal (el. top coal 2488)
55-120	Grey bentonitic shale; some grey bentonitic siltstone (marine)	114-120	Dark brown carbonaceous shale
120-155	Blue grey coarse sandstone (continental)	120-130	Grey silty shale; thin coal seam
155-180	Blue very coarse sandstone	130-145	Light grey argillaceous sandstone
180-195	Dark grey and greenish grey coarse sandstone	145-175	Grey silty shale
		175-185	Light grey argillaceous fine sandstone
		185-195	Grey siltstone
	NE cor. 32-39-16 2515; August 18, 1971		NE cor. 23-39-17 2586; August 17, 1971
0-5	Grey clay; many pebbles	0-5	Sandy clay
5-15	Brownish grey weathered shale (el. bedrock 2510)	5-25	Brown weathered shale (el. bedrock 2581)
15-20	Grey shale; little brown grey carbonaceous shale; trace coal	25-40	Grey bentonitic shale
20-60	Grey slightly bentonitic shale	40-85	Grey coarse siltstone; grey bentonitic shale
60-65	Chocolate brown carbonaceous shale; some white bentonite	85-91	Grey fine sandstone
65-80	Grey shale; grey siltstone	91-93	Coal (el. top coal 2495)
80-90	Greenish grey fine sandstone	93-100	Brown carbonaceous shale
90-135	Grey coarse to fine siltstone	100-125	Grey silty shale
135-145	Chocolate brown and brown grey carbonaceous shale	125-130	Grey sandstone
145-149	Grey slightly bentonitic siltstone	130-145	Grey silty shale
149-157	Coal (el. top coal 2366)	145-150	Grey argillaceous sandstone
157-160	Brown carbonaceous shale	150-165	Grey shale
160-180	Brown grey shale; trace coal	165-170	Dark grey, brown and black carbonaceous shale
180-185	Grey shale	170-195	Grey very bentonitic shale
185-190	Grey siltstone; some light grey sandstone		
	NE cor. 10-39-17 2600; August 17, 1971	0-2	Soil
0-5	Brown clay	2-5	Grey shale (el. bedrock 2538)
5-10	Brown weathered shale (el. bedrock 2595)	5-10	Yellow bentonite
		10-15	Brown carbonaceous shale; trace weathered coal

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
15-20	Dark grey carbonaceous shale	155-160	Very light grey argillaceous sandstone
20-45	Grey silty shale	160-170	Dark grey very bentonitic shale; trace coal
45-50	Grey very argillaceous sandstone	170-185	Grey slightly bentonitic siltstone
50-115	Grey bentonitic shale; some grey siltstone; some dark grey silty shale	185-195	Grey coarse siltstone
115-117	Dark grey carbonaceous shale		
117-122	Coal (el. top coal 2423)		
122-125	Dark grey carbonaceous shale		
125-135	Grey bentonitic shale		
135-145	Grey very fine sandstone		NE cor. 23-39-19
145-150	Grey silty shale		2580; August 16, 1971
150-155	Dark green shale; trace coal	0-10	Brown clay; many pebbles
155-195	Grey shale; grey siltstone	10-18	Brown very coarse sand
		18-29	Grey clay; some sandstone fragments
	NE cor. 32-39-18	29-50	Light grey very bentonitic shale (el. bedrock 2551)
	2550; August 16, 1971	50-85	Grey bentonitic siltstone
0-30	Brown and brown grey clay; many pebbles	85-105	Grey silty shale
30-41	Brown fine sand	105-110	Light grey bentonitic fine sandstone
41-80	Grey and blue grey very bentonitic shale (el. bedrock 2509)	110-160	Grey shale to grey fine siltstone
80-110	Grey siltstone; some light brown harder siltstone	160-170	Grey fine sandstone
110-140	Grey and dark grey shale	170-195	Grey silty shale
140-165	Grey very bentonitic shale		
165-180	Grey hard siltstone		
180-195	Green grey very bentonitic shale		NE cor. 36-39-19
			2577; August 16, 1971
	NE cor. 10-39-19	0-60	Brown and grey clay; many pebbles and boulders; some sandy sections
	2595; August 17, 1971	60-87	Brown coarse sand
0-10	Brown silty clay; few pebbles	87-110	Grey clay; some bedrock and coal fragments
10-30	Grey clay; some sand; many pebbles	110-120	Grey sand
30-43	Grey clay	120-170	Grey silty shale; grey siltstone (el. bedrock 2457)
43-50	Grey shale (el. bedrock 2552)	170-175	Green grey very bentonitic shale
50-65	Grey fine sandstone	175-180	Grey bentonitic sandstone
65-100	Grey silty shale; some grey siltstone	180-190	Grey bentonitic sandstone; some coarse siltstone
100-105	Grey fine argillaceous sandstone	190-195	Grey bentonitic shale
105-135	Grey bentonitic shale; little light grey sandstone		
135-155	Green grey and grey silty shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 22-40-13 2350; September 8, 1971		NE cor. 33-40-13 2324; September 8, 1971
0-20	Brown clay; some pebbles and small boulders	0-20	Brown clay; many pebbles and boulders
20-25	Grey sand; grey clay; some fine gravel	20-30	Greenish grey siltstone (el. bedrock 2304)
25-30	Grey clay	30-40	Slightly dark grey shale (marine)
30-40	Dark grey silty shale (el. bedrock 2320)	40-105	Green grey siltstone; sandstone (continental)
40-48	Grey fine siltstone	105-110	Grey shale
48-53	Grey fairly hard fine sandstone	110-145	Greenish grey siltstone to fine sandstone
53-70	Grey silty shale	145-175	Grey siltstone
70-120	Grey to slightly dark grey shale (marine)	175-195	Grey silty shale; grey siltstone
120-145	Green grey fine sandstone (continental)		
145-175	Grey medium to coarse siltstone		NE cor. 9-40-14 2378; September 4, 1971
175-195	Greenish grey fine to medium sandstone	0-15	Brown clay; many pebbles and small boulders
		15-20	Bluish grey sandstone (el. bedrock 2363)
	NE cor. 24-40-13 2340; September 8, 1971	20-95	Uniform slightly dark grey silty shale (marine)
0-3	Soil and brown clay	95-130	Grey fine to medium slightly argillaceous sandstone (continental)
3-10	Brown weathered shale (el. bedrock 2337)	130-165	Grey siltstone; grey silty shale
10-45	Grey siltstone; some grey silty shale	165-195	Grey fine to medium sandstone
45-110	Grey and green sandstone		
110-120	Greenish grey fine sandstone		NE cor. 22-40-14 2348; September 7, 1971
120-150	Grey shale; trace dark brown carbonaceous shale; some grey fine siltstone	0-5	Fine gravel; sand
150-195	Uniform grey silty shale (marine)	5-10	Brown sandy clay
		10-15	Fine gravel; few boulders
	NE cor. 31-40-13 2327; September 7, 1971	15-25	Grey clay; few pebbles
0-15	Brown sandy clay; some pebbles and boulders	25-80	Grey siltstone; some grey fine sandstone (el. bedrock 2323)
15-35	Fine gravel; boulders; abandoned at 35 feet	80-100	Grey and light grey argillaceous sandstone
		100-123	Grey to slightly dark grey shale (marine)
		123-150	Bluish grey fine sandstone (continental)

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
150-160	Grey very bentonitic shale	35-40	Brown shale; some creamy brown bentonite; trace coal
160-180	Grey very fine sandstone	40-52	Dark grey carbonaceous shale; thin coal seam
180-195	Grey siltstone	52-55	Coal (el. top coal 2358)
	NE cor. 35-40-14 2335; September 7, 1971	55-60	Brown grey carbonaceous shale
0-5	Brown sandy clay	60-90	Grey siltstone; some light grey fine to medium sandstone
5-20	Brown soft plastic lake clay	90-110	Grey slightly bentonitic shale (marine)
20-38	Brown silty clay; pebbles	110-150	Uniform slightly dark grey shale
38-60	Bluish grey sandstone (el. bedrock 2297)	150-160	Grey siltstone (continental)
60-65	Grey fine sandstone	160-165	Chocolate brown carbonaceous shale
65-95	Grey shale	165-190	Bluish grey and grey sandstone
95-130	Grey siltstone; grey shale	190-195	Grey fine siltstone
130-160	Grey coarse to medium siltstone		NE cor. 11-40-15 2423; September 4, 1971
160-195	Grey fine sandstone		
	NE cor. 7-40-15 2465; September 7, 1971	0-10	Brown silty clay; few small pebbles
0-15	Brown clay; few small pebbles	10-15	Very dark brown weathered shale (el. bedrock 2413)
15-22	Light grey very bentonitic shale (el. bedrock 2450)	15-32	Dark grey carbonaceous shale
22-27	Coal (el. top coal 2443)	32-35	Coal (el. top coal 2391)
27-32	Brown and dark grey carbonaceous shale	35-65	Grey argillaceous sandstone; grey siltstone
32-39	Coal (el. top coal 2433)	65-70	Grey silty shale
39-119	Grey shale; grey siltstone	70-75	Grey fine sandstone
119-126	Coal (el. top coal 2346)	75-80	Grey coarse siltstone
126-130	Chocolate brown carbonaceous shale; some creamy white bentonite	80-140	Uniform slightly dark grey shale (marine)
130-185	Grey silty shale; some grey bentonitic siltstone	140-155	Grey sandstone (continental)
185-195	Slightly dark grey shale	155-195	Grey fine to medium slightly argillaceous sandstone
	NE cor. 9-40-15 2410; September 4, 1971		NE cor. 31-40-15 2395; September 1, 1971
0-7	Brown very soft clay; few pebbles	0-34	Brown and brown grey clay; few pebbles
7-15	Brown weathered shale (el. bedrock 2403)	34-42	Coal (el. bedrock and top coal 2361)
15-30	Blue grey coarse sandstone	42-55	Light grey soft bentonitic sandstone
30-35	Grey shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
55-85	Light grey very argillaceous sandstone	115-165	Grey slightly bentonitic shale; little grey siltstone
85-145	Grey shale	165-190	Grey siltstone
145-150	Grey siltstone	190-195	Blue grey fine sandstone
150-170	Blue grey very fine sandstone		
170-195	Grey fine to medium sandstone		NE cor. 24-40-16 2390; September 1, 1971
	NE cor. 9-40-16 2425; August 18, 1971	0-13	Brown clay
		13-25	Brown weathered shale (el. bedrock 2377)
0-5	Brown grey clay; few pebbles	25-30	Brown grey shale
5-15	Brown weathered shale (el. bedrock 2420)	30-34	Creamy white bentonite; some chocolate brown carbonaceous shale
15-40	Grey siltstone; grey shale	34-36	Coal (el. top coal 2356)
40-55	Grey fine sandstone; grey siltstone	36-45	Dark brown carbonaceous shale
55-75	Dark grey shale; trace coal	45-75	Light grey fairly coarse sandstone
75-80	Grey silty shale	75-85	Light grey very hard calcareous sandstone
80-90	Brown grey carbonaceous shale; thin coal seam	85-160	Uniform grey silty shale (marine)
90-108	Grey bentonitic shale	160-195	Grey fine slightly argillaceous sandstone (continental)
108-115	Dark grey shale; trace coal		
115-120	Light grey bentonitic sandstone		NE cor. 20-40-17 2473; August 15, 1971
120-141	Grey shale		
141-145	Coal (el. top coal 2284)	0-25	Brown sandy clay; few pebbles; few boulders
145-150	Chocolate brown carbonaceous shale; some white bentonite	25-36	Grey clay; few pebbles
150-155	Grey shale	36-70	Grey silty shale (el. bedrock 2437)
155-165	Dark grey shale; thin coal seam	70-80	Grey, dark grey and little brown carbonaceous shale; trace coal
165-185	Grey argillaceous fine sandstone	80-90	Grey fine argillaceous sandstone
185-195	Grey silty shale	90-100	Dark grey and brown grey carbonaceous shale; trace coal
	NE cor. 11-40-16 2405; August 18, 1971	100-105	Grey shale
0-5	Brown sandy clay; few pebbles	105-135	Light grey very bentonitic sandstone; grey siltstone
5-30	Grey silty shale (el. bedrock 2400)	135-185	Grey silty shale; some grey sandstone
30-35	Bluish grey fine sandstone	185-190	Grey sandstone
35-58	Grey shale; grey siltstone	190-195	Grey silty shale
58-67	Coal (el. top coal 2347)		
67-70	Brown grey carbonaceous shale		
70-115	Bluish grey slightly argillaceous sandstone		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 33-40-17 2453; August 15, 1971	25-44	Grey very coarse sand; few coal fragments
0-35	Brown and grey clay; many pebbles	44-70	Grey very soft silty shale (el. bedrock 2446)
35-40	Grey and dark grey slightly carbonaceous shale (el. bedrock 2418)	70-75	Brownish grey slightly carbonaceous shale
40-42	Coal (el. top coal 2413)	75-80	Grey very bentonitic shale
42-50	Dark grey and brown carbonaceous shale	80-95	Light grey dry sandstone
50-85	Grey argillaceous sandstone; grey siltstone	95-130	Grey silty shale; grey coarse siltstone
85-90	Dark grey shale; trace coal	130-140	Light grey bentonitic fine sandstone
90-140	Grey shale; grey siltstone	140-153	Grey silty shale
140-145	Grey fine sandstone	153-159	Coal (el. top coal 2337)
145-170	Grey shale; grey siltstone	159-165	Dark brown and grey carbonaceous shale
170-180	Grey fine sandstone; grey siltstone	165-170	Brown grey slightly carbonaceous shale
180-190	Dark grey and black carbonaceous shale	170-195	Grey silty shale
190-195	Light grey fine bentonitic sandstone		NE cor. 33-40-19 2650; August 9, 1971
	NE cor. 9-40-18 2515; August 16, 1971	0-20	Sandy clay; pebbles
0-25	Brown and grey clay; few small pebbles	20-25	Fine gravel and sand
25-35	Grey sand; little clay	25-140	Grey clay; many sandy and fine gravel stringers; few boulders
35-40	Grey silty clay	140-145	Gravel; abandoned at 145 feet
40-55	Grey shale (el. bedrock 2475)		NE cor. 8-41-13 2302; September 8, 1971
55-65	Light grey bentonitic sandstone		
65-75	Grey shale	0-10	Brown clay; few pebbles
75-80	Dark brown carbonaceous shale; trace coal	10-60	Brown and grey unconsolidated sand
80-85	Grey shale	60-90	Grey very soft sandstone; some grey siltstone (el. bedrock 2242)
85-95	Dark brown carbonaceous shale; trace coal	90-165	Grey siltstone
95-145	Grey and greenish grey shale	165-195	Slightly dark grey shale (marine)
145-180	Grey fine argillaceous sandstone		NE cor. 11-40-18 2490; August 16, 1971
180-195	Grey shale		NE cor. 21-41-13 2280; September 8, 1971
0-25	Brown and grey sandy clay; few pebbles	0-15	Brown clay; few pebbles
		15-35	Grey sandy clay; few pebbles

