MAP NO.	**ASSESSMENT REPORT**	**DOCUMENT NO.:**	092032
	PROSPECTUS X	**MINING DISTRICT:**	WHITEHORSE
	CONFIDENTIAL X	**TYPE OF WORK:**	GEOLOGICAL, ROTARY DRILLING
115 I 1	**OPEN FILE**	I.S.N. 134681	

REPORT FILED UNDER: Cyprus Anvil Mining Corporation

DATE PERFORMED: 1977 **DATE FILED:** April 1978

LOCATION: **LAT.:** 62°05'N **AREA:** Carmacks

LONG.: 136°15'W **VALUE $:**

CLAIM NAME & NO.: COAL LEASES 2950-2983

WORK DONE BY: Roderic P. Hill

WORK DONE FOR: Cyprus Anvil Mining Corporation

DATE TO GOOD STANDING		REMARKS:	
			#1 SOUTH TANTALUS
			#2 TANTALUS MINE
			#3 TANTALUS BUTTE

REPORT ON 1977 RECONNAISSANCE OF YUKON COAL OCCURRENCES

By:

Roderic P. Hill

CYPRUS ANVIL MINING CORPORATION

April 1978

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REPORT ON 1977 RECONNAISSANCE OF YUKON COAL OCCURRENCES

1. INTRODUCTION

Coal Measures occur at four distinct horizons within the Yukon Territory. These are:

1. Upper part of the Laberge Group of Lower to Middle Jurassic age in the Whitehorse Trough.
2. Tantalus Formation of Uppermost Jurassic and Lowermost Cretaceous Age in the Whitehorse Trough.
3. Lower Cretaceous to Palaeocene Bonnet Plume Formation and equivalent rocks in the Northern and Central Yukon.
4. Eocene or younger deposits in intermontane basins, now preserved as pockets at the base of Plateau Basalt sequences.

The principal coal areas are shown on Figure 1.

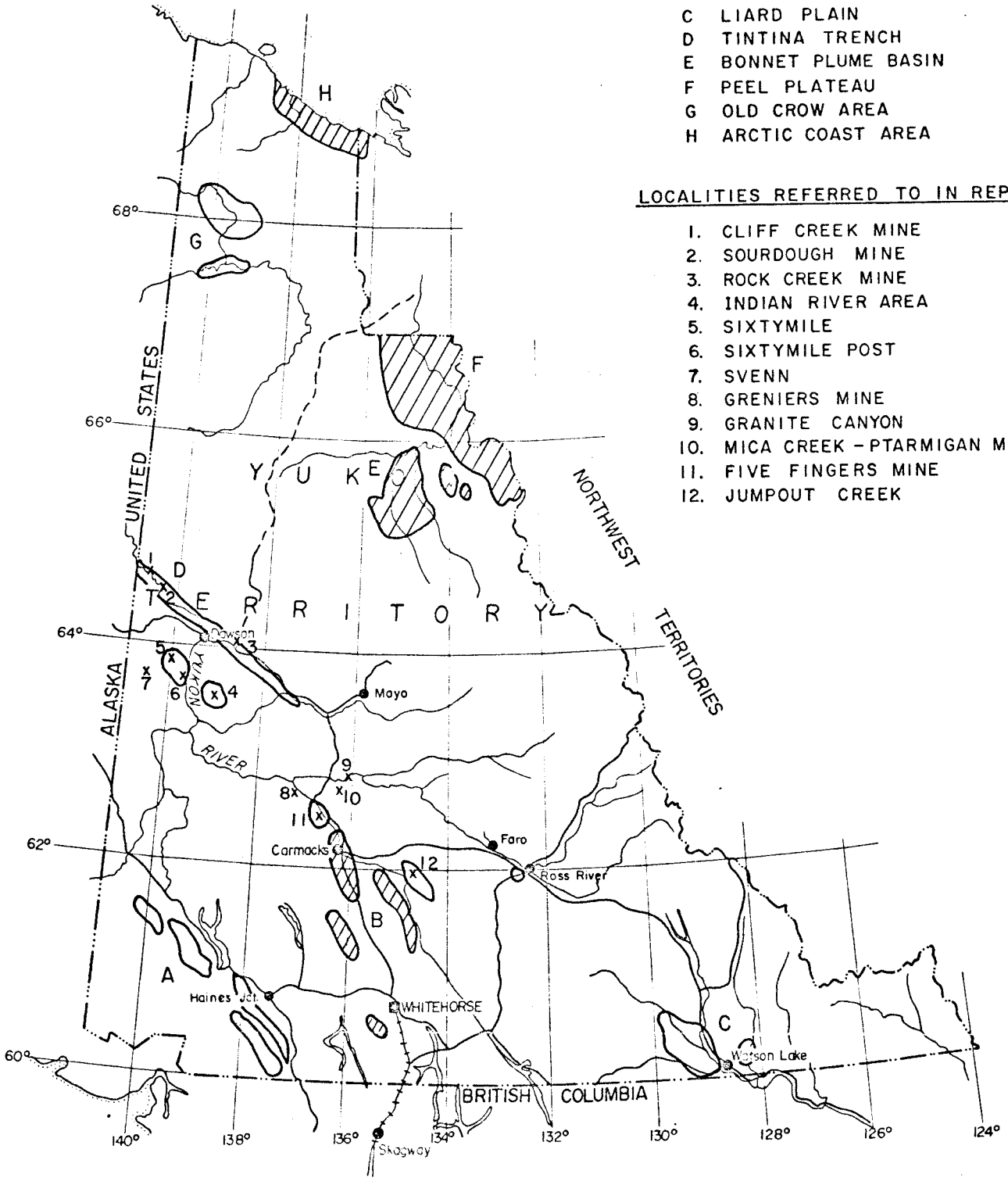
During the summer of 1977, three weeks were spent in reconnaissance of many reported coal occurrences. Local helicopters were used for much of the work, although some locations near roads were examined by vehicle. This report describes the Tertiary deposits visited in the central Yukon.