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
35-60	Grey soft sandstone; some very argillaceous sandstone (el. bedrock 2245)		NE cor. 21-41-15 2346; September 1, 1971
60-125	Grey silty shale; grey siltstone; some grey sandstone (marine).	0-30	Brown silty to sandy clay; few pebbles
125-140	Slightly dark grey silty shale	30-60	Grey very sandy clay; many sandy sections
140-170	Slightly dark grey siltstone	60-85	Grey fine sand; little grey clay
170-180	Grey sandstone (continental)	85-90	Fine gravel; some grey sandy clay
180-190	Grey fine siltstone	90-95	Grey sandy clay
190-195	Grey coarse siltstone	95-140	Grey silty shale (el. bedrock 2251)
	NE cor. 34-41-13 2277; September 8, 1971	140-165	Grey siltstone; some grey sandstone
0-13	Brown and grey clay; many pebbles	165-195	Grey siltstone; little grey silty shale
13-20	Grey siltstone (el. bedrock 2264)		NE cor. 34-41-15 2340; September 9, 1971
20-90	Grey very soft sandstone; some grey siltstone	0-15	Brown fine sand
90-100	Grey slightly harder sandstone; some grey siltstone	15-25	Fine gravel and brown sand
100-140	Grey shale; little grey siltstone (marine)	25-30	Grey clay; some grey sand
140-150	Grey fine sandstone	30-65	Brown grey fine sand; some fine gravel
150-155	Brown grey shale	65-75	Bluish grey fine sandstone (el. bedrock 2275)
155-160	Green bentonitic shale	75-90	Light grey siltstone
160-175	Grey very silty shale	90-115	Grey siltstone
175-180	Light grey very bentonitic shale	115-135	Light bluish grey fine sandstone
180-185	Greenish grey shale	135-150	Grey siltstone; very poor samples; abandoned at 150 feet
185-195	Grey silty shale		NE cor. 36-41-15 2327; September 9, 1971
	NE cor. 8-41-15 2363; September 1, 1971	0-30	Light brown and grey clay; many boulders; some pebbles
0-30	Light brown and grey clay; many boulders; some pebbles	30-85	Grey slightly bentonitic shale (el. bedrock 2333)
30-85	Grey slightly bentonitic shale (el. bedrock 2333)	85-90	Grey siltstone
85-90	Grey siltstone	90-95	Dark grey and brown carbonaceous shale; trace coal
90-95	Dark grey and brown carbonaceous shale; trace coal	95-100	Blue grey coarse sandstone
95-100	Blue grey coarse sandstone	100-150	Grey argillaceous sandstone
100-150	Grey argillaceous sandstone	150-190	Grey slightly silty shale
150-190	Grey slightly silty shale	190-195	Blue grey sandstone
190-195	Blue grey sandstone		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
80-100	Bluish grey slightly argillaceous sandstone		NE cor. 8-41-17 2452; August 15, 1971
100-170	Grey silty shale; some grey siltstone	0-45	Brown clay; pebbles; some sandy sections
170-180	Grey to slightly greenish grey fine sandstone	45-65	Brown sand; some bedrock fragments
180-195	Grey coarse siltstone	65-90	Brown weathered fine sandstone (el. bedrock 2387)
	NE cor. 19-41-16 2430; August 14, 1971	90-130	Grey silty shale
0-15	Brown clay; many boulders	130-135	Dark grey and chocolate brown carbonaceous shale
15-25	Brown sand; many boulders	135-160	Grey bentonitic shale
25-40	Grey sandy clay; many boulders	160-170	Grey siltstone
40-46	Brown grey coarse sand; some boulders	170-175	Coal (el. top coal 2282)
46-55	Light grey bentonitic sandstone (el. bedrock 2384)	175-180	Dark brown carbonaceous shale
55-65	Grey shale	180-190	Grey silty shale
65-80	Light grey bentonitic fine sandstone	190-195	Blue grey fairly hard sandstone
80-140	Grey silty shale; some grey siltstone		NE cor. 10-41-17 2440; August 15, 1971
140-150	Light grey argillaceous sandstone	0-40	Brown and grey clay; pebbles and boulders
150-195	Grey siltstone; grey fine sandstone	40-100	Blue grey medium to coarse sand; some coal and bedrock fragments
	NE cor. 32-41-16 2397; August 14, 1971	100-110	Grey shale; brown grey siltstone (el. bedrock 2340)
0-15	Brown clay; many pebbles	110-120	Brownish grey slightly carbonaceous shale
15-20	Brown grey sand	120-135	Grey silty shale
20-51	Grey clay; some gravel stringers; some coal fragments		NE cor. 36-41-17 2430; August 15, 1971
51-60	Brown grey carbonaceous shale; trace coal (el. bedrock 2346)	0-7	Brown silty clay; few small pebbles
60-80	Grey silty shale; grey coarse siltstone	7-22	Brown weathered and grey shale (el. bedrock 2423)
80-90	Blue grey coarse sandstone	22-27	Coal (el. top coal 2408)
90-125	Light grey argillaceous sandstone; grey siltstone	27-40	Dark grey and dark brown carbonaceous shale
125-180	Grey shale; grey coarse siltstone	40-50	Grey bentonitic fine sandstone
180-190	Dark grey shale; trace coal	50-90	Grey bentonitic shale; grey bentonitic siltstone
190-195	Blue grey sandstone		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
90-100	Grey siltstone; dark grey carbonaceous shale; thin coal seam	120-125	Brown grey carbonaceous shale
100-125	Grey shale; grey siltstone	125-171	Grey slightly bentonitic shale; some grey siltstone
125-150	Grey argillaceous sandstone	171-173	Coal (el. top coal 2299)
150-195	Grey silty shale; grey siltstone	173-180	Brown and grey carbonaceous shale
		180-195	Grey silty shale
	NE cor. 32-41-18 2370; August 10, 1971		NE cor. 10-41-19 2555; August 9, 1971
0-2	Soil		
2-40	Brown weathered very silty shale; brown weathered siltstone (el. bedrock 2368)	0-60	Brown and grey clay; pebbles and boulders
40-54	Grey silty shale	60-80	Brown grey shale; thin coal seam (el. bedrock 2495)
54-59	Coal (el. top coal 2316)	80-90	Grey very silty shale
59-65	Brown and dark grey shale	90-100	Dark grey and brown carbonaceous shale; trace coal
65-80	Grey siltstone	100-115	Grey fine sandstone
80-85	Chocolate brown and grey carbonaceous shale	115-170	Grey silty shale; grey siltstone
85-90	Grey silty shale	170-180	Grey very fine sandstone
90-110	Light grey very argillaceous sandstone	180-195	Light grey bentonitic sandstone
110-120	Grey and brown carbonaceous shale		
120-125	Grey very fine sandstone		NE cor. 23-41-19 2565; August 9, 1971
125-135	Grey shale		
135-160	Light grey fine soft sandstone	0-15	Brown silty clay; few boulders
160-180	Brownish grey slightly carbonaceous shale	15-82	Grey silty to sandy clay; many large boulders
180-195	Brown shale; some white bentonite; thin coal seam	82-102	Grey silty shale (el. bedrock 2483)
		102-111	Grey fine sandstone
	NE cor. 34-41-18 2470; August 10, 1971	111-120	Grey siltstone
		120-195	Grey silty shale; grey siltstone
0-5	Brown grey clay; few pebbles		
5-20	Brown weathered siltstone (el. bedrock 2465)		NE cor. 36-41-19 2548; August 9, 1971
20-25	Bluish grey shale		
25-50	Brown weathered sandstone	0-20	Brown sandy clay; many pebbles; few boulders
50-65	Grey soft silty shale	20-85	Sandy to silty clay; many pebbles and boulders; some bedrock fragments
65-70	Grey, chocolate brown and black carbonaceous shale; trace coal		
70-85	Grey fine siltstone	85-110	Grey silty shale (el. bedrock 2463)
85-120	Grey bentonitic siltstone; grey silty shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
110-115	Light grey slightly bentonitic fine sandstone		NE cor. 35-42-14 2260; September 9, 1971
115-135	Grey fairly hard siltstone		
135-152	Grey silty shale	0-20	Brown clay; few pebbles
152-161	No sample; lost circulation; abandoned at 161 feet	20-29	Grey clay; some thin fine gravel seams
		29-40	Grey siltstone (el. marine bed- rock 2231)
	NE cor. 7-42-14 2320; September 9, 1971	40-50	Grey silty shale
		50-120	Grey medium to coarse silt- stone
0-15	Sand; very little brown clay; some fine gravel	120-150	Grey silty shale
15-25	Brown very sandy clay		
25-45	Grey sandy clay; many boul- ders and pebbles		
45-55	Sand; grey clay; little gravel		
55-70	Grey silty shale (el. bed- rock 2265)		NE cor. 7-42-16 2427; August 14, 1971
70-110	Grey medium to very coarse siltstone	0-15	Brown clay; much sand
110-120	Grey slightly bentonitic shale	15-60	Grey clay; much sand; some boulders
120-155	Bluish grey silty shale; grey siltstone	60-80	Grey shale (el. bedrock 2367)
155-170	Bluish grey coarse siltstone	80-85	Chocolate brown carbona- ceous shale
170-195	Grey siltstone	85-130	Grey fine to medium sand- stone
	NE cor. 20-42-14 2305; September 9, 1971	130-145	Grey siltstone
		145-175	Grey bentonitic shale
		175-195	Grey siltstone
0-18	Brown clay; pebbles and few boulders		
18-45	Grey shale (el. bedrock 2287)		
45-78	Grey fine sandstone		
78-92	Grey shale (marine)		
92-175	Grey silty shale; grey coarse siltstone		NE cor. 11-42-17 2442; August 14, 1971
175-195	Grey shale		
		0-10	Brown clay
		10-16	Chocolate brown weathered shale (el. bedrock 2432)
	NE cor. 22-42-14 2305; September 9, 1971	16-18	Coal (el. top coal 2426)
		18-25	Grey sandstone
0-5	Brown clay	25-35	Grey silty shale
5-25	Brown weathered siltstone (el. marine bedrock 2300)	35-65	Grey fine to medium argilla- ceous sandstone
25-150	Grey coarse to medium silt- stone; grey silty shale	65-115	Grey shale; grey siltstone; few harder ledges light brown silt- stone
150-165	Grey fine siltstone		
165-195	Grey silty shale	115-195	Light bluish grey sandstone

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE 22-42-17 2437; August 13, 1971		NE cor. 35-42-17 2410; August 13, 1971
0-10	Brown grey clay; pebbles	0-10	Brown clay; few pebbles
10-20	Brown weathered shale (el. bedrock 2427)	10-20	Brown weathered siltstone; light grey bentonitic sandstone (el. bedrock 2400)
20-30	Dark grey slightly carbonaceous shale; trace coal	26-30	Coal (el. top coal 2384)
30-69	Grey shale; grey siltstone; hard ledge brown siltstone	30-35	Chocolate brown shale
69-81	Coal (el. top coal 2368)	35-40	Blue grey coarse sandstone
81-85	Brown very bentonitic shale	40-65	Grey bentonitic siltstone; some grey shale
85-105	Brown grey siltstone; grey shale	65-80	Light grey bentonitic sandstone
105-110	Grey fine argillaceous sandstone	80-99	Grey shale; little grey siltstone
110-140	Grey bentonitic shale	99-101	Coal (el. top coal 2311)
140-150	Brown carbonaceous shale; thin coal seam	101-105	Brown shale
150-182	Grey shale; some almost white bentonite	105-125	Grey silty shale
182-185	Coal (el. top coal 2255)	125-135	Chocolate brown carbonaceous shale; thin coal seam
185-190	Dark grey shale	135-140	Grey very bentonitic shale
190-195	Grey very bentonitic shale	140-170	Blue sandstone; some very dry light grey sandstone
		170-173	Coal (el. top coal 2240)
		173-180	Blue grey sandstone; brown and brown grey siltstone
		180-195	Grey fine sandstone
			NE cor. 9-42-18 2520; August 10, 1971
	NE cor. 24-42-17 2440; August 13, 1971	0-1	Soil
0-10	Brown silty clay; very few pebbles	1-10	Brown weathered shale (el. bedrock 2519)
10-18	Coal (el. bedrock and top coal 2430)	10-20	Grey shale
18-30	Grey fine sandstone	20-30	Light grey sandstone; trace coal
30-40	Grey shale	30-50	Grey silty shale; some harder brown siltstone
40-80	Grey bentonitic fine sandstone	50-55	Bluish grey sandstone
80-95	Grey silty shale	55-95	Grey shale and siltstone
95-105	Black and dark grey shale; thin coal seam	95-99	Coal (el. top coal 2425)
105-119	Grey bentonitic shale	99-110	Brown and dark grey shale; some white bentonite
119-123	Coal (el. top coal 2321)	110-130	Grey bentonitic shale
123-150	Grey very bentonitic fine sandstone	130-135	Greyish white bentonite
150-185	Grey very bentonitic siltstone	135-155	Brownish grey slightly carbonaceous shale
185-195	Grey bentonitic fine sandstone	155-160	Grey argillaceous sandstone
		160-195	Grey and brown grey shale; some grey bentonitic siltstone

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 20-42-18 2512; August 10, 1971		NE cor. 35-42-18 2450; August 11, 1971
		0-5	Brown clay; many small pebbles
0-2	Soil	5-10	Brown weathered shale (el. bedrock 2445)
2-20	Brown weathered shale (el. bedrock 2510)	10-14	Coal (el. top coal 2440)
20-40	Grey silty shale	14-20	Brown carbonaceous shale
40-50	Light grey argillaceous sandstone	20-51	Bluish grey silty shale
50-90	Grey shale; grey siltstone	51-53	Coal (el. top coal 2399)
90-95	Brown carbonaceous shale	53-75	Grey silty slightly bentonitic shale
95-100	Grey argillaceous sandstone	75-80	Light brown, brown and light grey very bentonitic shale
100-104	Grey silty shale	80-85	Grey siltstone
104-107	Coal (el. top coal 2408)	85-120	Grey and light grey very bentonitic shale
107-120	Chocolate brown carbonaceous shale	120-130	Grey, dark grey and brown grey carbonaceous shale
120-140	Grey siltstone, light grey argillaceous sandstone	130-150	Grey silty slightly bentonitic shale; grey coarse siltstone
140-148	Grey slightly bentonitic shale	150-155	Brownish grey slightly carbonaceous shale
148-150	Coal (el. top coal 2364)	155-160	Coal (el. top coal 2295)
150-155	Brown carbonaceous shale	160-195	Grey bentonitic shale; grey siltstone
155-195	Grey shale and grey siltstone		
	NE cor. 22-42-18 2485; August 10, 1971		NE cor. 7-42-19 2690; August 7, 1971
0-10	Brown silty clay; few pebbles	0-15	Brown silty clay; many pebbles and boulders
10-20	Brown weathered shale (el. bedrock 2475)	15-160	Grey clay; thin gravel and sand stringers; many pebbles and boulders; many bedrock fragments
20-45	Grey silty shale	160-187	Gravel; some grey clay
45-50	Dark grey and little brown carbonaceous shale	187-189	Gravel; abandoned at 189 feet
50-69	Grey coarse siltstone		
69-73	Coal (el. top coal 2416)		NE cor. 20-42-19 2590; August 7, 1971
73-85	Grey silty shale		
85-100	Grey slightly bentonitic fine sandstone	0-15	Brownish grey clay; few pebbles
100-115	Grey bentonitic shale	15-67	Brown and grey clay; many boulders and pebbles
115-125	Light brown and chocolate brown bentonitic shale; trace coal	67-85	Grey silty shale (el. bedrock 2523)
125-145	Grey silty shale		
145-150	Grey and light brown siltstone		
150-195	Grey shale; grey siltstone		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
85-90	Grey fine sandstone	145-150	Light grey fine sandstone
90-100	Grey shale	150-160	Grey and greenish grey shale
100-115	Light grey fine argillaceous sandstone	160-170	Brownish grey slightly car- bonaceous shale
115-125	Grey silty shale	170-173	Coal (el. top coal 2375)
125-150	Light grey and grey bentonitic shale	173-180	Brown and dark grey carbona- ceous shale
	NE cor. 22-42-19 2545; August 7, 1971	180-195	Light grey bentonitic siltstone
0-22	Brown sandy clay; few pebbles and boulders		
22-30	Brown weathered shale (el. bedrock 2523)		NE cor. 31-42-20 2622; August 4, 1971
30-40	Grey very bentonitic shale		
40-45	Light grey very bentonitic fine sandstone	0-15	Brown clay; pebbles; few boul- ders
45-55	Grey silty shale	15-45	Grey sandy clay; few pebbles
55-75	Dark grey slightly carbona- ceous shale	45-80	Grey clay; few pebbles
75-85	Black and dark brown car- bonaceous shale	80-105	Light grey fine sandstone; some grey siltstone (el. bed- rock 2542)
85-130	Grey bentonitic siltstone		
130-140	Light grey argillaceous sand- stone	105-120	Grey silty shale; grey siltstone
140-160	Grey silty shale; grey siltstone	120-140	Bluish grey shale
160-170	Light grey argillaceous sand- stone	140-155	Grey silty shale
170-180	Grey siltstone	155-195	Grey shale; grey siltstone
180-195	Brownish grey carbonaceous shale		
	NE cor. 35-42-19 2545; August 6, 1971		NE cor. 35-42-21 2575; August 4, 1971
0-20	Brown silty clay	0-15	Brown clay; few pebbles
20-55	Grey shale; grey siltstone (el. bedrock 2525)	15-70	Brown grey and grey clay; many small pebbles
55-60	Dark grey and brown carbona- ceous shale	70-85	Grey silty shale (el. bed- rock 2505)
60-62	Coal (el. top coal 2485)	85-105	Grey fine siltstone
62-65	Dark grey and brown carbona- ceous shale	105-140	Grey shale; grey siltstone
65-70	Grey shale	140-145	Brownish grey sandstone
70-75	Grey fine sandstone	145-155	Bluish grey siltstone
75-135	Grey bentonitic shale; grey bentonitic siltstone	155-165	Bluish grey very dry slightly bentonitic sandstone
135-145	Brown grey carbonaceous shale	165-175	Grey siltstone
		175-192	Light grey sandstone; lost cir- culation; abandoned at 192 feet

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 20-43-16 2340; August 12, 1971	25-35	Grey fine sandstone
		35-95	Grey bentonitic shale; grey coarse siltstone
0-25	Brown and grey silty clay; few pebbles	95-100	Brown very bentonitic carbonaceous shale; trace coal
25-70	Grey siltstone; little grey shale (el. bedrock 2315)	100-110	Dark grey slightly carbonaceous shale
70-80	Grey silty shale; trace coal	110-150	Light grey fine to medium argillaceous sandstone
80-120	Grey medium to fine sandstone; grey siltstone	150-155	Grey siltstone; ledge hard brown grey siltstone
120-140	Grey silty shale	155-195	Grey silty shale
140-170	Grey soft sandstone		
170-195	Grey siltstone		
			Lsd 8-18-43-17 2380; August 11, 1971
	NE cor. 33-43-16 2325; August 13, 1971	0-3	Soil
0-5	Brown sandy clay	3-20	Brown weathered silty shale (el. bedrock 2377)
5-30	Brown silty clay; few pebbles	20-25	Brown weathered coarse sandstone
30-65	Grey sand	25-27	Dark grey shale
65-70	Very coarse preglacial gravel; abandoned at 70 feet	27-31	Coal (el. top coal 2353)
		31-35	Dark brown carbonaceous shale
	NE cor. 9-43-17 2273; August 12, 1971	35-50	Grey bentonitic shale
0-1	Soil	50-55	Grey fine argillaceous sandstone
1-15	Brownish grey weathered shale (el. bedrock 2272)	55-60	Grey shale
15-20	Brown carbonaceous very bentonitic shale	60-80	Grey argillaceous sandstone
20-23	Coal (el. top coal 2253)	80-139	Grey bentonitic shale; grey bentonitic siltstone
23-35	Greenish grey sandstone	139-141	Coal (el. top coal 2241)
35-95	Grey bentonitic shale and siltstone	141-145	Dark grey shale
		145-155	Grey siltstone
95-140	Fine to medium grey sandstone	155-175	Grey fine sandstone
140-185	Bluish grey and grey siltstone; some grey silty shale	175-195	Grey silty shale
185-195	Grey soft fine sandstone		
			NE cor. 24-43-17 2340; August 12, 1971
	NE cor. 11-43-17 2385; August 12, 1971	0-20	Brown and grey sandy clay; few pebbles
0-5	Brown silty clay; few small pebbles	20-25	Grey silty shale (el. bedrock 2320)
5-25	Brown weathered coarse siltstone (el. bedrock 2380)	25-60	Grey sandstone; some grey coarse siltstone
		60-70	Dark brown, dark grey and black carbonaceous shale; trace coal

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
70-85	Light grey fine sandstone	120-155	Bluish grey fine sandstone; few ledges of light brown hard siltstone
85-130	Grey silty shale	155-195	Grey silty shale; little grey siltstone
130-165	Blue grey medium to coarse sandstone		NE cor. 20-43-18 2345; August 6, 1971
165-180	Grey siltstone; some grey fine sandstone	0-10	Brown weathered shale; some coarse light brown sandstone (el. bedrock 2345)
180-195	Grey siltstone; few ledges harder brown grey siltstone	10-15	Dark grey and brown carbona- ceous shale; trace coal
	NE cor. 7-43-18 2500; August 6, 1971	15-30	Grey shale
0-5	Brown clay; very few pebbles	30-40	Light grey very coarse argilla- ceous sandstone
5-26	Brown weathered and grey shale (el. bedrock 2495)	40-65	Grey shale; grey siltstone
26-29	Coal (el. top coal 2474)	65-70	Grey argillaceous sandstone
29-30	Brown carbonaceous shale	70-90	Brown grey slightly carbona- ceous shale
30-80	Grey silty shale, grey siltstone	90-110	Greenish grey and brown grey shale
80-85	Black, brown and dark grey carbonaceous shale	110-115	Grey fine sandstone
85-95	Brown shale; thin coal seam	115-131	Grey, dark grey, some dark brown carbonaceous shale
95-115	Grey shale	131-163	Light grey bentonitic fine sandstone
115-135	Greenish grey siltstone; grey soft shale	163-165	Light grey very hard ben- tonitic sandstone
135-155	Light grey fine bentonitic sandstone	165-189	Light grey bentonitic fine sandstone
155-165	Grey hard sandstone	189-191	Light grey very hard sandstone
165-170	No sample; lost circulation; abandoned at 170 feet		NE cor. 24-43-18 2352; August 11, 1971
	NE cor. 11-43-18 2325; August 11, 1971	0-2	Soil
0-25	Brownish grey weathered shale (el. bedrock 2325)	2-5	Brownish grey shale (el. bed- rock 2350)
25-30	Light brown argillaceous weathered sandstone	5-10	Brown carbonaceous shale; trace weathered coal
30-50	Brown weathered and grey shale	10-20	Light grey coarse sandstone
50-70	Light grey very argillaceous sandstone	20-35	Grey shale; trace coal
70-100	Grey silty very bentonitic shale	35-45	Grey silty shale
100-120	Dark grey and chocolate brown carbonaceous shale; trace coal	45-80	Light grey bentonitic shale; grey bentonitic siltstone
		80-90	Dark grey and brown carbona- ceous shale; trace coal
		90-95	Light grey argillaceous sand- stone

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
95-123	Grey bentonitic shale		NE cor. 33-43-18
123-125	Coal (el. top coal 2229)		2380; August 11, 1971
125-130	Brown carbonaceous shale		
130-140	Green grey coarse siltstone; grey shale	0-20	Brown and grey clay; many pebbles
140-165	Grey very argillaceous fine sandstone	20-30	Grey shale (el. bedrock 2360)
165-170	Grey shale	30-40	Light grey bentonitic sand- stone
170-180	Grey fine sandstone	40-105	Grey bentonitic shale; grey bentonitic siltstone
180-195	Grey silty shale	105-110	Brown grey carbonaceous shale; thin coal seam
	NE cor. 31-43-18	110-126	Grey silty shale
	2400; August 5, 1971	126-128	Coal (el. top coal 2254)
0-10	Brown clay; few pebbles	128-130	Black shale
10-30	Grey and greenish grey shale (el. bedrock 2390)	130-140	Blue grey soft sandstone; some brown grey shale
30-65	Dark grey siltstone; grey silty shale	140-160	Blue very soft sandstone
65-70	Dark grey carbonaceous shale; trace coal	160-170	Blue sandstone
70-87	Grey coarse siltstone; grey silty shale	170-187	Light grey argillaceous sand- stone; lost circulation; aban- doned at 187 feet
87-89	Coal (el. top coal 2313)		
89-102	Grey very bentonitic shale		NE cor. 9-43-19
102-106	Coal (el. top coal 2298)		2540; August 6, 1971
106-120	Brown grey carbonaceous shale	0-20	Brown clay; few pebbles
120-130	Brown grey carbonaceous shale; trace coal	20-80	Grey silty clay; few pebbles; some bedrock fragments
130-135	Grey shale	80-100	Grey soft silty shale (el. bed- rock 2460)
135-140	Grey shale; harder brown silt- stone ledges	100-150	Grey shale; grey siltstone
140-155	Grey silty shale	150-155	Dark grey and brown carbona- ceous shale
155-160	Bluish grey coarse sandstone	155-165	Grey silty shale
160-170	Grey very bentonitic shale	165-175	Grey very fine sandstone
170-185	Brown grey shale; trace coal	175-180	Grey silty shale
185-195	Grey shale	180-185	Grey fine slightly argillaceous sandstone
	Lsd 8-32-43-18	185-195	Grey fine siltstone
	2235; September 10, 1971		
0-20	Brown weathered and grey clay		NE cor. 24-43-19
20-80	Grey soft clay; bedrock and coal fragments		2540; August 5, 1971
80-120	Very soft plastic lake clay	0-7	Brown clay
120-170	Disturbed bedrock (siltstone, shale and coal fragments)	7-15	Brown grey weathered fine sandstone (el. bedrock 2533)
170-195	Reworked bedrock (siltstone)	15-25	Grey shale

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
25-40	Dark brown, black and dark grey carbonaceous shale; trace coal	126-130	Dark grey and brown carbonaceous shale
40-115	Grey shale; grey siltstone	130-190	Grey silty shale; grey siltstone
115-125	Brown grey silty shale	190-195	Light grey fairly hard bentonitic sandstone
125-140	Grey siltstone		
140-150	Light grey argillaceous sandstone		
150-155	Coal (el. top coal 2390)		NE cor. 35-43-19 2472; August 5, 1971
155-160	Brown and dark grey carbonaceous shale; trace coal		
160-195	Grey siltstone; little grey shale	0-30	Brown and grey clay; boulders; pebbles
		30-55	Grey very soft shale (el. bedrock 2442)
	NE cor. 31-43-19 2575; August 3, 1971	55-60	Chocolate brown and dark grey carbonaceous shale; trace coal
0-10	Brown clay	60-75	Grey silty shale
10-15	Grey sandstone (el. bedrock 2565)	75-80	Black and brown carbonaceous shale; trace coal
15-20	Bluish green shale	80-85	Green grey very bentonitic shale
20-25	Brown grey carbonaceous shale	85-90	Light grey soft sandstone
25-30	Grey fine argillaceous sandstone	90-101	Grey bentonitic shale
30-92	Grey shale; grey siltstone	101-104	Coal (el. top coal 2371)
92-100	Light grey bentonitic sandstone	104-110	Dark grey and brown carbonaceous shale
100-105	Chocolate brown carbonaceous shale	110-118	Dark grey carbonaceous shale
105-115	Grey slightly argillaceous sandstone	118-125	Dark grey and brown carbonaceous shale; trace coal
115-130	Grey coarse very argillaceous sandstone	125-185	Grey and light brown grey shale
130-140	Brown carbonaceous shale; some white bentonite; thin coal seam	185-195	Dark brown grey carbonaceous shale
140-195	Grey shale; grey siltstone		NE cor. 9-43-20 2527; August 4, 1971
		0-5	Fine gravel; brown sandy clay
	NE cor. 33-43-19 2575; August 5, 1971	5-40	Brown and grey clay
0-18	Brown silty clay; few pebbles	40-50	Brownish grey slightly carbonaceous shale (el. bedrock 2487)
18-25	Brown weathered sandstone (el. bedrock 2557)	50-85	Green grey and grey shale
25-110	Grey siltstone; grey silty shale	85-95	Grey siltstone; grey shale
110-123	Dark grey and brown carbonaceous shale	95-100	Dark grey shale; trace coal
123-126	Coal (el. top coal 2452)	100-130	Grey shale; grey siltstone
		130-135	Grey fine argillaceous sandstone

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
135-164	Grey bentonitic shale		NE cor. 19-44-15
164-170	Dark grey and brown grey carbonaceous shale; thin coal seam		2315; September 10, 1971
170-180	Grey siltstone	0-15	Brown sandy clay; many boulders
180-195	Grey silty shale	15-75	Grey sandy clay; many boulders and pebbles
		75-130	Grey sandy clay; many gravel and sand stringers
	NE cor. 22-43-20 2522; August 4, 1971	130-135	Fine gravel
0-15	Brown sand; some brown clay; coal fragments		NE cor. 32-44-15
15-102	Grey clay; many sandy sections; coal fragments		2320; September 10, 1971
102-130	Grey silty shale; some grey siltstone (el. bedrock 2420)	0-5	Brown sand
130-150	Grey siltstone; grey fine sandstone	5-10	Brown sandy clay
150-190	Grey silty shale	10-20	Brown clay; many boulders
190-195	Grey fine sandstone	20-82	Grey sandy clay; many boulders
		82-100	Grey siltstone (el. marine bedrock 2238)
	NE cor. 35-43-20 2595; August 3, 1971	100-195	Grey shale; some grey silty shale
0-32	Brown and grey clay; many pebbles		NE cor. 10-44-16
32-70	Grey siltstone; grey shale (el. bedrock 2563)		2315; August 13, 1971
70-75	Grey fine sandstone	0-35	Brown and grey silty clay; pebbles; boulders
75-104	Grey shale; little grey siltstone	35-50	Very coarse sand
104-110	Brown carbonaceous shale; thin coal seam	50-60	Grey clay; some coarse sand
110-135	Grey very bentonitic shale	60-117	Coarse sand; many coal fragments
135-140	Grey shale; hard ledge of brown siltstone	117-119	Coarse preglacial gravel; abandoned at 119 feet
140-145	Almost white bentonite; little grey shale		NE cor. 12-44-16
145-148	Grey shale		2323; September 10, 1971
148-170	Light grey fine bentonitic sandstone	0-15	Brown silty clay; few pebbles
170-175	Dark brown carbonaceous shale	15-25	Brown silty clay; few thin fine gravel seams
175-177	Grey sandstone	25-65	Grey silty to sandy clay; many thin gravel stringers
177-182	Dark grey slightly carbonaceous shale	65-75	Grey clay; some grey fine sand
182-185	Coal (el. top coal 2413)	75-105	Dark grey fine to medium sand; some small coal fragments
185-190	Brown carbonaceous shale		
190-195	Grey shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
105-175	Grey hard fine sand		NE cor. 10-44-18
175-180	Preglacial gravel; some bed-rock fragments		2340; July 21, 1971
		0-20	Brown and grey silty clay; few pebbles
	NE cor. 19-44-17	20-30	Brown grey fine unconsolidated sand
	2315; July 23, 1971	30-60	Grey coarser unconsolidated sand
0-35	Brown and grey clay	60-165	Very poor samples due to sand; shale and sandstone (assumed el. bedrock 2280)
35-85	Blue grey coarse sand		
85-95	Very coarse preglacial gravel; abandoned at 95 feet		NE cor. 23-44-18
			2330; July 21, 1971
	NE cor. 32-44-17	0-10	Very sandy clay
	2310; July 20, 1971	10-21	Brown sand
0-15	Brown sandy clay	21-45	Very coarse preglacial gravel; abandoned at 45 feet
15-78	Grey sandy clay; many thin sand sections		
78-82	Bluish grey sand; some very fine coal fragments		NE cor. 36-44-18
82-90	Very coarse preglacial gravel; abandoned at 90 feet		2285; July 21, 1971
		0-30	Brown and grey clay
		30-70	Blue grey coarse unconsolidated sand
	NE cor. 8-44-18	70-80	Blue sand; little clay
	2365; July 21, 1971	80-90	Very coarse preglacial gravel; abandoned at 90 feet
0-15	Brown and grey clay; few pebbles		
15-20	Grey siltstone (el. bed-rock 2350)		NE cor. 10-44-19
20-40	Grey very bentonitic fine sandstone		2450; July 22, 1971
40-65	Grey silty shale	0-29	Brown clay; many pebbles
65-70	Dark grey and brown carbonaceous shale; thin coal seam	29-31	Coarse preglacial gravel
70-92	Grey siltstone; grey silty shale	31-33	Brown shale (el. bed-rock 2419)
92-110	Grey fine sandstone	33-38	Coal (el. top coal 2417)
110-124	Grey shale	38-40	Brown carbonaceous shale
124-130	Coal (el. top coal 2241)	40-47	Light grey very bentonitic fine sandstone
130-145	Light bluish grey fine sandstone	47-75	Grey shale; grey siltstone
145-150	Grey siltstone	75-83	Grey bentonitic fine sandstone
150-195	Light grey argillaceous fine to coarse sandstone	83-86	Coal (el. top coal 2367)
		86-105	Grey coarse siltstone
		105-110	Brown carbonaceous shale

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
110-112	Coal (el. top coal 2340)	135-150	Grey silty shale
112-148	Grey very bentonitic shale and siltstone	150-155	Chocolate brown carbonaceous shale
148-151	Coal (el. top coal 2302)	155-160	Light grey coarse sandstone
151-155	Dark brown carbonaceous shale	160-169	Grey silty shale
155-170	Grey siltstone	169-173	Coal (el. top coal 2308)
170-180	Light grey very argillaceous sandstone	173-175	Brown carbonaceous shale
180-195	Grey silty shale	175-186	Grey silty shale
		186-189	Coal (el. top coal 2291)
		189-195	Grey shale
			NE cor. 21-44-19 2535; July 22, 1971
	NE cor. 12-44-19 2425; July 21, 1971	0-5	Brown grey clay
0-10	Brown clay	5-15	Brown grey weathered shale (el. bedrock 2530)
10-30	Brown weathered shale (el. bedrock 2415)	15-18	Grey shale
30-45	Grey very bentonitic shale	18-20	Weathered coal (el. top coal 2517)
45-90	Grey silty shale	20-28	Very light grey argillaceous sandstone
90-92	Light grey sandstone	28-68	Grey bentonitic shale; grey siltstone
92-100	Coal (el. top coal 2333)	68-73	Coal (el. top coal 2467)
100-110	Light brown and dark grey carbonaceous shale	73-93	Light grey sandstone; grey siltstone
110-140	Grey silty shale	93-100	Dark brown carbonaceous shale; two thin coal seams
140-142	Brown carbonaceous shale	100-182	Grey silty shale; little grey siltstone
142-146	Coal (el. top coal 2283)	182-185	Coal (el. top coal 2353)
146-170	Brown carbonaceous shale	185-195	Grey shale
170-195	Grey silty shale; some grey siltstone		NE cor. 34-44-19 2361; July 22, 1971
	NE cor. 17-44-19 2477; July 22, 1971	0-15	Brown clay; pebbles; boulders
0-15	Brown clay; pebbles; boulders	15-20	Brown sand
15-20	Brown sand	20-39	Brown and grey clay; few pebbles
20-39	Brown and grey clay; few pebbles	39-100	Grey siltstone; grey silty shale (el. bedrock 2438)
39-100	Grey siltstone; grey silty shale (el. bedrock 2438)	100-110	Light grey argillaceous sandstone
100-110	Light grey argillaceous sandstone		NE cor. 12-44-20 2515; August 3, 1971
110-121	Grey silty shale	110-121	Grey silty shale
121-124	Coal (el. top coal 2356)	121-124	Coal (el. top coal 2356)
124-130	Brown grey carbonaceous shale	124-130	Brown grey carbonaceous shale
130-135	Light grey fine sandstone; ledge hard brown siltstone	130-135	Light grey fine sandstone; ledge hard brown siltstone
		0-20	Brown clay; few pebbles
		20-55	Grey silty to sandy clay; few pebbles
		55-70	Grey silty shale (el. bedrock 2460)

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
70-75	Black carbonaceous shale		NE cor. 9-45-17
75-100	Grey fine siltstone; grey fine sandstone		2323; July 20, 1971
100-130	Grey silty shale	0-52	Brown and grey clay; few pebbles
130-140	Grey slightly argillaceous fine sandstone	52-65	Grey fine sandstone; some grey siltstone (el. bed-rock 2271)
140-145	Brown and brown grey carbonaceous shale	65-70	Grey siltstone
145-150	Grey shale	70-129	Grey silty shale; grey fine sandstone
150-155	Light grey argillaceous very fine sandstone	129-131	Coal (el. top coal 2194)
155-160	Grey shale; grey siltstone	131-135	Grey bentonitic shale
160-180	Brown grey carbonaceous shale; two thin coal seams	135-140	Grey siltstone
180-185	Grey shale	140-145	Grey argillaceous sandstone
185-195	Grey coarse sandstone	145-195	Grey shale; very little grey siltstone
	NE cor. 34-44-21 2529; August 3, 1971		
0-10	Mostly gravel; some brown clay		NE cor. 11-45-17 2310; July 20, 1971
10-45	Brown and grey clay; some pebbles	0-10	Brown grey silty clay; boulders; few pebbles
45-55	Brown sand	10-90	Grey clay; sandy sections; some boulders
55-70	Grey unconsolidated sand	90-95	Coarse preglacial gravel; many small coal fragments; abandoned at 95 feet
70-75	Coarse preglacial gravel; abandoned at 75 feet		
	NE cor. 9-45-15 2285; September 11, 1971		
0-10	Brown clay; many pebbles		NE cor. 24-45-17 2308; July 20, 1971
10-25	Grey clay; thin gravel seam	0-43	Brown and grey clay; few pebbles
25-55	Light grey fine sand	43-90	Grey soft bentonitic siltstone; some grey sandstone (el. bed-rock 2265)
55-90	Grey clay; many coal fragments; many fine thin gravel and sand stringers	90-110	Grey siltstone; some yellow brown sandstone
	NE cor. 31-45-16 2305; July 20, 1971	110-135	Grey coarse siltstone
0-10	Brown clay; some fine gravel	135-170	Grey shale; some grey siltstone
10-110	Grey clay; some sandy sections; some pebbles; few boulders	170-180	Grey coarse siltstone
110-135	Grey silty shale (el. bed-rock 2195)	180-185	Grey shale; very little dark grey and brown grey carbonaceous shale
135-195	Grey shale; some grey siltstone (marine)	185-195	Grey silty shale

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 31-45-18 2318; July 23, 1971	20-30	Grey sand
0-15	Brown clay; few pebbles	30-45	Grey very sandy clay; many coal fragments
15-140*	Grey silty to very sandy clay	45-105	Blue grey unconsolidated sand; many fine coal fragments; abandoned at 105 feet
140-142*	Grey shale (el. bedrock 2178)		
142-152*	Coal (el. top coal 2176)		
152-160*	Grey shale		
160-164*	Coal (el. top coal 2158)		NE cor. 20-45-20 2385; August 2, 1971
164-170*	Grey shale		
170-173*	Coal (el. top coal 2148)		
173-180*	Grey fine sandstone	0-25	Brown clay; few pebbles
180-195*	Grey silty shale	25-35	Brown grey clay; few pebbles and boulders
		35-56	Brown coarse sand
		56-59	Coarse preglacial gravel; abandoned at 59 feet
	NE cor. 33-45-18 2320; July 23, 1971		
0-15	Brown clay; many small pebbles		NE cor. 9-45-21 2430; August 3, 1971
15-95	Grey silty clay; some sandy sections; pebbles	0-20	Brown very silty clay; few pebbles
95-110	Grey very sandy clay; few thin gravel stringers	20-55	Grey very sandy clay; many pebbles
110-117	Grey soft shale (el. bedrock 2210)	55-60	Coarse preglacial gravel; abandoned at 60 feet
117-121	Coal (el. top coal 2203)		
121-130	Grey shale		
130-150	Bluish grey fine sandstone		NE cor. 11-45-21 2440; August 3, 1971
150-180	Grey siltstone		
180-195	Light grey very fine sandstone		
		0-10	Brown clay; few pebbles
		10-20	Brown silty clay; many pebbles
		20-90	Brown sand; some clay
0-25	Brown clay; pebbles; boulders	90-95	Coarse preglacial gravel; abandoned at 95 feet
25-71	Brown coarse unconsolidated sand		
71-75	Coarse preglacial gravel; abandoned at 75 feet		NE cor. 24-45-21 2405; August 2, 1971
	NE cor. 24-45-19 2295; July 23, 1971	0-30	Brown silty clay; boulders and pebbles
		30-45	Grey silty clay; few pebbles
0-5	Brown very coarse sand to fine gravel	45-50	Brown fine sand
		50-60	Grey clay; few pebbles
5-20	Brown sandy clay	60-65	Coarse preglacial gravel; abandoned at 65 feet

* Very poor samples

Depth (feet)	Location W 4th Mer Top elevation (feet)	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 19-46-17 2360; July 18, 1971		NE cor. 8-46-18 2327; July 17, 1971
0-21	Brown and grey clay; very few pebbles	0-40	Brown and grey silty clay; few pebbles
21-72	Blue fine to medium bentonitic sandstone (el. bedrock 2339)	40-114	Grey clay; thin sand and gravel stringers; many boulders
72-85	Grey silty shale	114-123	Grey shale (el. bedrock 2213)
85-100	Dark grey, some brown grey, carbonaceous shale	123-127	Coal (el. top coal 2204)
100-150	Blue grey sandstone	127-140	Brownish shale
150-195	Grey silty shale; some grey siltstone	140-145	Light grey shale
		145-150	Coal (el. top coal 2182)
		150-155	Light grey shale
		155-158	Coal (el. top coal 2172)
		158-175	Light grey shale
		175-195	Grey shale
	NE cor. 21-46-17 2355; July 18, 1971		NE cor. 10-46-18 2340; July 18, 1971
0-10	Brown clay; few pebbles	0-10	Brown soft clay; some boulders
10-15	Bluish grey fine sandstone (el. bedrock 2345)	10-60	Grey clay; few boulders; some thin gravel stringers
15-32	Grey shale	60-114	Grey shale; little grey siltstone (el. bedrock 2280)
32-45	Light grey argillaceous sandstone	114-122	Coal (el. top coal 2226)
45-55	Dark grey shale	122-130	Chocolate brown and dark grey carbonaceous shale
55-85	Bluish fine sandstone	130-150	Grey very dry fine sandstone
85-160	Grey silty shale; some grey siltstone	150-155	Grey silty shale; trace coal
160-170	Grey fine sandstone	155-195	Grey silty shale; some grey siltstone
170-180	Grey siltstone		
180-195	Grey shale		NE cor. 12-46-18 2345; July 18, 1971
	NE cor. 34-46-17 2340; July 18, 1971	0-54	Brown and grey clay; many pebbles
0-20	Almost solid boulders; little clay	54-62	Brownish grey shale (el. bedrock 2291)
20-40	Grey siltstone (el. bedrock 2320)	62-67	Coal (el. top coal 2283)
40-60	Grey soft silty shale	67-70	Brown carbonaceous shale
60-195	Grey shale; grey siltstone (poor samples; poor circulation due to boulders)	70-75	Grey coarse sandstone
		75-80	Grey coarse sandstone; trace coal; some brown shale
		80-125	Bluish grey fine to medium sandstone