COAL AREAS

- A SAINT ELIAS BELT
- B WHITEHORSE TROUGH BELT
- C LIARD PLAIN
- D TINTINA TRENCH
- E BONNET PLUME BASIN
- F PEEL PLATEAU
- G OLD CROW AREA
- H ARCTIC COAST AREA

LOCALITIES REFERRED TO IN REPORT

1. CLIFF CREEK MINE
2. SOURDOUGH MINE
3. ROCK CREEK MINE
4. INDIAN RIVER AREA
5. SIXTYMILE
6. SIXTYMILE POST
7. SVENN
8. GRENIERS MINE
9. GRANITE CANYON
10. MICA CREEK - PTARMIGAN MTN. AREA
11. FIVE FINGERS MINE
12. JUMPOUT CREEK



AREAS CONTAINING MESOZOIC COAL MEASURES

" " TERTIARY " "

CYPRUS ANVIL MINING CORPORATION

YUKON COAL PROJECT

FIGURE 1. YUKON COAL AREAS

PROPERTY LOCATION MAP

YUKON

SCALE - 1" = 100 MILES

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2. TERTIARY COAL DEPOSITS IN TINTINA TRENCH

2.1 INTRODUCTION

Tertiary beds, consisting of poorly-consolidated conglomerates, sandstones and shales containing coal seams, occur within Tintina Trench in the Dawson area (see Figure 1). They form a sedimentary basin up to 10 miles wide and at least 200 miles long. The Yukon portion of this basin probably extends for at least 120 miles, to as far south as McQuesten River (Bostock, 1950), and the Alaska portion for at least 80 miles (Mertie, 1937; pp 172-180).

The trench in this area is at a low elevation, has subdued topography, locally is floored by Pleistocene and recent sands and gravels, and is blanketed by heavy moss and stunted spruce, typical of permafrost regions. As a result, there are very few exposures; most are in the cutbanks of creeks crossing the trench, and it is often difficult to distinquish between the poorly-consolidated Tertiary sediments and overlying unconsolidated material (Green, 1972).

During and after the Klondike Gold Rush, large amounts of fuel were needed for domestic heating, for thawing frozen ground and for riverboats. Wood soon became scarce in the area, and attempts were made to utilize the coal deposits found in the Trench. At least three mines were established in the Dawson area, and numerous other localities were staked and prospected. An attempt was made to revitalize one of the mines during the Second World War. At least

two mines were also operated at various times in the Alaska portion of the basin.

Most early reports refer to this coal as "lignite", however it is likely that most is subbituminous coal according to contemporary terminology.

2.2 DESCRIPTIONS OF OCCURRENCES

(a) Cliff Creek Mine

Location:

N.T.S. 116-C/9; Approximately 64°33'N, 140°25'W. Located on Cliff Creek, about 1-3/4 miles from the Yukon River.

History:

Staked in September 1895 by W. F. Cornellin as coal lease 215. North American Trading and Transportation Company Ltd. began development about 1899; they drove two adits and a number of exploratory drifts and raises over a total lateral interval of 2,800 feet. A narrow-gauge railway was built to transport the coal to the Yukon River; it is reported that "a considerable quantity" was shipped to Dawson, and some had been tried on river steamers with satisfactory results. Work had ceased by 1903. In 1968, the coal rights were held by North American Trading and Transportation (lots 13, 16 and 22) and by J. H. Watson (lots 17 and 18). In January 1968, Selwyn Exploration Ltd. took out Coal Exploration Licence #1 (116-B/9, SW¼), but they are

believed to have been chiefly concerned with Precambrian iron formations in the area and did no work on the coal.

Description:

In 1896, Wm. Ogilvie described a seam 5.3 feet thick. Later McConnell (1901) described the workings. The upper tunnel, on the left bank of the creek, had been driven mostly in lignite for 800 feet, with a seam at least 40 feet thick (including partings) in which individual lignite lenses varied from a few inches to 5 feet thick. The beds were found to dip 50 to 75° to the south, and had locally been faulted. The lower working, on the right bank, followed two seams; the upper was 9 feet thick and the lower 3 feet thick, separated by 24 feet of clays and shales, and dips were gentle. McConnell gave the following analyses:

	Upper Working	Lower Working
Moisture	8.57%	10.58%
Ash	3.62	2.58
Volatiles	42.04	40.10
Fixed Carbon	45.77	46.74

Milner and Craig (1973) noted that little remained. A lower portal was found and a seam at least 6 feet thick dipping 35° north was recognised; the upper workings had sluffed in.

This study:

The writer visited the location in 1977. No suitable landing place for the helicopter could be found nearby

because of thick brush in the valley bottom. From the air, no trace of railway, buildings, workings, coal or any rock outcrop could be seen anywhere along the creek. Outcrop was found in cliffs along the north bank of the Yukon River at the mouth of Cliff Creek, and it appeared to comprise a thick sequence of poorly-consolidated sandstones and conglomerates with dips of up to 45°.