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
125-150	Grey silty shale		NE cor. 12-46-19
150-180	Grey coarse siltstone with few ledges		2345; July 17, 1971
180-195	Bluish grey fine sandstone		
		0-70	Brown and grey sandy clay; pebbles and boulders
	NE cor. 8-46-19 2440; July 8, 1971	70-105	Grey sandy clay; some very sandy sections
0-7	Brown clay	105-118	Grey shale (el. bedrock 2240)
7-15	Grey argillaceous sandstone (el. bedrock 2433)	118-125	Grey shale; very thin coal seam
25-30	Grey shale; some chocolate brown carbonaceous shale	125-136	Grey silty shale
30-32	Almost white pure bentonite	136-171	Light grey fairly hard slightly bentonitic sandstone
32-45	Light grey sandstone	171-174	Grey shale
45-75	Light grey and brown grey shale	174-182	Coal (el. top coal 2171)
75-90	Grey siltstone; some light grey sandstone	182-195	Dark grey and brown carbonaceous shale
90-100	Brown grey carbonaceous shale; thin coal seam		
100-135	Grey shale; some grey siltstone		NE cor. 19-46-19
135-175	Light grey sandstone; some grey siltstone		2465; July 13, 1971
175-190	Grey shale		
190-195	Brown shale; thin coal seam	0-42	Brown and grey silty clay; few pebbles and boulders
		42-55	Grey shale (el. bedrock 2423)
	NE cor. 10-46-19 2385; July 17, 1971	55-79	Grey fine sandstone; some grey siltstone
0-31	Brown and grey sandy clay; many pebbles	79-81	Coal (el. top coal 2386)
31-48	Grey shale (el. bedrock 2354)	81-85	Chocolate brown carbonaceous shale
48-55	Black and chocolate brown carbonaceous shale; trace coal	85-100	Grey bentonitic siltstone; some light grey bentonitic sandstone
55-100	Grey shale; grey siltstone	100-109	Grey siltstone
100-110	Light grey argillaceous sandstone	109-115	Dark grey and brown carbonaceous shale; thin coal seams
110-132	Grey shale	115-125	Grey siltstone; some grey sandstone
132-134	Coal (el. top coal 2253)	125-130	Grey shale
134-145	Dark brown carbonaceous shale	130-140	Light grey bentonitic sandstone
145-155	Light grey fine sandstone	140-180	Grey shale; some grey siltstone
155-166	Grey silty shale	180-185	Brown carbonaceous shale; trace coal
166-168	Coal (el. top coal 2219)	185-195	Brownish grey carbonaceous shale
168-175	Dark grey carbonaceous shale		
175-185	Light grey very bentonitic fine sandstone		
185-195	Grey shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	Lsd. 10-20-46-19 2448; July 17, 1971		NE cor. 34-46-19 2415; July 8, 1971
0-26	Brown and grey silty clay; few pebbles and boulders	0-25	Brown and grey clay; few pebbles
26-30	Grey soft siltstone (el. bed-rock 2422)	25-45	Bluish grey sand; some coal fragments
30-40	Dark grey and brown carbonaceous shale; trace coal	45-60	Grey soft shale (el. bed-rock 2370)
40-50	Light grey fine bentonitic sandstone	60-63	Grey and dark grey shale
50-102	Grey siltstone; some grey shale	63-65	Coal (el. top coal 2352)
102-104	Coal (el. top coal 2346)	65-135	Grey shale; grey siltstone
104-110	Dark grey carbonaceous shale	135-140	Dark grey shale; trace coal
110-115	Grey fine sandstone	140-150	Brown grey silty shale
115-145	Greenish grey very bentonitic shale		
145-160	Grey silty shale		NE cor. 36-46-19 2398; July 8, 1971
160-175	Light grey fine to medium sandstone		
175-195	Grey silty shale	0-15	Brown silty clay; few pebbles and boulders
	NE cor. 21-46-19 2427; July 8, 1971	15-85	Grey silty clay; some sandy sections; some pebbles and boulders
0-27	Brown and grey clay; few pebbles	85-110	Grey silty shale (el. bed-rock 2313)
27-45	Grey silty shale (el. bed-rock 2400)	110-135	Grey fine sandstone; some grey siltstone
45-50	Dark grey and dark brown carbonaceous shale	135-150	Grey, dark grey and brown grey slightly carbonaceous shale
50-97	Grey siltstone; some light grey benonitic shale	150-156	Coal (el. top coal 2248)
97-108	Light grey bentonitic sandstone	156-170	Grey and dark grey shale
108-111	Coal (el. top coal 2319)	170-175	Light grey argillaceous fine sandstone
111-125	Chocolate brown and dark grey shale	175-195	Grey siltstone; some light grey sandstone
125-130	Grey silty shale		
130-140	Dark grey slightly carbonaceous shale		Lsd. 6-4-46-20 2250; August 2, 1971
140-150	Light grey very bentonitic shale		
150-155	Dark grey and black carbonaceous shale	0-4	Brown clay
155-160	Light grey very bentonitic shale	4-6	Grey clay; some woody material
160-175	Grey and dark grey shale	6-15	Grey clay; many freshwater shells; some woody material
175-180	Grey siltstone	15-32	Dark grey soft clay; much woody material; some freshwater shells
180-195	Brown grey carbonaceous silty shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
32-42	Dark grey much firmer clay; some woody material; few freshwater shells		NE cor. 21-46-20 2425; July 13, 1971
42-45	Brown grey clay	0-45	Brown silty to sandy clay; pebbles; boulders
45-60	Brown grey very silty clay		
60-75	Grey to dark grey silty clay	45-50	Brown weathered shale (el. bedrock 2380)
75-90	Grey very silty clay		
90-105	Grey silty clay	50-60	Grey bentonitic siltstone
105-107	Grey soft clay	60-64	Coal (el. top coal 2365)
107-115	Grey silty clay; some dark grey clay	64-84	Grey siltstone; some grey sandstone
115-125	Grey soft clay	84-90	Dark grey and brown shale; thin coal seam
125-130	Grey soft clay; some coal fragments	90-195	Grey silty shale; some grey coarse siltstone
130-132	Gravel seam; coal fragments		
132-145	Grey clay; some fine gravel; little sand		NE cor. 23-46-20 2450; July 13, 1971
145-148	Gravel; some coal fragments		
	NE cor. 10-46-20 2420; July 13, 1971	0-15	Brown clay; many boulders
0-35	Brown silty clay; pebbles	15-120	Grey clay; many boulders; some sandy sections; some bedrock and coal fragments
35-40	Fine gravel; some brown sand; some brown grey clay		
40-80	Grey silty clay; few pebbles	120-155	Grey silty shale; little grey siltstone (el. bedrock 2330)
80-100	Well sorted lake clay	155-160	Light grey sandstone
100-135	Grey siltstone; some grey fine sandstone (el. bedrock 2320)	160-190	Grey siltstone; some grey fine sandstone
135-195	Grey silty shale; some grey siltstone with few hard ledges	190-195	Grey siltstone; thin coal seam
	NE cor. 12-46-20 2415; July 13, 1971		NE cor. 28-46-20 2430; July 23, 1971
0-25	Brown and grey sandy clay; pebbles; few boulders	0-30	Brown and brown grey clay; many boulders
25-40	Brown coarse unconsolidated sand; some coal fragments	30-40	Mostly fine gravel; some sand; little clay
40-75	Grey silty clay; pebbles	40-50	Grey shale (el. bedrock 2390)
75-125	Mostly grey fine sand; some clay	50-60	Light grey argillaceous sand- stone; grey siltstone
125-170	Grey soft shale (el. bed- rock 2290)	60-65	Dark grey and little brown grey carbonaceous shale; lost circulation; abandoned at 65 feet
170-190	Light grey sandstone; some grey siltstone		
190-195	Dark grey siltstone; trace coal		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 32-46-20 2460; July 14, 1971		NE cor. 21-47-16 2320; July 19, 1971
0-43	Brown and grey clay; few pebbles	0-10	Brown clay; few boulders
43-75	Grey silty shale (el. bedrock 2417)	10-14	Grey clay; few pebbles
75-95	Light grey very bentonitic siltstone	14-180	Uniform slightly dark grey shale (el. marine bedrock 2306)
95-98	Grey shale	180-195	Dark grey and chocolate brown shale (continental)
98-111	Brown shale; three thin coal seams		
111-115	Dark grey, black and brown carbonaceous shale		NE cor. 23-47-16 2330; July 19, 1971
115-160	Grey shale; some grey siltstone	0-15	Brown clay; many boulders
160-170	Grey very bentonitic shale	15-20	Grey clay; few pebbles
170-195	Grey silty shale	20-160	Uniform dark grey shale (el. marine bedrock 2310)
	NE cor. 32-46-21 2470; July 15, 1971	160-190	Grey fine to medium sandstone (continental)
0-59	Brown grey and grey clay; few pebbles and boulders	190-195	Greenish grey silty shale
59-90	Grey silty shale; some coarse grey siltstone (el. bedrock 2411)		
90-105	Light grey argillaceous sandstone	0-15	Brown soft clay; few pebbles
105-150	Grey shale; some grey siltstone	15-75	Grey very sandy clay; few pebbles
150-155	Black and chocolate brown carbonaceous shale	75-90	Grey silty shale (el. bedrock 2250)
155-170	Grey shale	90-100	Grey fine sandstone
170-175	Coal (el. top coal 2300)	100-110	Grey siltstone; very thin coal seam
175-180	Dark grey and brown carbonaceous shale	110-195	Grey shale; grey siltstone
180-195	Grey silty shale		
	NE cor. 8-47-16 2315; July 19, 1971		NE cor. 8-47-18 2380; July 7, 1971
0-25	Brown and grey clay; very few pebbles	0-56	Brown and grey clay; pebbles and boulders
25-30	Dark grey shale; trace coal (el. bedrock 2290)	56-60	Grey shale (el. bedrock 2324)
30-60	Grey siltstone	60-82	Light grey bentonitic sandstone
60-70	Grey shale; few thin siltstone ledges	82-95	Dark grey and brown carbonaceous shale
70-85	Grey fine sandstone	95-97	Coal (el. top coal 2285)
85-195	Uniform slightly dark grey shale (marine)	97-122	Dark grey, brown and grey shale

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
122-128	Coal (el. top coal 2258)		NE cor. 34-47-18
128-135	Chocolate brown and dark grey carbonaceous shale		2403; July 7, 1971
135-169	Grey and brown clay shale; some grey siltstone	0-15	Brown clay; many boulders
169-174	Coal (el. top coal 2211)	15-40	Grey shale; trace coal (el. bedrock 2388)
174-185	Brown grey shale	40-50	Light grey bentonitic sandstone
185-190	Coal (el. top coal 2195)	50-55	Grey silty shale
190-195	Grey shale	55-65	Dark grey and brown shale; trace coal
	NE cor. 21-47-18	65-81	Grey bentonitic shale
	2390; July 7, 1971	81-88	Coal (el. top coal 2322)
0-10	Brown clay; few pebbles and boulders	88-95	Chocolate brown carbonaceous shale
10-30	Grey very sandy clay; few pebbles and boulders	95-105	Dark grey and brown carbonaceous shale
30-37	Grey shale (el. bedrock 2360)	105-130	Grey silty shale; some grey siltstone
37-55	Light grey very argillaceous sandstone	130-135	Mostly creamy white bentonite; some dark grey shale
55-85	Grey bentonitic shale; some grey siltstone	135-155	Chocolate brown carbonaceous shale; some coal
85-94	Dark grey and brown carbonaceous shale	155-160	Brown grey shale
94-96	Coal (el. top coal 2296)	160-195	Grey silty shale
96-105	Dark grey brown carbonaceous shale		
105-150	Grey shale		NE cor. 36-47-18
	NE cor. 32-47-18		2370; July 6, 1971
	2412; July 7, 1971	0-15	Light brown and grey clay; few small pebbles
0-5	Brown clay	15-20	Grey shale (el. bedrock 2355)
5-58	Brown weathered and grey shale; some grey siltstone (el. bedrock 2407)	20-24	Coal (el. top coal 2350)
58-62	Coal (el. top coal 2354)	24-30	Dark grey and brown carbonaceous shale
62-80	Dark brown and grey shale	30-70	Grey shale; some grey coarse siltstone
80-90	Grey sandstone	70-103	Blue grey medium to coarse sandstone
90-103	Dark grey shale; thin coal seam	103-107	Coal (el. top coal 2267)
103-105	Coal (el. top coal 2309)	107-115	Chocolate brown carbonaceous shale
105-122	Dark grey, brown and grey shale	115-122	Brown grey carbonaceous shale
122-129	Coal (el. top coal 2290)	122-124	Coal (el. top coal 2248)
129-160	Light grey bentonitic siltstone and fine sandstone	124-145	Light grey very bentonitic siltstone
160-172	Grey silty shale	145-175	Grey shale; grey siltstone
172-177	Coal (el. top coal 2240)	175-180	Brown and dark grey carbonaceous shale
177-185	Grey and brown shale		
185-190	Dark grey shale	180-195	Grey silty shale
190-195	Grey argillaceous sandstone		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 12-47-19 2405; July 7, 1971	100-110	Grey siltstone
		110-125	Grey fine sandstone
		125-150	Grey soft siltstone
0-55	Brown and grey silty clay; some pebbles; few boulders	150-172	Grey shale; some grey siltstone
55-60	Grey silty shale (el. bed- rock 2350)	172-195	Light grey very argillaceous sandstone
60-70	Light grey argillaceous fine sandstone		NE cor. 19-47-20 2440; July 15, 1971
70-120	Grey shale; some grey siltstone		
120-150	Light grey medium to coarse sandstone with few harder ledges	0-45	Brown and grey clay; very few pebbles
	NE cor. 32-47-19 2430; July 16, 1971	45-75	Grey silty shale (el. bed- rock 2395)
		75-85	Dark grey and brown carbona- ceous shale
0-33	Brown and grey silty clay; very few pebbles	85-95	Grey siltstone
33-45	Grey siltstone (el. bed- rock 2397)	95-110	Grey fine sandstone
45-50	Light grey argillaceous sand- stone	110-135	Grey shale; some grey siltstone
50-90	Grey shale; little grey siltstone	135-153	Grey argillaceous fine sand- stone
90-105	Grey fine sandstone	153-195	Grey shale; some grey siltstone
105-125	Grey shale		NE cor. 21-47-20 2420; July 15, 1971
125-135	Dark grey and brown carbona- ceous shale; some creamy white bentonite; thin coal seam	0-20	Brown clay; few pebbles; very few boulders
135-143	Grey silty shale	20-55	Grey clay; sandy stringers
143-155	Grey fine sandstone	55-70	Fine gravel; some sand; little clay
155-165	Grey coarse siltstone	70-90	Grey sandy clay
165-170	Light grey slightly argillaceous sandstone	90-110	Grey silty shale (el. bed- rock 2330)
170-180	Dark grey and brown carbona- ceous shale; thin coal seam	110-120	Light grey bentonitic fine sandstone
180-195	Dark grey slightly carbona- ceous shale	120-155	Grey shale; grey siltstone
	NE cor. 8-47-20 2475; July 14, 1971	155-165	Grey sandstone
		165-180	Grey silty shale
		180-195	Grey fine sandstone
			NE cor. 34-47-20 2435; July 15, 1971
0-21	Brownish grey clay; few peb- bles	0-20	Brown sandy clay; few pebbles
21-80	Grey shale; very little grey siltstone (el. bedrock 2454)	20-48	Grey silty clay
80-100	Dark grey carbonaceous shale; trace coal	48-65	Dark grey and brown carbona- ceous shale (el. bedrock 2387)

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
65-90	Grey fine sandstone; some grey siltstone	25-30	Brownish grey clay
90-125	Grey shale; some grey siltstone	30-50	Grey siltstone; some grey sandstone (el. bedrock 2440)
125-145	Light grey bentonitic sandstone	50-80	Grey silty shale
145-159	Grey siltstone	80-85	Light grey sandstone
159-161	Coal (el. top coal 2276)	85-150	Grey shale; some grey coarse siltstone
161-165	Chocolate brown carbonaceous shale	150-165	Grey fine argillaceous sandstone
165-180	Grey silty shale	165-180	Grey silty shale
180-187	Coal (el. top coal 2255)	180-190	Grey fine sandstone
187-190	Grey hard siltstone	190-195	Grey silty shale
190-195	Grey shale		
	NE cor. 36-47-20 2465; July 15, 1971		NE cor. 12-47-21 2480; July 14, 1971
0-15	Brown and brown grey sandy clay	0-18	Brown silty clay; few pebbles
15-20	Dark brown and dark grey carbonaceous shale; thin weathered coal seam (el. bedrock 2450)	18-25	Light brown weathered sandstone (el. bedrock 2462)
20-40	Grey siltstone; some light grey coarse sandstone	25-35	Grey sandstone
40-45	Dark grey and brown carbonaceous shale	35-60	Grey silty shale
45-65	Grey silty shale; some bentonite	60-70	Dark grey and brown carbonaceous shale; thin coal seam
65-82	Light grey coarse sandstone; grey siltstone	70-100	Grey silty shale
82-84	Coal (el. top coal 2383)	100-110	Light grey very bentonitic shale
84-100	Brown and brown grey carbonaceous shale; some creamy white bentonite	110-143	Grey siltstone; little grey shale
100-170	Grey shale; some grey siltstone	143-155	Light grey bentonitic sandstone
170-175	Brown and dark grey carbonaceous shale; thin coal seam	155-175	Grey shale
175-180	Dark grey shale	175-195	Grey sandstone; some grey siltstone
180-190	Light grey fine argillaceous sandstone		
190-195	Grey siltstone		
	NE cor. 10-47-21 2470; July 14, 1971		NE cor. 20-48-16 2303; June 21, 1971
0-15	Brown clay; few small pebbles	0-5	Brown very sandy clay
15-25	Fine gravel; some clay; little sand	5-16	Brown clay; pebbles
		16-40	Dark grey very silty shale (el. bedrock 2287)
		40-70	Dark grey shale (marine)
		70-75	Dark grey shale; hard ledge brown siltstone
		75-158	Dark grey shale; hard ledge at 137 feet
		158-160	Grey, dark grey and brown grey carbonaceous shale; few coal fragments (continental)

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
160-170	Greenish grey very bentonitic shale	20-25	Grey siltstone (el. bedrock 2350)
170-180	Grey very argillaceous fine sandstone	25-76	Blue grey sandstone with few ledges
180-185	Brown and brown grey carbonaceous shale	76-82	Coal (el. top coal 2294)
185-195	Grey very bentonitic siltstone	82-93	Chocolate brown carbonaceous shale
		93-97	Coal (el. top coal 2277)
		97-100	Grey and dark grey siltstone
	NE cor. 33-48-16 2270; June 21, 1971	100-160	Grey shale and grey siltstone
		160-185	Light grey bentonitic siltstone
		185-195	Grey soft shale
0-6	Brown coarse sand		
6-88	Uniform grey shale (el. marine bedrock 2264)		NE cor. 9-48-17 2350; July 6, 1971
88-105	Grey siltstone (continental)		
105-110	Grey, dark grey and brown carbonaceous shale	0-10	Brown clay; few pebbles
110-120	Greenish grey to very light grey bentonitic shale	10-40	Grey sandy clay; few pebbles
120-130	Green grey shale; some grey siltstone	40-50	Brown fine sand with fine gravel stringers
130-140	Grey siltstone	50-60	Sandy clay with fine gravel stringers
140-150	Grey salt and pepper sandstone	60-90	Little brown sand; mostly fine gravel; abandoned at 90 feet
			NE cor. 22-48-17 2340; June 22, 1971
0-16	Brown clay; few pebbles	0-10	Brown clay; few small pebbles
16-77	Uniform grey to dark grey shale (el. marine bedrock 2249)	10-15	Brown coarse unconsolidated sand
77-85	Grey siltstone (continental)	15-35	Grey sandy clay; some pebbles
85-90	Grey, dark grey and brown grey slightly carbonaceous shale	35-37	Fine gravel stringer
90-135	Grey medium to coarse siltstone	37-57	Grey clay
135-145	Greenish grey very bentonitic shale; some almost pure bentonite	57-75	Grey silty shale (el. bedrock 2283)
145-150	Grey silty shale	75-92	Grey siltstone; few hard sandstone ledges
		92-106	Grey siltstone
		106-150	Poor samples due to gravel; appears to be siltstone and sandstone
			NE cor. 24-48-17 2330; June 21, 1971
0-20	Brown and grey sandy clay; many pebbles	0-2	Soil
		2-15	Brown grey shale (el. bedrock 2328)

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
15-54	Grey silty shale	105-109	Dark grey and brown carbonaceous shale
54-75	Grey some greenish grey argillaceous sandstone	109-111	Coal (el. top coal 2331)
75-105	Grey silty shale (marine)	111-120	Dark grey and brown carbonaceous shale
105-115	Green grey coarse siltstone (continental)	120-155	Grey shale; some grey siltstone
115-150	Grey silty shale	155-157	Coal (el. top coal 2285)
		157-170	Dark grey and brown carbonaceous shale
	NE cor. 33-48-17 2350; June 22, 1971	170-184	Grey silty shale
0-2	Soil	184-189	Coal (el. top coal 2256)
2-10	Brown grey weathered silty shale (el. bedrock 2348)	189-195	Dark grey slightly carbonaceous shale
10-13	Grey shale		
13-24	Coal with one parting (el. top coal 2337)		
24-35	Grey siltstone		
35-40	Greenish grey fine argillaceous sandstone		NE cor. 9-48-18 2418; July 5, 1971
40-65	Grey silty shale		
65-70	Grey silty shale; some creamy white bentonite		
70-90	Grey fine to medium sandstone	0-15	Brown and grey clay; boulders
90-107	Grey siltstone; some grey silty shale	15-30	Sandstone and shale; disturbed bedrock
107-115	Light grey sandstone	30-40	Grey clay; pebbles
115-136	Grey shale; some grey siltstone	40-45	Blue grey sandstone (el. bedrock 2378)
136-150	Grey fine sandstone	45-50	Dark grey and brown carbonaceous shale
		50-53	Coal (el. top coal 2368)
	NE cor. 7-48-18 2440; July 5, 1971	53-80	Grey shale; some grey siltstone
		80-90	Dark brown carbonaceous shale; two thin coal seams
0-10	Brown clay; few pebbles and boulders	90-95	Grey silty shale
10-20	Brown weathered siltstone (el. bedrock 2430)	95-108	Grey siltstone; some grey sandstone
20-40	Grey siltstone and light grey sandstone	108-116	Dark grey shale
40-55	Grey silty shale	116-122	Coal (el. top coal 2302)
55-65	Bluish grey argillaceous sandstone	122-135	Brown and dark grey carbonaceous shale
65-85	Grey silty shale	135-145	Grey fine sandstone
85-100	Light grey fine sandstone; some grey siltstone	145-167	Brown grey silty shale
100-105	Light grey very bentonitic siltstone	167-172	Coal (el. top coal 2251)
		172-179	Brown grey siltstone
		179-183	Coal (el. top coal 2239)
		183-195	Light grey bentonite; some brown grey shale

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	Lsd. 15-11-48-18 2407; July 6, 1971	166-180	Grey silty shale
0-15	Brown clay; few pebbles	180-195	Grey fine sandstone; some grey siltstone
15-18	Weathered coal (el. bedrock and top coal 2392)		NE cor. 31-48-18
18-30	Grey silty shale		2352; June 23, 1971
30-35	Light grey fine sandstone		
35-40	Grey very bentonitic shale	0-17	Brown clay; few small pebbles
40-50	Dark grey and brown carbona- ceous shale; trace coal	17-25	Brown grey weathered silty shale (el. bedrock 2335)
50-79	Grey shale; some light grey sandstone	25-30	Thin coal seam in grey and brown shale
79-86	Coal (el. top coal 2328)	30-70	Grey shale; some brown car- bonaceous shale
86-90	Dark grey and brown shale	70-85	Light grey bentonitic sand- stone
90-105	Light grey argillaceous fine sandstone	85-88	Grey shale
105-141	Grey shale; some grey siltstone	88-90	Coal (el. top coal 2264)
141-152	Coal (el. top coal 2266)	90-120	Brown grey, black and dark brown carbonaceous shale; little coal
152-155	Grey shale	120-125	Grey silty shale
155-165	Light grey fine sandstone	125-130	Light grey argillaceous fine sandstone
	NE cor. 20-48-18 2420; June 22, 1971	130-135	Grey shale
0-10	Brown clay; few pebbles	135-140	Black and dark brown car- bonaceous shale; little coal
10-26	Grey shale; some dark grey slightly carbonaceous shale (el. bedrock 2410)	140-155	Grey and light grey bentonitic siltstone
26-29	Coal (el. top coal 2394)	155-180	Grey shale and grey siltstone
29-45	Dark grey and brown carbona- ceous shale	180-185	Grey argillaceous sandstone
45-59	Light grey fine sandstone; some grey silty shale	185-190	Chocolate brown carbona- ceous shale
59-63	Coal (el. top coal 2361)	190-195	Grey fine sandstone
63-70	Dark grey and little brown shale		NE cor. 33-48-18
70-94	Grey siltstone and grey silty shale		2387; June 23, 1971
94-98	Coal (el. top coal 2326)		
98-130	Brownish grey slightly car- bonaceous shale; some white bentonite	0-21	Brown clay; some pebbles
130-135	Brown grey slightly carbona- ceous shale	21-25	Brown grey weathered shale (el. bedrock 2366)
135-142	Light grey argillaceous sand- stone	25-50	Grey silty shale
142-146	Coal (el. top coal 2278)	50-52	Coal (el. top coal 2337)
146-161	Grey siltstone; some grey shale	52-55	Slightly dark grey shale
161-166	Coal (el. top coal 2259)	55-65	Grey shale and siltstone
		65-70	Light grey fine to medium sandstone

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
70-85	Grey silty shale	10-35	Grey clay; few pebbles
85-95	Light grey bentonitic sandstone	35-38	Fine gravel in grey clay
95-97	Grey shale	38-45	Light grey sandstone (el. bedrock 2422)
97-105	Little coal in dark grey and brown grey carbonaceous shale	45-85	Grey shale; some grey siltstone
105-115	Grey silty shale	85-95	Light grey very argillaceous sandstone
115-122	Grey fine sandstone	95-128	Grey silty shale
122-128	Coal (el. top coal 2265)	128-133	Coal (el. top coal 2332)
128-135	Grey and dark grey shale	133-135	Brown grey carbonaceous shale
135-145	Grey coarse siltstone	135-144	Grey siltstone
145-147	Brown grey and brown carbonaceous shale	144-180	Grey medium to very coarse sandstone
147-160	Some coal in grey sandstone	180-190	Light grey fine sandstone
160-195	Grey fine sandstone; some grey silty shale	190-195	Grey silty shale
	NE cor. 7-48-19 2470; July 16, 1971		
0-10	Brown clay; few pebbles		NE cor. 22-48-19 2453; June 24, 1971
10-20	Brown weathered siltstone (el. bedrock 2460)		
20-36	Grey fine sandstone; grey siltstone	0-18	Brown clay; some boulders and pebbles
36-38	Coal (el. top coal 2434)	18-20	Brown weathered siltstone (el. bedrock 2435)
38-60	Dark grey and brownish grey carbonaceous shale	20-25	Grey siltstone; trace coal
60-75	Greenish grey silty shale	25-50	Grey silty shale; some grey siltstone
75-80	Brown carbonaceous shale	50-80	Grey shale; some dark grey, brown and dark brown carbonaceous shale
80-90	Greenish grey siltstone	80-86	Light bluish grey bentonitic shale
90-105	Grey fine slightly argillaceous sandstone	86-92	Blue grey salt and pepper sandstone
105-123	Grey shale; some grey siltstone	92-125	Grey silty shale
123-125	Coal (el. top coal 2347)	125-130	Grey and dark grey shale; thin coal seam
125-130	Brown carbonaceous shale	130-150	Grey and light grey bentonitic shale
130-140	Grey silty shale	150-158	Grey siltstone
140-145	Light grey fairly hard bentonitic sandstone	158-164	Coal (el. top coal 2295)
145-185	Grey shale; some grey siltstone	164-190	Grey silty shale; some grey siltstone
185-195	Grey sandstone	190-195	Light grey fine sandstone
	NE cor. 20-48-19 2460; July 16, 1971		
0-10	Brown clay; some bedrock fragments		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 24-48-19 2428; June 24, 1971	75-132	Grey shale; some grey siltstone
		132-137	Light grey fine sandstone
		137-195	Grey silty shale
0-16	Brown and brown grey silty clay; few pebbles		
16-40	Brown grey shale; grey siltstone (el. bedrock 2412)		NE cor. 24-48-20 2453; July 16, 1971
40-45	Light grey argillaceous sandstone	0-10	Brown sandy clay
45-60	Grey, dark grey, some brown grey carbonaceous shale; thin coal seam	10-20	Brown coarse sand; fine gravel; brown clay
60-64	Light grey bentonitic shale	20-55	Grey sand; many coal fragments
64-70	Black and brown shale; thin coal seam	55-60	Grey clay; some pebbles
70-75	Light grey very bentonitic siltstone	60-134	Grey shale; grey siltstone (el. bedrock 2393)
75-80	Chocolate brown carbonaceous shale	134-144	Grey fine sandstone
80-85	Light grey bentonitic sandstone	144-150	Coal (el. top coal 2309)
85-89	Grey, dark grey and brown carbonaceous shale	150-170	Grey bentonitic shale
89-95	Coal (el. top coal 2339)	170-174	Coal (el. top coal 2283)
95-120	Grey silty shale	174-195	Grey silty shale
120-125	Light grey fine sandstone		NE cor. 8-49-15 2230; June 19, 1971
125-132	Grey silty shale	0-20	Brown and brown grey clay; many boulders
132-134	Coal (el. top coal 2296)	20-30	Blue grey fine sandstone (el. bedrock 2210)
134-155	Grey shale; grey siltstone	30-135	Mostly grey siltstone; some grey shale
155-160	Mostly white bentonite; some dark grey carbonaceous shale	135-140	Grey very argillaceous sandstone
160-164	Brown grey carbonaceous shale	140-150	Grey very bentonitic shale
164-167	Coal (el. top coal 2264)		NE cor. 21-49-15 2225; June 19, 1971
167-195	Grey siltstone	0-32	Brown and grey silty clay; few pebbles
		32-40	Grey silty shale (el. bedrock 2193)
0-15	Brown and grey silty clay; many boulders	40-50	Greenish grey very bentonitic siltstone
15-35	Grey silty shale (el. bedrock 2460)	50-65	Grey argillaceous fine sandstone
35-55	Light grey salt and pepper sandstone	65-120	Grey shale; grey siltstone
55-65	Grey siltstone	120-140	Grey fine sandstone
65-75	Chocolate brown and dark grey carbonaceous shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
140-175	Grey silty shale; little grey siltstone	110-115	Light greenish grey very bentonitic shale
175-180	Light grey harder fine sandstone	115-150	Grey bentonitic siltstone
180-195	Grey silty shale		NE cor. 19-49-16 2240; June 21, 1971
	NE cor. 8-49-16 2260; June 21, 1971	0-10	Brown sandy clay; few pebbles
0-8	Brown clay; few pebbles	10-15	Fine gravel; little sand
8-15	Brown, grey and brown grey silty shale; some yellow bentonite (el. marine bedrock 2252)	15-65	Grey silty shale (el. marine bedrock 2225)
15-60	Dark grey shale	65-75	Grey siltstone (continental)
60-70	Dark brown and black carbonaceous shale (continental)	75-80	Grey argillaceous sandstone
70-75	Grey siltstone	80-100	Grey coarse siltstone
75-80	Chocolate brown carbonaceous shale	100-125	Grey to light greenish grey bentonitic shale
80-90	Bluish grey fine sandstone	125-135	Grey fine sandstone
90-110	Grey silty shale	135-145	Grey siltstone
110-115	Dark grey and brown grey carbonaceous shale	145-150	Grey fine sandstone
115-140	Grey and some green grey shale		NE cor. 8-49-17 2355; June 22, 1971
140-145	Light grey bentonitic shale	0-18	Brown sandy clay; many small pebbles
145-165	Grey salt and pepper sandstone; some brown oil-stained sandstone	18-28	Brown weathered and some grey coarse siltstone (el. bedrock 2337)
	NE cor. 12-49-16 2252; June 19, 1971	28-35	Coal (el. top coal 2327)
0-15	Brown clay; few pebbles	35-55	Grey, brown and brown grey siltstone
15-25	Grey clay; few boulders	55-70	Grey silty shale
25-40	Grey silty shale (el. marine bedrock 2227)	70-73	Grey silty shale; some light grey bentonite
40-50	Greenish grey shale	73-100	Grey fine to medium sandstone
50-55	Brown and brown grey slightly carbonaceous shale	100-150	Slightly dark grey shale; few harder ledges (marine)
55-70	Grey silty shale		NE cor. 19-49-17 2335; June 15, 1971
70-80	Very light grey bentonitic shale	0-13	Brown very sandy clay; pebbles and boulders
80-90	Grey siltstone	13-23	Grey and dark grey shale; trace coal (el. bedrock 2322)
90-100	Grey fine sandstone (continental)	23-30	Grey coarse siltstone
100-110	Grey shale; grey siltstone		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
30-50	Uniform dark grey shale (marine)	15-49	Dark grey silty shale
50-70	Grey siltstone (continental)	49-75	Light grey argillaceous sandstone (continental)
70-80	Grey shale; trace coal	75-85	Grey siltstone
80-85	Light grey very bentonitic shale	85-90	Grey fine sandstone
85-113	Grey silty shale	90-95	Grey, brown grey and little brown carbonaceous shale; trace coal
113-120	Grey silty shale; trace coal	95-105	Grey siltstone; some green grey fine sandstone
120-150	Grey shale; some grey siltstone	105-110	Grey silty shale
	NE cor. 21-49-17 2330; June 15, 1971	110-115	Grey fine sandstone
		115-125	Grey and some green shale
0-4	Brown clay	125-140	Grey coarse argillaceous sandstone
4-20	Brown weathered shale (el. bedrock 2326)	140-150	Grey silty shale
20-35	Grey shale		
35-55	Grey sandstone		NE cor 10-49-18 2305; June 15, 1971
55-105	Grey silty shale		
105-116	Grey and greenish grey shale	0-14	Brown clay; few pebbles and boulders
116-125	Grey silty shale (marine)	14-16	Grey siltstone (el. bedrock 2291)
125-130	Grey fine sandstone	16-23	Coal (el. top coal 2289)
130-195	Grey shale to fine grey siltstone	23-30	Dark grey silty shale
	NE cor. 34-49-17 2257; June 15, 1971	30-50	Grey sandstone; some grey siltstone
		50-70	Grey to light grey very bentonitic shale
0-8	Brown clay; many boulders	70-75	Grey to light brown grey siltstone
8-15	Grey shale (el. marine bedrock 2249)	75-80	Grey shale
15-26	Greenish grey fine sandstone	80-110	Light grey coarse sandstone
26-100	Grey uniform silty shale	110-120	Grey silty shale
100-130	Grey siltstone; some light grey fine bentonitic sandstone (continental)	120-155	Grey to bluish green sandstone; some hard ledges
130-135	Grey fine sandstone; harder ledge grey siltstone	155-170	Grey fine sandstone; trace coal
135-140	Grey siltstone	170-190	Grey shale; trace coal
140-150	Light grey bentonitic shale	190-195	Greenish grey shale
	NE cor. 36-49-17 2245; June 15, 1971		NE cor. 12-49-18 2335; June 22, 1971
		0-7	Brown clay; some pebbles
0-9	Brown sandy clay; few pebbles	7-15	Brown weathered siltstone; thin coal seam (el. bedrock 2328)
9-15	Brown weathered shale (el. marine bedrock 2236)		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
15-25	Light grey very argillaceous sandstone	10-25	Grey to bluish grey argillaceous sandstone
25-30	Grey sandstone; some grey and brown grey silty shale	25-80	Grey shale; some grey siltstone
30-50	Grey fine sandstone; some grey siltstone	80-90	Light grey fairly hard sandstone
50-72	Grey silty shale	90-100	Grey shale
72-85	Greenish grey fine sandstone	100-105	Brownish grey shale; thin coal seam
85-90	Grey siltstone	105-130	Grey shale
90-97	Light grey bentonitic sandstone	130-135	Dark grey silty shale
97-130	Grey shale	135-150	Grey shale
130-136	Greenish grey very fine sandstone		NE cor. 30-49-18
136-150	Grey silty shale		2310; June 28, 1971
	NE cor. 19-49-18	0-8	Brown clay
	2305; June 14, 1971	8-13	Coal (el. bedrock and top coal 2302)
0-13	Brown and grey clay	13-30	Dark grey and brown carbonaceous shale; some grey sandstone
13-20	Light grey sandstone (el. bedrock 2292)	30-45	Light grey sandstone
20-25	Coal (el. top coal 2285)	45-50	Brown and brown grey carbonaceous shale
25-33	Grey shale	50-80	Blue grey and light grey sandstone; some grey and dark grey shale
33-45	Uniform brownish grey shale (marine)	80-90	Grey silty shale
45-60	Light grey sandstone (continental)	90-105	Grey fine sandstone; some grey siltstone
60-70	Grey shale	105-125	Grey shale; some harder grey siltstone
70-80	Light grey argillaceous sandstone	125-130	Grey coarse to medium sandstone
80-85	Grey shale	130-150	Grey very bentonitic siltstone
85-110	Grey siltstone and grey sandstone		NE cor. 31-49-18
110-125	Grey shale and grey fine siltstone		2297; June 28, 1971
125-130	Light grey sandstone	0-8	Brown clay; very few pebbles
130-135	Grey fine sandstone; some black shale; coal traces	8-14	Coal (el. bedrock and top coal 2289)
135-140	Grey shale	14-45	Bluish grey siltstone
140-145	Light grey bentonitic sandstone	45-55	Dark grey silty shale
145-150	Grey shale	55-60	Grey fine sandstone
	NE cor. 21-49-18	60-120	Grey shale; some grey coarse to medium siltstone
	2280; June 14, 1971	120-170	Uniform grey shale (marine)
0-5	Sandy brown clay	170-180	Grey fine sandstone (continental)
5-10	Brown weathered shale (el. bedrock 2275)		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
180-185	Grey shale		NE cor. 25-49-19
185-190	Dark grey and brown carbonaceous shale		2305; June 28, 1971
190-195	Grey silty shale	0-30	Brown and grey clay; few pebbles
	NE cor. 23-49-19	30-34	Brown grey shale (el. bedrock 2275)
	2330; June 29, 1971	34-39	Weathered coal (el. top coal 2271)
0-24	Brown clay; few pebbles	39-50	Brown and brown grey carbonaceous shale
24-30	Brown grey weathered sandstone (el. bedrock 2306)	50-60	Grey soft sandstone
30-35	Light blue grey sandstone	60-65	Brown and dark grey carbonaceous siltstone
35-40	Light grey coarse siltstone	65-75	Brown carbonaceous shale; trace coal
40-50	Grey shale	75-80	Brown carbonaceous shale
50-70	Grey, dark grey and brown carbonaceous shale	80-88	Light grey bentonitic sandstone
70-85	Grey shale	88-95	Brown carbonaceous shale; trace coal
85-90	Grey soft sandstone	95-120	Fine bentonitic sandstone; some grey siltstone
90-100	Brown carbonaceous shale	120-140	Grey coarse siltstone with few hard ledges
100-105	Grey, brown and some yellow brown siltstone	140-150	Grey fine sandstone
105-110	Light grey very argillaceous sandstone	150-165	Grey shale
110-120	Brown, grey and dark grey carbonaceous shale		NE cor. 24-49-19
120-150	Grey shale; some grey siltstone		2315; June 28, 1971
	NE cor. 24-49-19	0-30	Brown and grey clay; boulders and pebbles
	2315; June 28, 1971	30-45	Light grey soft argillaceous sandstone (el. bedrock 2285)
0-30	Brown and grey clay; boulders and pebbles	45-75	Dark grey and brown carbonaceous shale; trace coal
30-45	Light grey soft argillaceous sandstone (el. bedrock 2285)	75-90	Grey and slightly dark grey silty shale
45-75	Dark grey and brown carbonaceous shale; trace coal	90-115	Grey fine sandstone; some grey harder siltstone
75-90	Grey and slightly dark grey silty shale	115-140	Grey shale with few hard ledges
90-115	Grey fine sandstone; some grey harder siltstone	140-145	Grey and brown grey shale; trace coal
115-140	Grey shale with few hard ledges	145-155	Light grey bentonitic sandstone
140-145	Grey and brown grey shale; trace coal	155-165	Grey bentonitic shale
145-155	Light grey bentonitic sandstone		NE cor. 34-49-19
155-165	Grey bentonitic shale		2364; June 14, 1971
		0-75	Brown silty clay; few pebbles; some large boulders
		75-105	Grey sandy clay; few pebbles and boulders; coal fragments
		105-115	Grey very silty shale; trace coal (el. bedrock 2259)
		115-125	Grey siltstone; some coal fragments
		125-130	Light grey sandstone; few coal fragments
		130-145	Grey and brown grey silty shale
		145-155	Grey fine to medium sandstone
		145-190	Grey sandstone and grey siltstone
		190-195	Grey shale