References:

McConnell (1901, 1906)
Milner and Craig (1973)
Archer and Cathro (1972)

(b) Sourdough (Coal Creek) Mine

Location:

N.T.S. 116-C/8; Approximately 64°28'N, 140°07'W. Located on south fork of Coal Creek, about 11 miles east of, and 960 feet above, the Yukon River.

History:

Wm. Ogilvie found coal float at the mouth of the creek in 1887; in 1895 he found a coal outcrop which, in March 1896, he staked as coal lease 245 on behalf of North American Trading and Transportation Company Ltd. Development work, which included two adits and a narrow-gauge railway 11-3/4 miles long to the Yukon River, was carried out by Coal Creek Mining Company Ltd. from 1903. Initially all production was shipped by barge to Dawson or used in riverboats. In 1906, the property was sold

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to Sourdough Coal Company Ltd. A thermal generating plant and a transmission line to Dawson were built in 1907, and the operation supplied electricity for a short time to the City, and to the power dredges in the Klondike, until development of hydroelectric power on Little Twelve Mile River and (a couple of years later) on Klondike River. Production is reported as 22,000 tons in 1906, 10,000 tons in 1907 and 5,000 tons in 1908. The mine and power plant were in operation intermittently until about 1913 (at which time they were owned by Northern Light, Power and Coal Company Ltd.). The property was later held as ten Crown-granted lots by B. Levielle.

Description:

Collier (1903) described three showings; the most easterly consisted of a 100 foot-long adit. A quarter mile to the west, a decline had been driven at 33° dip to 240° azimuth into a seam consisting of 6" coal, 2' clay and 4'6" coal on the south bank of the creek. Another half mile to the west, an outcrop on the north bank exposed 14 feet of coal. McConnell (1906) reported that in 1903 the main working consisted of an incline 490 feet long driven in at the base of a cliff. The seam worked was 4 to 11 feet thick, dipping 45° to the southeast for the first 210 feet, then bending round to dip gently southwest.

This study:

When visited in 1977, the rights-of-way for both railway and transmission line, and the foundations and remains of several buildings, were clearly visible from the air. An old, solidly-built concrete structure, presumably the old power-house, proved an excellent helicopter pad. A number of old steam boilers were lying around, and one collapsed adit was located. Much coaly material was present in waste dumps and in the soil downstream. Coal was mostly banded, was dull black with some bright bands, and contained resin globules (samples somewhat resembled coal from the Tulameen basin in southern B.C.). Very thick brush covers the valley bottom, and outcrops are scarce. One outcrop in the creek near the buildings consisted of poorly consolidated sandstone and pebble conglomerates which had slumped. Several hundred feet downstream, other small outcrops of unconsolidated sands and shales were found along the north bank.

References:

Collier, A. J. (1903)
McConnell, R. G. (1906)
Green, L. H. (1972)
Archer and Cathro (1972)

(c) Rock Creek Mine

Location:

N.T.S. 116-B/2; Approximately 64°08'N, 138°55'W.

Located on Coal Creek, a tributary of Rock Creek,

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about 8 miles upstream from the Klondike River.

History:

Staked as coal lease 209 in August 1898 by M. J. Gates. Development was commenced about 1899 by Alaska Exploration Company Ltd. In 1900, the working consisted of a 400-foot decline, descending at 25° to the southeast for the first 200 feet, beyond which the angle gradually reduced to about 4°. At 225 feet from the mouth a short drift to the northeast was driven following the seam. Some coal was shipped to Dawson, but the mine had closed by 1903. In 1937, the mine was reactivated by J. D. Simpson and associates; part of the entry was dug out and retimbered and some development work undertaken. The property was idle in 1938, but was worked during late 1939 and 1940 by D. W. Ballentine, who sold a few tons in Dawson.

Description:

According to McConnell (1901), lignite outcrops occurred in the face of a low, rounded hill, part of which had been cut away by the stream, but he noted the absence of outcrops nearby. He considered that the hill was due to "recent uplift", as the dips of the strata approximately followed its slopes. Two seams were present in the decline and drift - an upper 3-foot seam and a lower seam 2 to 3 feet thick, separated by 1 foot of clay, dipping 3 to 10° to the northeast. The lignite was locally disrupted by

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faulting. McConnell provided two analyses:

	Upper Seam	Lower Seam
Moisture	18.31%	19.37%
Ash	5.85	9.33
Volatiles	34.96	33.85
Fixed Carbon	40.88	37.45

When the mine re-opened in 1937 Bostock obtained the following analyses:

Upper Seam

Sample No.	18,595	18,597
Moisture	31.1	30.5
Ash	13.1	12.5
Volatiles	25.4	26.0
Fixed Carbon	30.4	31.0

Lower Seam

Sample No.	18,596	18,598	18,599	18,600
Moisture	29.3	33.6	25.1	30.7
Ash	11.4	10.2	9.6	9.6
Volatiles	28.1	25.8	28.8	28.1
Fixed Carbon	31.2	30.4	36.5	31.6
Sulphur	0.5	0.5	0.6	0.5
B.T.U./lb. (raw)	7,430	7,220	8,150	7,540

This study:

The location was easy to find since several wooden buildings, a steam boiler and the remains of mine equipment were found nearby. Apart from the low, rounded hill described by McConnell, the creek valley is rather flat and covered with thick brush, and no outcrops were seen. Some burnt red shale and coaly material in the soil was found.