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 35-49-19 2330; June 28, 1971		NE cor. 34-49-20 2560; June 2, 1971
0-10	Brown clay; some pebbles	0-25	Brown and grey sandy clay; some pebbles
10-80	Grey sandy to silty clay; many boulders	25-30	Brown sand
80-95	Grey silty shale (el. bed- rock 2250)	30-65	Grey sand with many thin gravel stringers
95-105	Light grey and grey fine sand- stone	65-150	Grey clay, some sand; thin gravel stringers
105-135	Grey medium to coarse silt- stone		
135-150	Grey silty shale with few hard ledges		NE cor. 36-49-20 2620; June 2, 1971
	NE cor. 36-49-19 2310; June 14, 1971	0-15	Brown weathered clay; many pebbles
0-5	Brown sand	15-85	Grey clay; many pebbles and boulders; few sandy stringers
5-20	Brown clay; few pebbles; boul- ders	85-138	Grey clay; much sand; some gravel stringers
20-29	Coal (el. bedrock and top coal 2290)	138-149	Many fine gravel stringers; sand; little clay
29-35	Dark brown carbonaceous shale		
35-60	Light grey soft fine sandstone		NE cor. 31-50-15 2220; June 18, 1971
60-70	Dark grey and brown car- bonaceous shale; coal traces	0-5	Brown clay
70-85	Light grey very bentonitic sandstone	5-20	Brown coarse siltstone (el. bedrock 2215)
85-100	Dark grey shale; grey siltstone	20-80	Grey siltstone; some grey sandstone
100-110	Greenish grey coarse siltstone	80-85	Grey fairly hard sandstone
110-125	Grey shale; grey siltstone	85-105	Grey fine slightly argillaceous sandstone
125-135	Grey, dark grey and some chocolate brown carbonaceous shale; thin coal seam	105-120	Grey silty shale
135-140	Light grey argillaceous sand- stone	120-130	Green grey silty shale
140-165	Light grey very bentonitic shale	130-150	Grey siltstone
	Lsd. 5-27-49-20 2525; June 2, 1971		NE cor. 33-50-15 2198; September 11, 1971
0-5	Brown sand	0-30	Brown sandy clay; many peb- bles and boulders
5-25	Brown grey clay; few pebbles	30-35	Brown weathered shale (el. bedrock 2168)
25-150	Grey clay; minor sand string- ers; pebbles and boulders	35-60	Light grey and grey sandstone
		60-80	Bluish grey siltstone
		80-95	Grey shale

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
95-100	Brown carbonaceous shale		NE cor. 22-50-16
100-115	Grey bentonitic shale		2235; June 18, 1971
115-120	Grey fairly hard sandstone		
120-150	Grey bentonitic shale and siltstone	0-15	Brown and brown grey clay; few pebbles
150-160	Blue grey sandstone	15-26	Grey clay; many boulders
160-165	Grey silty shale	26-90	Grey shale; some grey siltstone (el. bedrock 2209)
165-170	Blue grey sandstone	90-100	Greenish grey and grey shale
170-195	Grey shale; harder ledge brown siltstone	100-130	Grey coarse siltstone; some grey sandstone
		130-150	Grey medium to coarse argillaceous sandstone
	NE cor. 7-50-16 2240; June 18, 1971		NE cor. 24-50-16 2230; June 18, 1971
0-16	Brown clay; many boulders	0-13	Brown clay; few pebbles
16-23	Grey siltstone; some grey sandstone (el. bedrock 2224)	13-35	Grey siltstone; grey sandstone (el. bedrock 2217)
23-35	Dark grey silty shale	35-44	Grey shale
35-40	Grey shale	44-60	Grey argillaceous sandstone
40-60	Grey siltstone	60-70	Light green grey very bentonitic shale
60-120	Grey shale	70-80	Grey silty shale
120-145	Light grey sandstone	80-105	Grey fine sandstone; some grey siltstone
145-150	Grey silty shale	105-115	Grey silty slightly bentonitic shale
	NE cor. 9-50-16 2240; June 18, 1971	115-150	Light grey fine sandstone
			NE cor. 31-50-17 2216; June 3, 1971
0-20	Brown and brown grey clay; many boulders and pebbles	0-10	Brown clay; few pebbles
20-34	Grey clay; few pebbles	10-60	Grey shale; some coarse siltstone (el. bedrock 2206)
34-65	Grey siltstone; grey fine sandstone (el. bedrock 2206)	60-70	Grey medium to very coarse sandstone
65-80	Grey argillaceous sandstone	70-80	Grey shale
80-95	Grey silty shale; some traces dark brown carbonaceous shale	80-95	Bluish grey and some grey sandstone and siltstone
95-105	Grey siltstone	95-100	Dark grey and some brown carbonaceous shale
105-110	Greenish blue shale	100-130	Grey shale and siltstone
110-120	Grey, dark grey and some brown carbonaceous shale	130-135	Bluish grey sandstone
120-128	Grey shale	135-145	Grey siltstone
128-135	Grey fine sandstone	145-150	Grey fairly hard sandstone
135-150	Grey silty shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 7-50-18 2290; June 29, 1971		Lsd. 13-36-50-18 2210; June 3, 1971
0-18	Brown clay; few pebbles	0-16	Brown clay; few pebbles; few large boulders
18-25	Light grey argillaceous sandstone (el. bedrock 2272)	16-40	Grey and brown grey silty shale (el. marine bedrock 2194)
25-35	Brownish grey shale	40-60	Light grey fine to medium sandstone (continental)
35-75	Grey coarse siltstone; some grey silty shale	60-70	Green grey shale
75-80	Brown carbonaceous shale; trace coal	70-95	Grey coarse sandstone
80-90	Grey fine sandstone	95-105	Green grey and some blue grey shale
90-100	Grey shale (marine)	105-110	Grey and some blue grey shale; trace coal; some greenish bentonitic shale
100-150	Uniform slightly dark grey shale with few hard ledges	110-170	Light grey to dark grey shale
	NE cor. 31-50-18 2270; June 2, 1971	170-175	Light grey coarse sandstone
0-5	Dark brown clay	175-180	Grey silty shale
5-10	Light grey coarse sandstone (el. bedrock 2265)		NE cor. 1-50-19 2314; June 28, 1971
10-15	Red brown ironstone	0-17	Brown and grey clay; few pebbles
15-20	Brown grey sandstone	17-21	Coal (el. bedrock and top coal 2297)
20-110	Uniform grey to dark grey shale (marine)	21-25	Light brown bentonitic shale
110-115	Grey shale (continental)	25-50	Grey medium to coarse sandstone
115-120	Grey shale; some coal traces	50-60	Brownish grey silty shale
120-185	Grey and some greenish grey shale; little grey siltstone	60-65	Light grey soft bentonitic sandstone
185-190	Grey slightly bentonitic sandstone	65-75	Brown grey and brown carbonaceous shale
190-195	Greenish grey silty shale	75-90	Grey fine to coarse siltstone
	Lsd. 14-33-50-18 2212; June 3, 1971	90-100	Brownish grey silty shale
0-20	Brown silty clay; few pebbles	100-140	Grey silty shale; some harder ledges light brown siltstone
20-95	Uniform brown grey and dark grey shale (el. marine bedrock 2192)	140-150	Grey silty shale; some brownish white siltstone
95-145	Grey shale and sandstone (continental)		NE cor. 7-50-19 2535; June 1, 1971
145-185	Grey silty shale	0-65	Brown and grey silty to sandy clay; some pebbles
185-190	Light grey bentonitic sandstone		
190-195	Greenish grey silty shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
65-130	Grey very sandy clay; few thin fine gravel stringers		NE cor. 22-50-19 2365; June 1, 1971
130-135	Coarse sand and fine gravel	0-35	Brown, grey and dark grey clay; few pebbles
135-188	Mostly sand; some grey clay; few thin gravel stringers	35-41	Grey shale (el. bedrock 2330)
188-195	Light grey fine sandstone (el. bedrock 2347)	41-47	Coal (el. top coal 2324)
		47-55	Grey and some light brownish grey shale
		55-70	Grey fine sandstone
	NE cor. 9-50-19 2425; June 1, 1971	70-150	Grey siltstone and shale
0-50	Brown and grey clay; few pebbles, some boulders	150-165	Grey fine sandstone
50-60	Grey silty shale (el. bed- rock 2375)	165-175	Grey sandstone
60-70	Grey sandstone	175-195	Grey shale, ledge at 190 feet
70-85	Grey, dark grey, little brown grey, slightly carbonaceous shale		NE cor. 24-50-19 2307; June 29, 1971
85-88	Coal (el. top coal 2340)	0-25	Brown and grey clay; few pebbles
88-115	Grey to dark grey shale; few coal fragments	25-50	Grey siltstone; some grey silty shale (el. bedrock 2282)
115-125	Grey shale	50-60	Grey sandstone
125-135	Light grey bentonitic sand- stone	60-70	Grey siltstone
135-151	Grey, some dark grey shale; some light grey bentonite	70-75	Grey sandstone
151-160	Coal (el. top coal 2274)	75-120	Grey shale; grey siltstone (marine)
160-185	Grey fine sandstone	120-150	Greenish grey sandstone (continental)
185-195	Grey siltstone		
	NE cor. 11-50-19 2348, June 29, 1971		
0-20	Brown silty clay; few pebbles		
20-42	Grey silty to sandy clay; few pebbles and boulders		NE cor. 33-50-19 2323; June 4, 1971
42-60	Grey medium to very coarse sandstone (el. bedrock 2306)	0-60	Brown and grey silty to sandy clay; some pebbles
60-70	Grey coarse argillaceous sand- stone	60-85	Grey sandy clay; some gravel and sand stringers
70-80	Grey siltstone	85-110	Grey fine to medium sand- stone (el. bedrock 2238)
80-85	Chocolate brown carbona- ceous shale	110-145	Uniform grey silty shale (marine)
85-95	Grey siltstone; some grey sandstone	145-150	Dark grey and brown car- bonaceous shale; trace coal (continental)
95-140	Grey silty shale; some grey fine to coarse siltstone	150-195	Bluish grey and grey silty shale
140-150	Dark grey shale; trace coal		
150-165	Grey bentonitic shale		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 35-50-19 2300; June 2, 1971	30-60	Grey sandstone; grey coarse siltstone
0-15	Brown and brown grey clay	60-180	Grey silty shale; some grey hard siltstone
15-35	Grey silty shale (el. bed- rock 2285)	180-185	Light grey slightly harder fine sandstone
35-40	Blue grey sandstone	185-195	Grey bentonitic shale
40-45	Grey to dark grey shale		
45-60	Grey to light grey sandstone		
60-95	Uniform grey shale (marine)		
95-100	Dark grey; some brown grey slightly carbonaceous shale (continental)		NE cor. 9-51-15 2205; September 11, 1971
100-125	Grey shale; some greenish grey fine sandstone	0-10	Brownish grey clay; few peb- bles
125-135	Dark grey shale; trace coal	10-25	Brown to yellow brown weathered siltstone (el. bed- rock 2195)
135-150	Grey shale and siltstone	25-30	Blue grey coarse sandstone
150-155	Grey shale; trace coal	30-40	Blue grey silty shale
155-195	Grey shale and siltstone	40-70	Blue grey sandstone
	NE cor. 31-51-14 2090; September 12, 1971	70-75	Light grey bentonitic sand- stone
0-10	Brown clay; many small peb- bles	75-115	Grey slightly argillaceous medium to coarse sandstone
10-30	Brown grey weathered and grey shale (el. bedrock 2080)	115-130	Grey shale
30-95	Grey siltstone; grey silty shale	130-140	Grey sandstone
95-100	Light grey fine sandstone	140-145	Brown grey silty shale
100-105	Dark grey to black carbona- ceous shale	145-150	Grey fine sandstone
105-125	Grey silty shale; some hard grey siltstone	150-195	Grey bentonitic shale
125-130	Grey silty shale; trace coal		
130-135	Grey very bentonitic shale		NE cor. 11-51-15 2153; September 11, 1971
135-165	Grey silty slightly bentonitic shale	0-25	Brown and grey clay; few pebbles
165-175	Light grey fine sandstone	25-55	Blue grey fine sand; few thin gravel stringers
175-185	Grey silty shale	55-90	Blue grey fine sand; many fine coal fragments
185-190	Grey fine very dry sandstone	90-165	Grey siltstone; little grey shale (el. bedrock 2063)
190-195	Grey shale	165-170	Dark grey shale; trace coal
	NE cor. 33-51-14 2150; September 13, 1971	170-175	Grey silty shale
0-6	Brown clay	175-180	Light grey fine sandstone
6-30	Grey shale; grey siltstone (el. bedrock 2144)	180-195	Grey siltstone

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 22-51-15 2137; September 12, 1971	35-40	Light grey sandstone
		40-45	Grey shale
		45-50	Creamy white almost pure bentonite
0-15	Brown clay; few pebbles	50-75	Grey silty shale
15-28	Brown fine sand; little brown clay	75-105	Grey sandstone and siltstone
28-30	Brown weathered siltstone (el. bedrock 2145)	105-110	Brown grey siltstone; some hard white boney material
30-60	Grey and blue shale	110-130	Grey medium to coarse sandstone
60-90	Grey fairly dry sandstone	130-135	Greenish blue shale
90-150	Grey silty slightly bentonitic shale; little grey bentonitic siltstone	135-140	Green grey siltstone
150-165	Light grey dry sandstone	140-150	Grey to dark grey fine sandstone
165-180	Grey silty shale		
180-190	Chocolate brown and brown carbonaceous shale; two thin coal seams		NE cor. 22-51-17 2218; June 4, 1971
190-195	Chocolate brown and brown carbonaceous shale	0-25	Brown clay; few pebbles
		25-41	Mostly coarse sand and gravel; little brown clay
		41-46	Grey clay
	NE cor. 24-51-15 2122; September 12, 1971	46-60	Grey soft shale (el. bedrock 2172)
0-20	Brown and grey clay	60-70	Greenish grey sandstone
20-29	Sand; some fine gravel; bedrock fragments	70-90	Grey silty shale
29-45	Light grey argillaceous sandstone (el. bedrock 2093)	90-95	Brown grey slightly carbonaceous shale
45-80	Grey silty shale	95-100	Grey fine sandstone
80-90	Grey very argillaceous sandstone	100-160	Grey shale; some green grey coarse siltstone
90-130	Grey silty shale	160-170	Grey sandstone
130-140	Grey shale; thin coal seam	170-177	Grey silty shale
140-160	Grey shale and siltstone	177-195	Light grey very coarse sandstone
160-165	Grey fine sandstone		
165-175	Grey bentonitic siltstone; trace coal		NE cor. 35-51-17 2212; June 4, 1971
175-195	Grey bentonitic medium to coarse siltstone	0-17	Brown and grey clay; few pebbles; few large boulders
		17-21	Fine gravel in grey clay
	NE cor. 9-51-17 2216; June 3, 1971	21-102	Grey clay; pebbles; many large boulders
0-10	Brown very sandy clay; few pebbles and boulders	102-140	Very sandy clay with sandy stringers
10-15	Brown clay; few pebbles	140-150	Grey soft shale (el. bedrock 2072)
15-35	Grey shale (el. bedrock 2201)		

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 31-51-18 2225; June 12, 1971		NE cor. 20-51-19 2425; June 10, 1971
0-22	Brown clay; many pebbles and small boulders	0-60	Brown and grey clay; boulders and pebbles
22-30	Blue grey coarse sandstone (el. bedrock 2203)	60-75	Grey sandy clay; many boulders
30-60	Grey to dark grey very silty shale	75-110	Mostly grey fine sand; some grey clay
60-80	Brownish grey shale; trace white grey boney material	110-142	Silty to sandy grey clay; many small boulders
80-115	Grey fine siltstone to grey coarse sandstone	142-160	Grey sandstone and siltstone (el. bedrock 2283)
115-125	Grey, brown grey and brown shale; some white grey boney material	160-165	Grey very silty shale; trace coal
125-140	Brown grey and grey silty shale	165-175	Grey coarse siltstone
140-150	Grey bentonitic soft and fine sandstone	175-180	Slightly harder grey sandstone
150-160	Green grey siltstone; trace brown and brown grey shale	180-195	Grey shale
160-165	Light grey dry sandstone		Lsd. 5-31-51-19 2445; June 10, 1971
165-175	Greenish grey bentonitic siltstone	0-25	Brown and brown grey clay; many pebbles and boulders
175-180	Brown grey bentonitic silty shale; trace green shale	25-90	Grey clay; sandy stringers; boulders and pebbles
180-190	Grey shale; little green grey shale	90-135	Grey clay; many boulders
190-195	Grey and brown siltstone; some brown carbonaceous shale	135-145	Grey coarse siltstone (el. bedrock 2310)
	NE cor. 9-51-19 2325; June 4, 1971	145-155	Bluish grey fine sandstone
0-10	Brown clay; few pebbles	155-165	Grey siltstone
10-15	Brown very coarse sand	165-170	Grey silty shale; trace coal
15-20	Mostly grey sand; some grey clay	170-180	Grey silty shale
20-65	Grey sand; some gravel stringers	180-185	Grey coarse sandstone
65-85	Grey clay with some sandy stringers	185-195	Grey siltstone
85-130	Grey sandy clay; few pebbles and boulders		Lsd. 5-32-51-19 2400; June 11, 1971
130-150	Mostly sand; some grey clay; some boulders	0-68	Brown and grey clay; many pebbles; few boulders
		68-85	Grey silty shale (el. bedrock 2332)
		85-110	Grey coarse to fine sandstone
		110-115	Grey sandstone; thin coal seam
		115-130	Grey fine sandstone

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
130-140	Grey shale; trace coal		Lsd. 5-35-51-19
140-150	Grey silty shale		2275; June 11, 1971
150-170	Grey to dark grey siltstone		
170-195	Grey silty shale	0-30	Brown clay; thin gravel string- er at 15 feet
		30-65	Brown grey and grey clay; few pebbles
		65-78	Sand and fine gravel
		78-85	Brown grey clay
		85-95	Brown and grey shale; some coal (el. bedrock 2190)
	Lsd. 5-33-51-19 2377; June 11, 1971	95-120	Grey silty shale
0-50	Light brown and grey clay; few pebbles	120-125	Grey shale; thin coal seam
50-55	Grey clay; gravel stringers	125-160	Grey shale and siltstone
55-87	Grey clay; some small pebbles; few boulders	160-170	No samples; poor circulation
87-115	Grey silty shale (el. bed- rock 2290)		
115-130	Bluish grey sandstone to fine siltstone		NE cor. 36-51-19 2252; June 11, 1971
130-140	Grey silty shale	0-20	Brown and grey clay; few pebbles
140-148	Greenish grey sandstone	20-25	Grey siltstone (el. bed- rock 2232)
148-170	Grey shale	25-35	Dark grey and dark brown shale; thin coal seam
170-175	Grey shale; thin coal seam	35-47	Grey silty shale
175-180	Grey shale	47-55	Grey, dark grey and some brown shale; thin coal seam
180-190	Grey fine sandstone	55-110	Uniform grey shale (marine)
190-195	Grey siltstone	110-120	Grey and brown siltstone (continental)
		120-130	Grey silty shale
	Lsd. 5-34-51-19 2323; June 11, 1971	130-140	Green grey, brown grey and some grey silty shale
0-50	Brown and grey clay; few pebbles	140-150	Grey silty shale
50-85	Uniform grey shale (el. marine bedrock 2273)		
85-88	Grey fine sandstone; some grey siltstone (continental)		
88-95	Grey silty shale; thin coal seam		NE cor. 19-52-13 2150; September 13, 1971
95-110	Grey silty shale		
110-125	Grey shale; trace coal	0-10	Brown silty clay
125-135	Grey silty shale	10-20	Brown weathered shale (el. bedrock 2140)
135-140	Grey silty shale; trace coal	20-165	Grey silty shale; some grey siltstone
140-165	Grey shale; hard thin ledge brown grey siltstone at 148 feet	165-195	Greenish grey siltstone

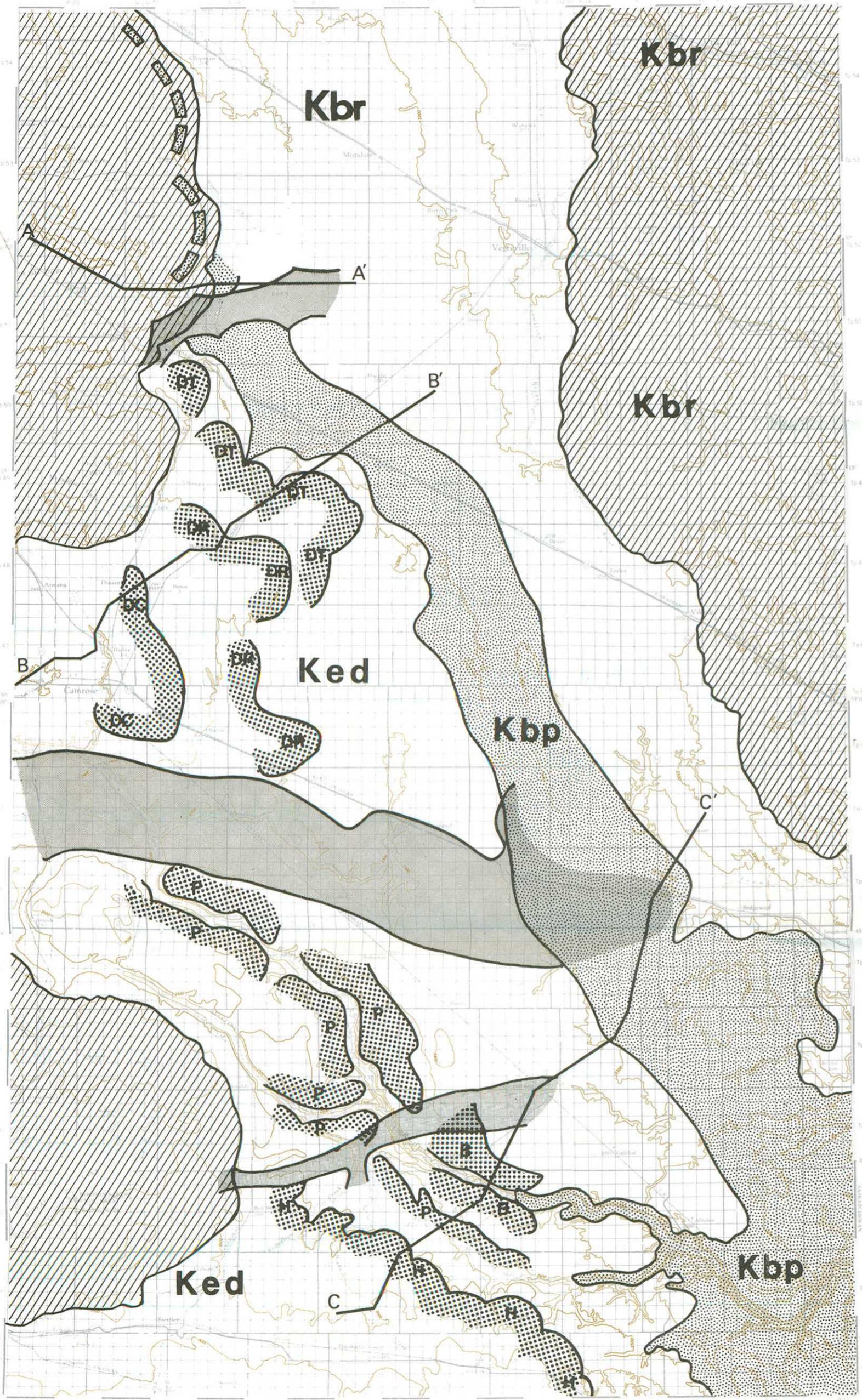
Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 32-52-13 2185; September 13, 1971	120-125	Grey bentonitic shale
0-15	Brown clay; many large pebbles; few boulders	125-130	Bluish grey siltstone
15-48	Grey sandy clay; many large pebbles; many boulders	130-155	Grey bentonitic silty shale
48-70	Grey silty shale (el. bedrock 2137)	155-195	Bluish grey siltstone
70-75	Grey silty shale; little brown and brown grey carbonaceous shale; trace coal		NE cor. 19-52-18 2230; June 12, 1971
75-90	Grey siltstone	0-20	Fine unconsolidated sand
90-95	Brown grey carbonaceous shale; trace coal	20-40	Grey clay
95-120	Grey siltstone; few thin hard ledges light brown siltstone	40-45	Grey clay with one fine gravel stringer
120-135	Grey silty shale; some grey coarse siltstone	45-55	Grey clay
135-190	Grey medium to coarse siltstone	55-75	Disturbed bedrock (bluish grey siltstone)
190-195	Brownish grey slightly carbonaceous shale; trace coal	75-85	Fine gravel
	NE cor. 10-52-14 2185; September 13, 1971	85-95	Grey shale (el. bedrock 2145)
0-10	Brown clay	95-115	Grey sandstone
10-15	Brown weathered sandstone (el. bedrock 2175)	115-150	Grey siltstone; some green and brown grey siltstone
15-40	Light grey very coarse sandstone; some grey siltstone		Lsd. 5-27-52-18 2210; June 12, 1971
40-90	Grey silty shale	0-15	Brown clay; few small pebbles
90-100	Grey silty shale; trace coal	15-72	Grey sandy clay; few small pebbles; few sandy stringers
100-150	Grey silty shale	72-95	Grey fine siltstone; some grey sandstone (el. bedrock 2138)
150-165	Grey fine sandstone	95-110	Grey shale
165-195	Grey silty shale; little grey siltstone	110-120	Light grey fine sandstone
	NE cor. 23-52-14 2175; September 13, 1971	120-135	Grey shale and siltstone
0-15	Brown silty clay; few pebbles	135-160	Grey fine argillaceous sandstone
15-25	Brown weathered shale (el. bedrock 2160)	160-165	Grey very coarse sandstone
25-75	Grey fine to medium argillaceous sandstone	165-175	Grey silty shale
75-120	Grey fine to very coarse siltstone	175-185	Some grey sandstone; some grey, brown and light green shale; few coal fragments
	NE cor. 34-52-18 2210; September 16, 1971	185-195	Grey shale and some grey siltstone
			NE cor. 34-52-18 2210; September 16, 1971
		0-15	Brown clay; very few pebbles
		15-20	Grey sandstone (el. bedrock 2195)

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
20-30	Green grey shale		NE cor. 33-53-12
30-40	Grey coarse sandstone		2170; September 14, 1971
40-45	Green grey shale		
45-95	Grey sandstone	0-15	Brown sandy clay; many pebbles and boulders
95-105	Green grey siltstone		
105-115	Grey fine argillaceous sandstone	15-45	Grey sandy clay; many boulders
115-120	Grey coarse sandstone	45-60	Bluish grey hard sandstone (el. bedrock 2105)
120-130	Grey sandstone		
130-165	Blue grey shale	60-70	Lost circulation; no samples
165-170	Light grey argillaceous fine sandstone	70-90	Bluish grey coarse siltstone
170-195	Grey silty shale	90-140	Lost circulation; no samples; abandoned at 140 feet
	NE cor. 12-52-19 2293; June 12, 1971		NE cor. 9-53-13 2092; September 14, 1971
0-5	Brown clay	0-15	Light brown silty clay; many boulders
5-20	Brown grey and grey shale (el. bedrock 2288)	15-49	Grey sandy clay; very many boulders
20-30	Dark grey and brown carbonaceous shale; trace coal	49-160	Grey silty shale; little grey siltstone (el. bedrock 2043)
30-110	Grey siltstone and shale	160-170	Grey silty shale; trace coal
110-115	Light grey very bentonitic shale	170-195	Grey shale and grey siltstone
115-125	Grey silty shale		
125-135	Green grey shale; trace brown carbonaceous shale		NE cor. 11-53-13 2125; September 14, 1971
135-150	Brown and brown grey silty shale; hard ledge chocolate brown siltstone at 144 feet	0-20	Brown medium to coarse sand
	NE cor. 31-53-12 2120; September 14, 1971	20-25	Brown weathered shale (el. bedrock 2125)
0-5	Brown fine sand	25-35	Bluish grey siltstone
5-25	Brown very sandy clay; many boulders	35-100	Grey silty shale; some grey siltstone
25-75	Grey very sandy clay; many boulders	100-110	Grey fine argillaceous sandstone
75-110	Grey silty shale (el. bedrock 2045)	110-188	Grey silty shale; some grey siltstone
110-155	Grey medium to coarse siltstone	188-190	Light grey fine hard sandstone
155-160	Grey siltstone; trace coal		NE cor. 24-53-13 2177; September 14, 1971
160-190	Grey medium to coarse siltstone	0-20	Light brown soft clay; few pebbles
190-195	Light grey argillaceous fine sandstone	20-80	Grey clay; few pebbles
		80-90	Grey sandy clay; thin gravel seam

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
90-120	Grey fine to medium siltstone (el. bedrock 2087)		NE cor. 7-53-17 2220; September 16, 1971
120-125	Light grey sandstone; lost circulation	0-10	Brown silty clay
125-195	Grey medium to coarse siltstone	10-15	Grey silty shale (el. bedrock 2210)
	NE cor. 31-53-16 2240; September 17, 1971	15-25	Grey slightly argillaceous sandstone
0-25	Brown and grey clay; few pebbles and boulders	25-45	Grey bentonitic shale
25-55	Grey silty slightly bentonitic shale (el. bedrock 2215)	45-50	Grey fine sandstone
55-65	Grey fine sandstone	50-100	Greenish grey very bentonitic shale
65-115	Grey shale to grey fine siltstone	100-135	Grey bentonitic sandstone and siltstone
115-131	Grey slightly argillaceous sandstone; few hard ledges	135-145	Brown carbonaceous shale
131-155	Grey silty bentonitic shale; few thin ledges	145-150	Grey sandstone
155-195	Grey slightly bentonitic siltstone; some grey bentonitic shale; few thin harder ledges	150-165	Grey siltstone; some very hard ledges
	NE cor. 33-53-16 2211; September 18, 1971	165-170	Light grey fine sandstone
		170-175	Light grey very bentonitic shale
		175-180	Brownish grey carbonaceous shale
		180-195	Bluish grey slightly bentonitic siltstone; hard ledge; lost circulation at 188 feet
0-15	Brown fine sand; little brown clay		NE cor. 9-53-17 2260; September 16, 1971
15-51	Grey very soft sandy clay	0-10	Sandy brown clay; pebbles
51-57	Grey bentonitic shale (el. bedrock 2160)	10-15	Fine gravel; some brown clay
57-66	Light grey coarse sandstone; hard ledge	15-28	Grey silty clay; many pebbles
66-80	Bluish grey slightly bentonitic shale	28-50	Grey bentonitic shale; thin ledge brown siltstone (el. bedrock 2232)
80-90	Grey siltstone	50-60	Blue grey coarse siltstone
90-105	Grey very bentonitic shale	60-90	Grey medium to very coarse sandstone
105-135	Grey argillaceous medium to very coarse sandstone	90-100	Grey shale
135-140	Grey bentonitic shale; trace chocolate brown carbonaceous shale	100-112	Grey argillaceous fine sandstone
140-155	Grey very bentonitic soft shale	112-150	Grey very bentonitic shale and siltstone
155-180	Grey slightly bentonitic siltstone	150-160	Grey slightly bentonitic siltstone
180-195	Grey bentonitic silty shale	160-195	Grey bentonitic silty shale; hard ledge

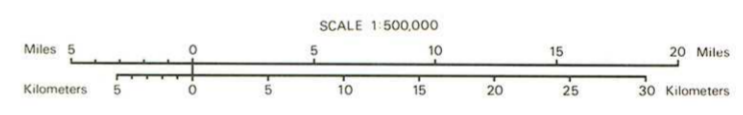
Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
	NE cor. 22-53-17 2248; September 17, 1971	67-95	Grey silty slightly bentonitic shale
0-17	Brown and grey clay	95-140	Grey slightly bentonitic fine to medium sandstone
17-45	Grey silty shale and siltstone (el. bedrock 2231)	140-170	Grey fine very argillaceous sandstone
45-57	Grey fine to medium sandstone	170-195	Grey bentonitic shale
57-70	Light grey very bentonitic shale		Lsd. 7-2-53-21 2420; October 5, 1971
70-85	Grey bentonitic shale	0-20	Brown silty clay; few small pebbles
85-115	Grey sandstone and siltstone	20-25	Grey fairly hard and brittle shale (el. bedrock 2400)
115-175	Grey slightly argillaceous sandstone; few ledges very hard sandstone	25-28	Dark grey to black carbonaceous shale
175-195	Grey silty slightly bentonitic shale	28-35	Brown and dark grey carbonaceous shale; some creamy white bentonite; two thin coal seams
	NE cor. 24-53-17 2245; September 17, 1971	35-65	Grey siltstone
0-4	Brown clay	65-76	Grey fine argillaceous sandstone
4-15	Brownish grey weathered sandstone (el. bedrock 2241)	76-100	Grey very silty shale
15-30	Grey bentonitic shale	100-120	Grey fine very argillaceous sandstone
30-55	Grey fine soft sandstone; grey siltstone	120-135	Grey very bentonitic shale
55-80	Grey fine to coarse argillaceous and slightly bentonitic sandstone	135-140	Chocolate brown carbonaceous shale; thin coal seam
80-90	Grey silty bentonitic shale	140-160	Brownish grey bentonitic shale (marine)
90-100	Light grey fine sandstone	160-180	Light grey fine sandstone
100-120	Light grey fine sandstone; some very hard ledges	180-200	Grey silty bentonitic shale
120-140	Light grey fine to medium sandstone; few harder ledges	100-220	Brownish grey bentonitic shale
140-180	Grey bentonitic siltstone	220-225	Brown grey slightly carbonaceous shale (continental)
180-195	Grey very argillaceous sandstone	225-300	Grey silty shale
	NE cor. 11-53-18 2206; September 16, 1971	300-310	Chocolate brown and black carbonaceous shale; trace coal
0-15	Brown sandy clay; few pebbles	310-320	Grey bentonitic shale
15-20	Light grey sandstone (el. bedrock 2191)	320-335	Grey fine siltstone
20-55	Grey silty shale; hard ledge	335-340	Grey siltstone
55-67	Grey slightly argillaceous sandstone; hard ledges	340-350	Grey slightly bentonitic shale
		350-365	Slightly darker grey bentonitic shale
		365-380	Grey fine siltstone; some hard thin ledges
		380-500	Samples rather poor; mostly grey silty slightly bentonitic shale; some grey fine siltstone

Depth (feet)	Location W 4th Mer Top elevation (feet); Date	Depth (feet)	Location W 4th Mer Top elevation (feet); Date
500-620	Grey bentonitic shale; many hard siltstone and sandstone ledges; poor samples	70-85	Brown weathered siltstone (el. bedrock 2117)
620-660	Very poor samples; some slightly harder sandstone; some shale and siltstone	85-90	Bluish grey fine sandstone
660-700	Grey shale; some grey sandstone	90-110	Grey silty shale; grey siltstone
		110-130	Grey to light grey sandstone; lost circulation
		130-150	Blue grey siltstone; lost circulation; abandoned at 150 feet
	NE cor. 19-54-11 2000; September 15, 1971		NE cor. 10-54-16 2190; September 17, 1971
0-15	Brown sand and boulders; too many boulders; abandoned at 15 feet	0-9	Brown grey clay; few small pebbles
	NE cor. 32-54-11 2175; September 15, 1971	9-40	Grey bentonitic silty shale (el. bedrock 2181)
0-5	Brown sand and very fine gravel; some boulders	40-70	Grey fine to medium sandstone
5-50	Light brown and grey sandy clay; many boulders and pebbles	70-85	Grey bentonitic shale
50-95	Grey slightly bentonitic silty shale (el. bedrock 2125)	85-100	Grey coarse to medium sandstone
95-110	Grey fine to medium siltstone	100-110	Grey very bentonitic shale; little black and brown carbonaceous shale; trace coal
110-145	Bluish grey coarse siltstone	110-120	Grey siltstone
145-155	Grey silty shale	120-125	Brownish grey carbonaceous shale
155-195	Bluish grey coarse to medium siltstone	125-135	Grey argillaceous sandstone
	NE cor. 10-54-12 2173; September 15, 1971	135-165	Grey very bentonitic shale; few thin harder ledges
0-20	Brown silty clay	165-195	Grey slightly bentonitic siltstone
20-95	Grey silty to sandy clay; many small pebbles		NE cor. 21-54-16 2192; September 17, 1971
95-105	Grey sandy clay; few thin gravel stringers	0-5	Brown sand
105-113	Grey sandy clay	5-20	Grey clay; many boulders
113-120	Grey silty shale (el. bedrock 2060)	20-30	Grey very sandy clay; boulders
120-140	Grey coarse siltstone	30-40	Sand; little sandy clay; fine gravel seam
140-195	Grey silty shale and siltstone	40-55	Grey sandy clay
		55-90	Grey bentonitic shale and siltstone (el. bedrock 2137)
	NE cor. 12-54-12 2187; September 15, 1971	90-100	Grey fine siltstone
0-70	Brown and brown grey sandy clay; many pebbles	100-120	Grey very bentonitic shale
		120-133	Bluish grey slightly argillaceous sandstone; lost circulation; abandoned at 133 feet