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References:

McConnell (1901, 1906)
Bostock (1937, 1941)
Green (1972)
Archer and Cathro (1972)

(d) Chandindu River

Location:

N.T.S. 116-B/5; Approximately 64°17'N, 138°31'W. Located on Chandindu (formerly Twelve Mile) River, near the mouth of Alder Creek.

History:

Float was discovered in Twelve Mile River, prior to 1896. A six-foot seam was found in 1896, and coal lots 26 and 27 were staked in March, 1900. No further details are available.

This study:

The writer was unable to locate the occurrence; no outcrop was seen in the vicinity.

References:

McConnell (1900)
Archer and Cathro (1972)

(e) Other Occurrences

Several other occurrences, most of them presumably coal float in creeks, have been reported on Fifteen Mile River, Ballarat Creek, Shell Creek and Thane Creek (Archer and Cathro, 1972). The writer made

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a brief helicopter reconnaissance along each of these creeks, but outcrops were very scarce, and no coal was seen at any of the locations.

2.3 CONCLUSIONS

Not enough information is available to assess the mining potential of the coal deposits in Tintina Trench. It is certain that the reserves are very large; the Yukon part of the basin is at least 1,000 square miles in area, and many coal occurrences have been reported over a distance of at least 80 miles along the Trench. In purely hypothetical terms, a six-foot seam which underlies half of an area 80 miles long and ten miles wide represents approximately 2.5 billion short tons of coal in place. More realistically, the Royal Commission on Coal "..... estimated 112 million tons of probable and possible lignite for one-tenth of its conservatively estimated area" (Bostock, 1953).

The structural geology of the Tintina Trench is not well known in this area; elsewhere transcurrent displacement of more than a hundred miles on the main Tintina Fault and vertical displacements on other faults in the system have been reported. The Tertiary deposits cover the floor of a fault-bounded valley and, although precise thicknesses have never been determined, available geological reports and maps suggest the thickness above the level of the Yukon River locally exceeds 900 feet.

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It is also known that the deposits are locally disrupted by recent movement along faults in the Tintina system. Therefore the potential exists for the development of thick, graben-filling deposits similar to those developed in the Hat Creek Valley in south-central British Columbia. To the writer's knowledge, this potential has never seriously been explored.

Available data indicate a good-quality, low-sulphur subbituminous coal with less than 15% ash. This coal would be ideal for on-site thermal electricity generation. A characteristic of Tertiary coals in the Circum-Pacific region is their very high (>90%) vitrinite contents, which makes these coals very suitable for conversion to liquid or gaseous fuels.

The development prospects of these deposits may be summarised in the following list of advantages and disadvantages:

Advantages

1. Relatively accessible area - previous mining activity (placer, coal, asbestos) has resulted in some good roads and a network of trails.

2. Large reserves, hence long mine life.

3. Good quality, low-sulphur coal.

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4. Close to Yukon River for cheap summer barge transportation - either to power/conversion plant, or even to tidewater for export.

5. Abundant supply of water and close to established power network, should preparation facilities be required.

6. Closure of the Clinton Creek asbestos mine in 1978 will have strong adverse economic and social impact on local communities, hence proposals for alternative industrial development would likely receive support at both Government and local levels.

7. A new power plant will be required in the Yukon within the next decade; if thermal generation using this coal proved to be the best alternative, substantial government financial assistance for development would probably be forthcoming.

Disadvantages

1. Tremendous acquisition and maintenance costs of such a large area, either as Coal Exploration Licences or as Coal Mining Leases, without some prior exploration to delineate the most attractive areas.

2. Lack of information - exploration programmes in such a large area would be very expensive.

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3. Local steep dips of coal seams and structural complications resulting from faulting would render mining rather difficult and relatively expensive.

2.4 RECOMMENDATIONS

The potential for a "Hat Creek type" deposit, however remote, should be tested without delay. The pronounced negative gravity anomaly over the Hat Creek Valley is well known, and a similar anomaly would be expected if a similar thickened sequence were present in Tintina Trench. Tests undertaken at Carmacks in 1977 showed no gravity response over seams up to 30 feet thick, but it should be possible for a geophysical consultant to construct a model defining the minimum thickness of coal which could be detected by a gravity survey. If such a survey were conducted at (say) three localities 20 miles apart, with two lines 10 miles long and 1 mile apart across the trench at each locality, the presence or absence of very thick coal sequences could be confirmed. Such a survey would have to be conducted in winter since lines would cross the Yukon River, and would cost of the order of $60,000, but the presence of negative gravity anomalies would define good drill targets.

An alternative approach would be "wildcat" drilling at one or more of the known coal occurrences.

The presence of thick deposits of Hat Creek type would certainly mean the development within the next couple of decades of a major energy project. Even without such

thickening, the known coal reserves are very large, and are sufficiently interesting to warrant further investigation.

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3. TERTIARY DEPOSITS AT THE BASE OF THE CARMACKS GROUP

3.1 INTRODUCTION

Throughout the Central Yukon Plateau many small deposits or poorly-consolidated conglomerates, sandstones and volcaniclastics are found immediately below, or intercalated within the basal layers of, the Carmacks Volcanics and equivalents of Eocene or younger age (Tempelman-Kluit, 1974a). In earlier literature, these sediments are referred to as the "Kenai Series". The remnants of these sediments are the fragmentary record of what may have been a widespread, discontinuous blanket or a series of channel deposits. They are believed to have been formed by rapid erosion caused by sudden uplift of the Yukon Plateau. This rejuvenation took place immediately before extrusion of the Carmacks Volcanics. Unlike the earlier Mount Nansen Volcanics, which were erupted from local explosive centres onto a peneplane surface, the Carmacks Group was laid down upon an irregular topography in which the present Yukon River valley and some of its tributaries had already been formed. They are of tholeiitic affinity and include mafic and felsic lavas, tuffs and breccias.

In many places the sediments are several hundred feet thick, and most are known or suspected to contain coal or carbonaceous material (see Figure 1). Several deposits which have previously been included in the upper part of the Laberge Group or in the Tantalus Formation are now known to be Tertiary.

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3.2 DESCRIPTION OF OCCURRENCES

(a) Haystack Mine - Indian River Area

Location:

N.T.S. 115-O/11; Approximately 63°40'N, 139°07'W.

History:

Coal was reported at three localities in this area; on Indian River opposite the mouth of Quartz Creek, along McKinnon Creek, and on Ruby Creek. Coal lease 1212 was staked on McKinnon Creek by Stephen Cord in 1900; he drove a short adit which had caved by the time of McConnell's visit in 1903. The area was re-staked as coal lease 9466 in September, 1903 by D. McKinnon, who held it at least until 1908.

Description:

One large and several small areas (total area at least 50 square miles) of Tertiary sediments, partly overlain by Carmacks Volcanics. When the Haystack Mine was visited by MacLean in 1912, a 7-foot seam dipping 10° to the north was exposed in an open cut. According to Bostock, over 500 feet of conglomerates with intercalations of sandstone and carbonaceous shale are exposed along McKinnon Creek, with dips up to 35°.

This study:

The area was examined by helicopter reconnaissance. Haystack Mountain consists of rocks resembling

Carmacks Group volcanics seen elsewhere. No outcrops of sediments below the volcanics were seen owing to their highly recessive nature, and no trace of coal was seen anywhere in this area. McKinnon Creek is a very small creek which threads across a flat, broad valley, and no outcrops were seen along it.

References:

McConnell (1901, 1904)
MacLean (1914)
Bostock (1942)
Archer & Cathro (1972)

(b) Sixtymile

Location:

N.T.S. 116-C/2; Approximately 64°02'N, 140°,45'W. Located at the junction of Little Gold and Big Gold Creeks, close to the abandoned settlement of Sixtymile.

History and Description:

Several occurrences of coal float and of coal in place in Tertiary sediments were reported during placer mining or road construction during the early 1900's. No other information is available.

This study:

No outcrops nor any trace of coal were found by the writer at this location.

Reference:

Cockfield (1921)

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(c) Sixtymile Post

Location:

N.T.S. 115-O/12; Approximately 63°34'N, 139°,45'W. Located at the "first rock bluff" on the west side of the Yukon River upstream from Sixtymile River, close to the abandoned settlement of Sixtymile Post.

History and Description:

Staked as coal exploration licence 28159 in July, 1912 by L. C. Cruikshank. No other information available.

This study:

No outcrops of Tertiary beds nor any trace of coal were found by the writer.

Reference:

Archer & Cathro (1972).

(d) Svenn

Location:

N.T.S. 115-N/9; Approximately 63°32'N, 140°25'W.

History and Description:

Pebbles of lignite were reported in gravels on Matson Creek by placer miners. The location is shown on Tempelman-Kluit's map (1974a, Figure 17) as a mineral property without reference, and no other information is available.

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This study:

No outcrops of sediments nor any trace of coal were found anywhere in the area. At the supposed location nothing but muscovite schist float was found. It is possible that a small occurrence of Tertiary beds is present, but a coal-bearing glacial erratic is more likely.

References:

Archer & Cathro (1972)
Tempelman-Kluit (1974a)

(e) Grenier's Mine

Location:

N.T.S. 115-I-11; Approximately 62°44'N, 137°19'W. Located on the west bank of Yukon River, 5 miles above Fort Selkirk.

History:

Staked as coal lease 26391 in April 1910 by G. Minchin and lease 27418 in December 1911 by G. Grenier, who explored the occurrence with a 30-foot shaft and a short adit. The coal was reported by Cairnes in a 1913 Canadian Government Guidebook to be bituminous coal of good quality.

Description:

Bostock examined the location in 1933 and described a shaft 20 to 30 feet deep, filled with water, and a collapsed adit at the water's edge. Dumps containing

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lumps of coaly shale or dirty coal occurred nearby. A nearby outcrop of conglomerate contained plant fragments which were not identified. Bostock correlated these rocks with the upper part of the Laberge Group, and noted that they probably extended some distance beneath the overlying Selkirk Volcanics (Quaternary). Milner and Craig reported no sign of the occurrence in 1973.

This study:

Carmacks helicopter pilot George Mackay reported that he has taken several parties of geologists to examine this occurrence and none has found any trace, and the writer fared no better. The location as described is close to river level beneath a cliff of columnar basalt. Any coal is almost certainly Eocene or younger, possibly as young as Quaternary. The occurrence is analagous to the Granite Canyon occurrence (q.v.).