LEGEND

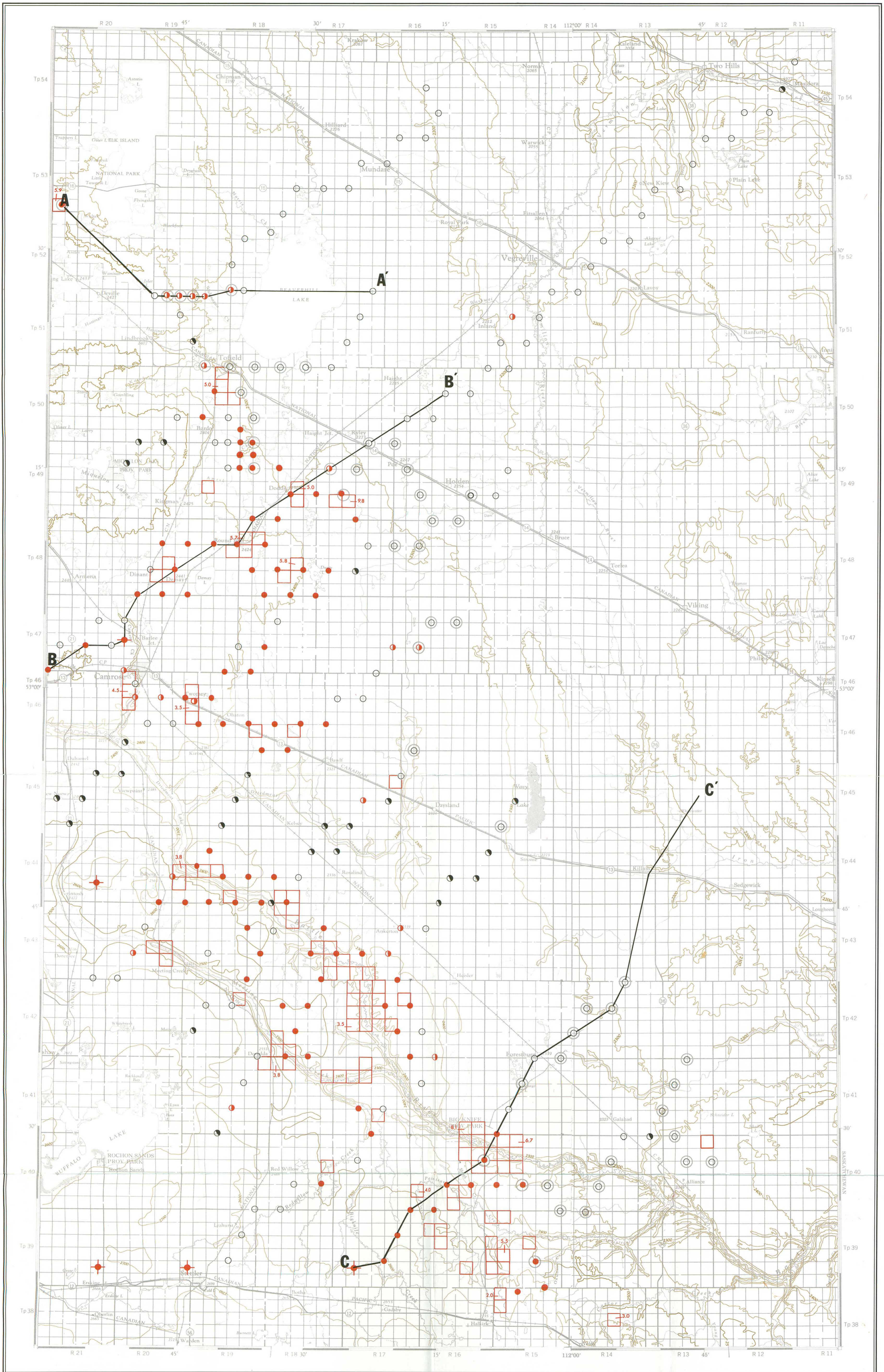
- Edmonton Formation **Ked**
- Bearpaw Formation: approximate; assumed **Kbp**
- Belly River Formation **Kbr**
- Coal seam or coal zone outcrop, subcrop (B - Battle River; DC - Dinant-Camrose; DR - Dusty Lake-Round Hill; DT - Dodds-Tofield; H - Halkirk; P - Paintearth): approximate, assumed
- Moraine uplands
- Preglacial valley
- Line of section **C**



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Figure 2. Geology of Study Area



LEGEND

- ARC coal testhole intersecting coal > 2 ft. thick ●
- ARC coal testhole intersecting coal trace ○●
- ARC coal testhole penetrating bedrock, no coal ○
- ARC coal testhole intersecting Bearpaw Formation ○
- ARC coal testhole intersecting drift only ●
- Oil or gas well intersecting coal ●
- Survey section with registered coal mine (to 1963) with depth of mined coal in feet .. □^{6.1}
- Lines of section A—A'
- Topographic contour (interval 200 feet) 2250

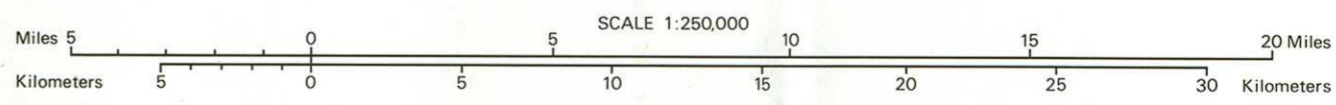
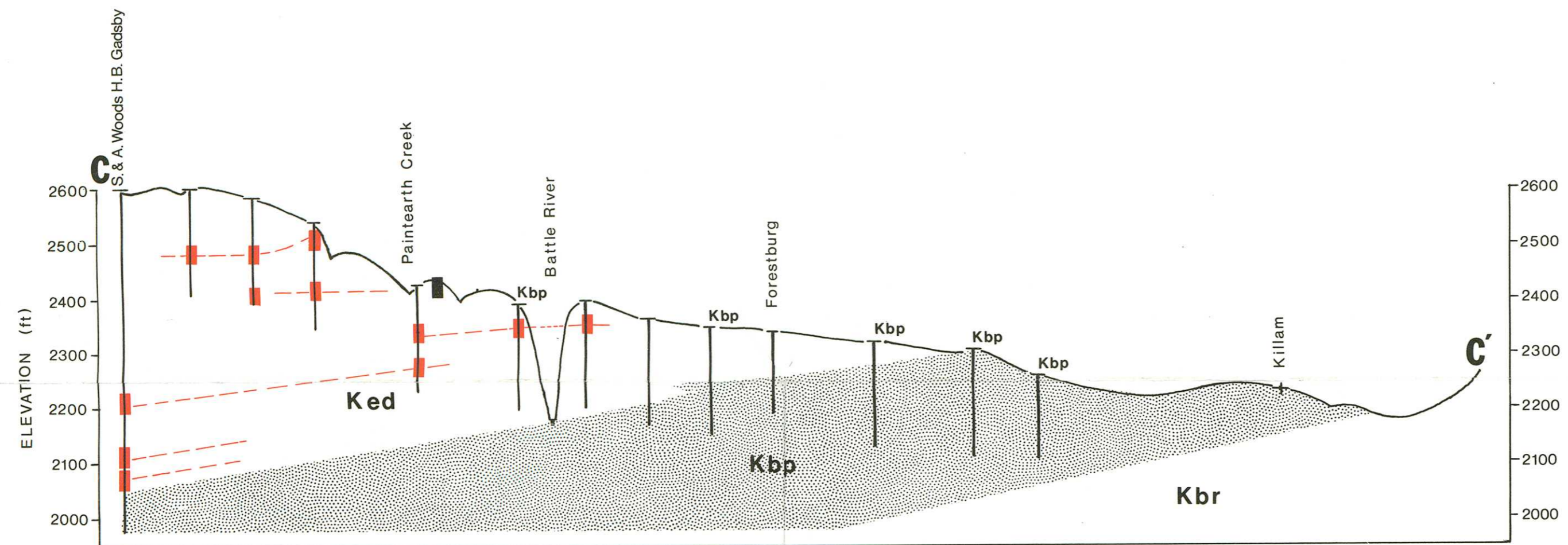
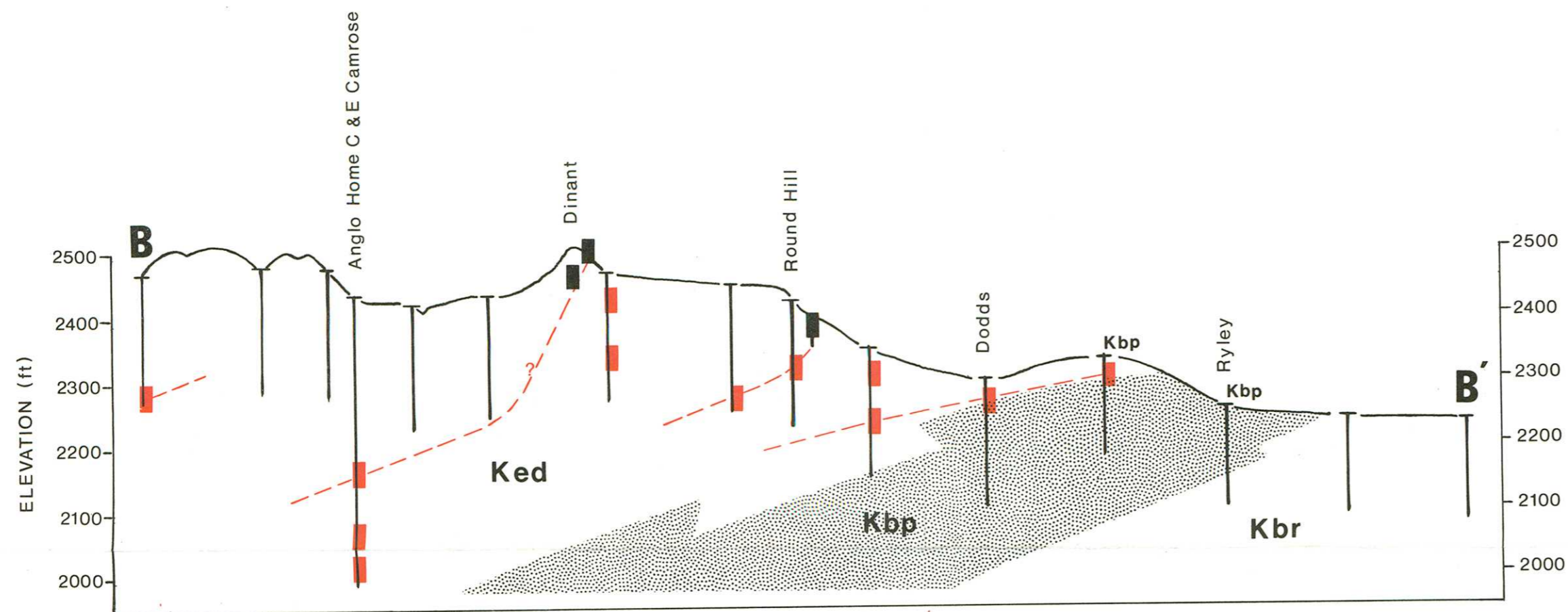
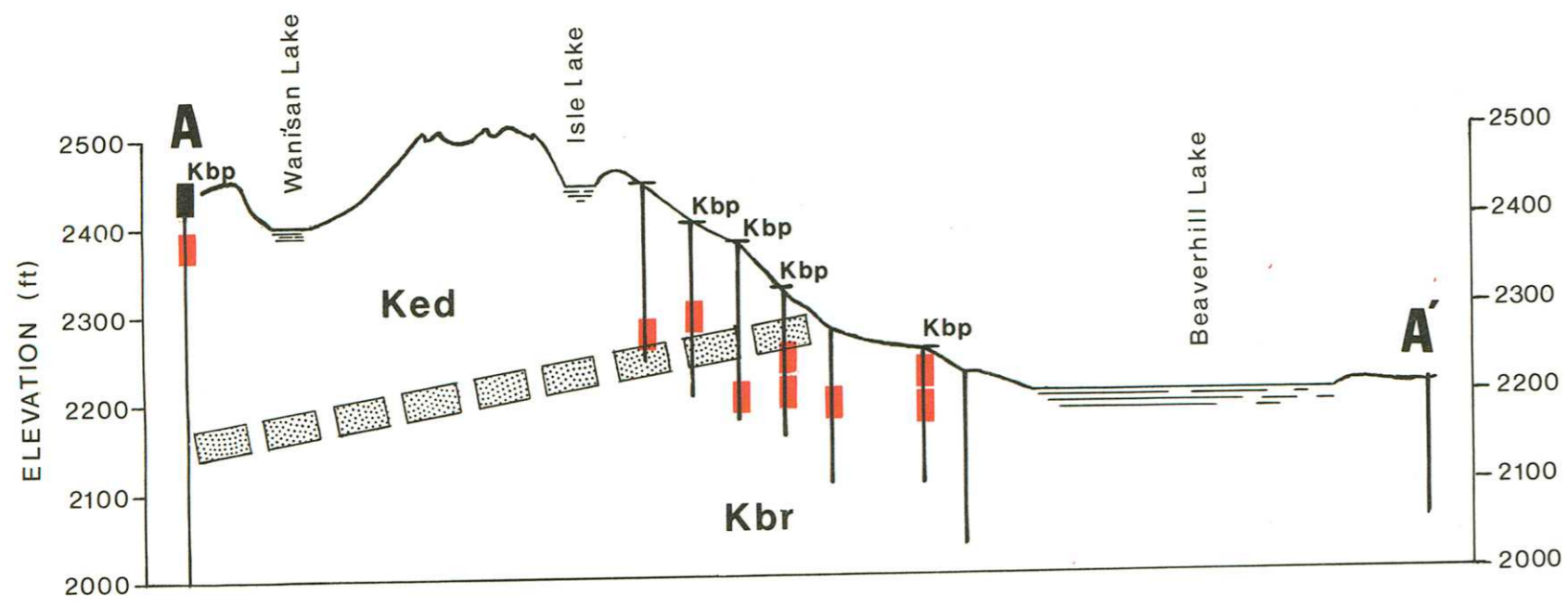


FIGURE 3A. COAL OCCURRENCES, TOFIELD-DONALDA AREA

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- LEGEND
- Bearpaw Formation: approximate; assumed; observed in testhole..... **Kbp** kbp
 - Borehole coal intersection.....
 - Mine coal intersection.....
 - Belly River Formation..... **Kbr**
 - Edmonton Formation..... **Ked**



FIGURE 3B. COAL OCCURRENCES, TOFIELD-DONALDA AREA (SECTIONS)

To accompany Alberta Research Council Report 75-8 by J. D. Campbell

Table 3. Proximate Analyses of Mined Coals, Tofield-Donalda Area¹

Location (W. 4th Mer)			AFCM Basis				CM Basis
Sec	Tp	R	H ₂ O	VM	FC	G. BTU	A
Central Battle River Field							
8	39	15	28.0	30.7	41.2	9030	11.2
17	39	15	29.1	30.8	40.1	8720	13.3
32	39	15	29.0	31.5	39.5	8920	9.9
28	39	16	27.0	31.4	41.6	8840	5.3
19	40	15	25.9	30.0	44.1	9410	7.9
20	40	15	27.5	31.4	41.1	9120	4.1
32	40	15	27.8	31.4	40.8	9260	6.7
32	40	15	27.2	32.8	40.0	9210	8.3
32	40	15	26.2	32.8	40.9	9420	7.4
25	40	16	27.4	31.1	41.6	9140	5.7
25	40	16	27.3	31.4	41.4	9360	5.0
26	40	16	28.1	31.1	40.8	9200	7.1
36	40	16	27.1	31.6	41.3	9230	5.6
2	41	16	28.0	31.2	40.8	9140	5.4
Heisler-Donalda Field							
28	41	17	26.8	30.7	42.6	9330	7.7
29	41	17	26.4	30.5	43.1	9310	6.0
16	42	17	26.4	31.1	42.5	9360	8.0
21	42	17	27.2	31.1	41.7	9230	8.0
22	42	17	27.6	29.9	42.5	9300	7.7
22	42	17	26.2	33.4	40.3	9440	12.0
27	42	17	28.1	30.3	42.7	9260	7.7
28	42	17	27.8	30.1	42.1	9150	5.5
29	42	17	26.4	31.1	42.5	9080	5.9
33	42	17	26.7	31.0	42.3	9360	8.3
7	43	17	27.3	31.1	41.6	9420	4.6
8	43	17	26.7	30.9	42.4	9570 ²	4.1 ²
2	44	19	28.5	30.1	41.4	9030	8.4
Camrose Field							
20	46	19	27.5	30.2	42.3	9310	4.9
-	46	20	26.6	30.8	42.6	9580 ²	5.2 ²
Dusty Lake-Round Hill Field							
14	48	18	30.3	29.2	40.5	8710	3.9
14	48	18	24.8	33.8	41.4	8620	8.2
14	48	18	24.2	34.4	41.4	8940	3.1
14	48	18	25.1	33.4	41.5	8790	-
30	48	18	29.4	29.4	41.1	8850	4.9
Dinant Field							
7	48	19	29.8	30.0	40.2	8670	4.0
18	48	19	28.0	31.4	40.6	8960	12.4
Dodds-Tofield Field							
8	49	17	31.1	29.5	39.3	8680	5.9
9	49	17	32.7	29.3	38.1	8430	6.0
11	49	18	31.7	28.2	40.1	8690	7.8
14	49	18	31.0	29.6	39.4	8680	7.4
26	50	19	29.1	30.0	40.9	9040	6.4
West Elk Island Park Mine							
2	53	21	30.9	32.3	36.8	8450	8.1

Abbreviations: A - ash percentage; AFCM - ash-free capacity moisture basis; CM - capacity moisture only basis; FC - fixed carbon percentage; G. BTU - gross calorific value in BTU/lb; H₂O - capacity moisture percentage; VM - volatile matter percentage.

¹All samples processed in Alberta Research Council analytical laboratory.

²Apparent rank: The noted samples are assumed to be Subbituminous B; all others are assumed to be Subbituminous C.

Strictly speaking, the boundary between Subbituminous B coals and Subbituminous C coals, according to American Society for Testing and Materials (ASTM) classification, is set at 9500 G. BTU per pound on a "Parr basis" (moist, mineral-matter-free, sulphur-corrected).