References:

Bostock (1936)
Archer and Cathro (1972)
Milner and Craig (1973)

(f) Granite Canyon

Location:

N.T.S. 115-I/16; Approximately 62°49'N, 136°10'W.

History and Description:

McConnell reported a thin seam of "carbonaceous shale or impure lignite" in Granite Canyon, associated with

andesites he believed to be Cretaceous in age. On Tempelman-Kluit's revised map of the Carmacks district the occurrence is shown as a small pocket of Tertiary sediments beneath Carmacks Volcanics.

This study:

The writer found the walls of the Canyon near the supposed location consisted of columnar basalts, which are more likely equivalent to the Selkirk Volcanics and Miles Canyon Volcanics of Quaternary age. Therefore, any coal beneath or associated with these volcanics is probably Eocene or younger, and the occurrence appears to be analagous to that at Grenier's mine (q.v.).

References:

McConnell (1903)
Tempelman-Kluit (1974b)

(g) Mica Creek - Ptarmigan Mountain Area

Location:

N.T.S. 115-I/9; Approximately 62°45'N, 136°25'W

History and Description:

McConnell reported that a shaft sunk by placer miners on an easterly branch of Mica Creek, about 8 miles from Pelly River, passed through several thin seams of lignite, and that drift lignite had been found in Mica Creek. He suggested that lignite-bearing beds underlie the surrounding area, although none was

exposed. Bostock reported finding remains of buildings and fragments of black carbonaceous shales, a fossilized tree-trunk and some coal float along Ptarmigan Creek, a branch of Mica Creek. He considered that the coal was from erratics of Laberge Series rocks in glacial drift, since the surrounding area was underlain by Yukon Group shists. Another occurrence on Ptarmigan Creek was reported by Mr. G. Simms of Pelly Crossing (personal communication, 1977). He described how, while fighting a fire, a bulldozer became bogged down and the tracks churned up lumps of lignite.

This study:

The writer spent some time in aerial reconnaissance of the area, but was unable to locate any of these occurrences. No outcrop and no trace of coal could be seen. Any coal in the area is likely to be either from glacial erratics, or from a pocket of Carmacks Group sediments, or possibly from even younger rocks by analogy with Granite Canyon and Grenier's Mine occurrences (q.v.).

References:

McConnell (1903)
Bostock (1936)

(h) Five Fingers Mine

Location:

N.T.S. 115-I/1; Approximately 62°12'N, 136°20'W.

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Situated on the east side of the Yukon River 8 miles north of Carmacks, about 5½ miles upstream from Five Fingers Rapids.

History:

Coal was first reported by G. M. Dawson in 1887. Lease 214 was staked in March 1898 by W. T. Edmonds. The area was re-staked as leases 256 and 258 in November 1899 by J. Cameron and C. E. Miller who, by 1904, had mined several hundred tons from close to surface. George J. Miller of Pittsburgh, Pa., acquired the property in 1905 and formed Five Fingers Coal Company, which unsuccessfully attempted diamond drilling. Their first decline was dangerously situated on a steep clay and sand bank beside the river, and after several slides a second decline was started some distance to the north on safer ground. By 1907, only a few hundred tons had been mined, and the workings were abandoned in 1908 in favour of the Tantalus Mine. In 1947, the assets of Five Fingers Coal Company were acquired by Yukon Coal Company, a subsidiary of Territorial Supply Company of Whitehorse (which was jointly owned by Cassiar Asbestos Corporation and United Keno Hills Mines and managed by the latter). These assets were in turn acquired by Anvil Mining Corporation Ltd. in 1969, although the bill of sale was not completed until January 11, 1972. Some exploratory work was done in 1970 by Norman Ursel and Associates, who blasted open the earlier workings. In

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1971, Teslin Exploration Ltd. acquired the surrounding area as exploration licence #16. They did geological mapping and drilled one hole in 1971 and, in 1973, staked coal lease 2964. This lease was optioned by Cyprus Anvil in 1976 along with Teslin's other leases in the Carmacks area.

Description:

Cairnes (1908) described the earlier working of Five Fingers Coal Company as a slope extending about 350 feet with rooms off it, the seam in the lower rooms being 3.5 to 4 feet wide. The newer working, when visited in 1906, was started in a seam higher in the measures, dipping 16° to the east, and was down to about 525 feet. At the bottom, the seam was 2 feet wide and apparently getting wider, and gave the following analysis:

Moisture	4.26%
Ash	10.81
Volatiles	40.26
Fixed Carbon	44.67

In 1907, a 26-foot winze was sunk 450 feet down the newer slope to a seam 4.5 feet thick, apparently the seam mined in the earlier working, and the slope was extended to 783 feet. Two samples were analysed, one from the bottom of the slope (A) and one from the bottom of the 26-foot winze (B), as follows:

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Sample	A	B
Moisture	5.95	5.29
Ash	8.43	18.45
Volatiles	40.46	36.14
Fixed Carbon	45.16	40.12

Cairnes mapped the area as Laberge Group, noting that there is almost continuous exposure of Laberge conglomerates along the right bank of the river from just north of Tantalus Butte to Five Finger Rapids. Bostock re-mapped the area, and quoted Cairnes' descriptions of the workings in his memoir. He noted that 1,500 feet above the Laberge conglomerates at Five Finger Rapids the rocks change from "light-coloured types" to darker coloured materials derived from basic and intermediate rocks, particularly basic volcanics, including tuffaceous greywackes and fine-grained andesitic and acid tuffs and sills of dioritic composition. He considered that the rocks in the vicinity of the mine were from this horizon because they contained volcanic material, and that the horizon was about 500 feet thick. Birch (1943) remarked that the old workings were below river level and were filled with water. Milner and Craig visited the property in 1972, and found several seams and timbers exposed 30 feet above river level, the result of blasting by Normal Ursel and Assoc. The company report of 1970 described the seam at three places measuring between 3 and 4 feet in thickness with partings. In 1971, Teslin Explorations' drill hole

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was collared about 200 feet above river level, approximately 4,000 feet south of the old workings; the hole penetrated "strongly fractured sandstone" from 118 to 188 feet and was abandoned in bad ground. After visiting the area, Tempelman-Kluit suggested the occurrence was Tertiary in age and lies within a pocket of sediments and volcaniclastics at the base of the Carmacks Group (personal communication, 1977).

This study:

The property was visited by the writer and Dr. J. G. Simpson in 1977. The remains of what may be the later workings were found by the riverbank. An outcrop of thin coal, shale and sandstone was found at water level. The cliffs above the mine are poorly exposed, but appear to consist of unconsolidated sands and gravels, which resemble Tertiary sediments seen elsewhere in the Yukon. A sample of the coal was sent to Robertson Research (North America) Ltd. for a petrographic analysis, the results of which are outlined below:

Vitrinite	83%
Exinite	2
Resinite	5
Fusinite	trace
Semifusinite	4
Micrinite	3
Mineral Matter	3
$\overline{R}_o$max	0.51

On a mineral-matter-free basis Vitrinite+Exinite is 93%. The very high vitrinite content, which is characteristic

of Uppermost Cretaceous (Senonian) and Tertiary coals of the circum-Pacific region , and the low vitrinite reflectivity, indicating low rank, confirm the age of this occurrence as Tertiary. For comparison, Laberge coal from Carmacks South contains 50 to 70% vitrinite and has mean maximum vitrinite reflectance of the order of 1.20%.

References:

Cairnes (1907, 1908, 1910)
Bostock (1936)
Birch (1943)
Archer and Cathro (1972)
Milner and Craig (1973)
Tempelman-Kluit (1974b)

(i) Jumpout Creek

Location:

N.T.S. 105-E/15; Approximately 62°00'N, 134°45'W.

History and Description:

Bostock and Lees reported sporadic outcrops of Tantalus Formation in the middle of a large area of glacial and recent deposits. According to them, sandstones and conglomerates were well-exposed along the second tributary up Walsh Creek (now called Jumpout Creek), with fragments of shale and coal locally and abundant coal float in gravels along Walsh Creek and Big Salmon River. Atlas Explorations Ltd. staked Coal Exploration Licences #6, 7 and 8 over this area in April 1970, and J. F. George spent 2½ months mapping the area. He described tuffaceous conglomerates,

sandstones and volcaniclastic rocks containing carbonaceous plant remains along Jumpout Creek and south of Walsh Creek, and noted that these beds were overlain by light-coloured volcanic flows (Carmacks Group). George also noted that a different lithology was present on the southern end of the ridge between Walsh and Illusion Creeks - a "conglomerate of light grey chert pebbles in a cherty cemented sandstone matrix, interbedded with sandstone, was overlain by white cherty siltstone". Kerr Addison Mines Ltd. obtained an exploration licence over the area in 1977, and mapped the area.

This study:

The deposits along Walsh and Jumpout Creeks are very poorly exposed, but where seen near the head of Jumpout Creek they consist of partially frozen, poorly consolidated material which flows on thawing. This material consists of light grey mudstone containing much carbonaceous plant material and coaly partings, and pebbles and cobbles of volcanic breccia and agglomerate. "Hoodoo"-like landforms are present, formed in thickly-bedded, poorly-consolidated conglomerate containing rounded igneous rock pebbles and cobbles, rounded tuffaceous and volcanic pebbles and angular mudstone clasts. Fragments are up to 6" in diameter and are embedded in a tuffaceous clay matrix. These sediments resemble Tertiary sediments seen elsewhere in the Yukon. A sample of coaly material was sent to Robertson

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Research for petrographic analysis, and the results are summarized below:

Vitrinite	59%
Exinite	1
Resinite	6
Fusinite	1
Semifusinite	3
Micrinite	1
Mineral Matter	29
$\overline{R}_o$max	0.48

Recalculated on a mineral-matter-free basis, the Vitrinite+Exinite content is 93%. These date confirm the Tertiary age of these rocks, and the setting is analagous to the Five Fingers deposit and other deposits at the base of the Carmacks Group. The "different lithology" described by George between Walsh and Illusion Creeks was not investigated by the writer, but is evidently Tantalus Formation.

References:

Bostock and Lees (1938)
George (1970)

3.3 CONCLUSIONS

Not enough information is available to assess the mining potential of the coal deposits at the base of the Carmacks Group. These areas are invariably very poorly exposed, and known coal seams tend to be thin and discontinuous.

The geological setting and age of these deposits is indentical to the Tulameen coalfield of southern B.C. Therefore, the potential exists for deposits of similar thickness and lateral extent within some of the restricted Tertiary basins

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described in the preceeding paragraphs. In particular, the Indian River basin seems attractive since a seven-foot seam has been mined there, and the basin is relatively large. At many of the other known deposits, exposure is so limited that the presence of thick coal seams cannot be ruled out, and there may be additional areas completely covered by volcanics or more recent deposits which have yet to be discovered. While at the present none of these deposits appear to host large tonnages of coal, further exploratory work may prove otherwise.

3.4 RECOMMENDATIONS

Three of the deposits outlined above appear sufficiently attractive to warrant limited exploration work. These are: Indian River Area, Mica Creek Area and Jumpout Creek Area. All the others are either too small to be of interest or else present adverse mining situations. Neither geological mapping nor geophysics is likely to provide much additional information in these areas, and so selective trenching and/or diamond drilling on a "wildcat" basis, based upon what limited outcrop information there is, is suggested.

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REPORT ON 1977 FIELD PROGRAMME

CARMACKS COAL PROJECT

Whitehorse Mining District

Yukon Territory

N.T.S. 115-I-1

Latitude: 62°05'N
Longitude: 136°15'W

By:

Roderic P. Hill

Cyprus Anvil Mining Corporation

April, 1978

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PART A

CARMACKS NORTH

1. INTRODUCTION AND SUMMARY

Exploration activity on Carmacks North in 1977 was confined to those areas with previous indication of coal reserves down-dip from the present underground working and in the area around the small open pit. The objectives of the 1977 programme were to outline sources of coal for the short-term supply to the Anvil Mine.

Forty-two rotary drill-holes, ranging in depth from 83 feet to 628 feet, were drilled. Three of these were sited in the mine yard to test the feasibility of opening a second, lower adit. The remaining holes were drilled around the open pit to test the geological interpretation and outline reserves. Rotary cuttings of coal intersections in selected holes were sampled for analysis. Geophysical logs were obtained for 33 of the holes and for part of 1976 diamond drill-hole C-76-11. Lithological descriptions, based upon cuttings logs and/or geophysical logs, depending upon availability, were compiled.

A programme of experimental geophysics was carried out in the Carmacks area during the summer of 1977. The objective was to assess the usefulness of various geophysical methods in prospecting for coal in areas of thick overburden. On Carmacks North, these tests were carried out on three east-west lines 100 feet apart, perpendicular to strike, across the open pit area. Of the methods employed, only side-looking dipole-dipole resistivity appeared to show promise as a method for detecting coal seams.

New aerial photographs of the Carmacks properties were obtained, and all necessary control surveys for tying the area to the Territorial Plane Coordinate System and Geodetic datum were undertaken. Coal Mining Lease and

Lot cornerposts were located and targetted, and a map showing actual locations of all the leases was prepared. A new topographic map of the open pit area, at a scale of 1 inch to 100 feet, was obtained and, using this map, a new geological compilation of the open pit area was prepared.

Since the structure of the area to the east of the open pit is not fully understood, further exploratory drilling will be required before any coal can be mined here. South of the open pit, reserves of approximately 40,000 raw short tons of coal are present in the syncline at a stripping ratio of 2.5:1.

Continued trenching and drilling is recommended.

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2. AGE OF TANTALUS FORMATION

Fossil plant specimens collected from core from Hole C-76-5 during 1976 were sent to Professor Wilson N. Stewart, Department of Botany, University of Alberta for identification. It was hoped that these specimens might provide a more precise age determination for the Tantalus Formation.

Professor Stewart identified the following specimens:

At 540-foot depth: *Cladophlebis* sp. (poorly preserved)

At 871-foot depth: *Cladophlebis* c.f. *angustifolia*
Cladophlebis virginiensis
Equisetites (nodal region)
Phoenicopsis angustifolia
Phyllites sp.
Pityophyllum nordenskioldii

With the exception of *Equisetites*, all have previously been reported from the Tantalus Formation. Unfortunately all are wide-ranging Mesozoic species. Professor Stewart's judgement is that these rocks probably span the Jurassic-Cretaceous boundary. Hence they are approximately time-correlative with the Kootenay Formation of southern B.C. and Alberta.

3. SPRING ROTARY DRILLING PROGRAMME

3.1 Mine Yard Area

During April, three rotary holes totalling 859 feet were drilled in the mine yard. The purpose of these holes was to investigate the feasibility of starting a new adit at a lower level, in order to recover reserves down-dip from the present main entry level (see Hampton, 1977). The three holes were intended to locate accurately No. 3 Seam ("Main seam") at depth and to determine thickness of overburden. Locations of these holes are shown on Figure 1. The first two holes (C-77-1 and 2) were drilled with tricone rock-bits (rotary drilling), using mud in overburden and air in bedrock. This process proved extremely slow and very destructive on bits. The third (C-77-15) was drilled with tricone using mud in overburden, and with down-hole hammer (rotary-percussion drilling) in bedrock. The latter process proved much faster and more efficient. All-inclusive average cost for the three holes was $23.29 per foot.

The first hole bottomed at 242 feet, still in overburden. The second penetrated 127 feet of overburden; a black coaly mudstone horizon which was initially taken to be No. 3 Seam was intersected from 282 to 287 feet, and the hole was terminated at 300 feet. Subsequently it was suggested that hole no. 2 did not reach No. 3 Seam. This was confirmed by hole C-77-15, which passed through 98 feet of overburden and ten feet of rather dirty coal from 293 to 303 feet, below the coaly mudstone encountered in hole C-77-2.

Results of the drilling indicated that the proposed lower portal would require considerable expense for a long tunnel through gravel

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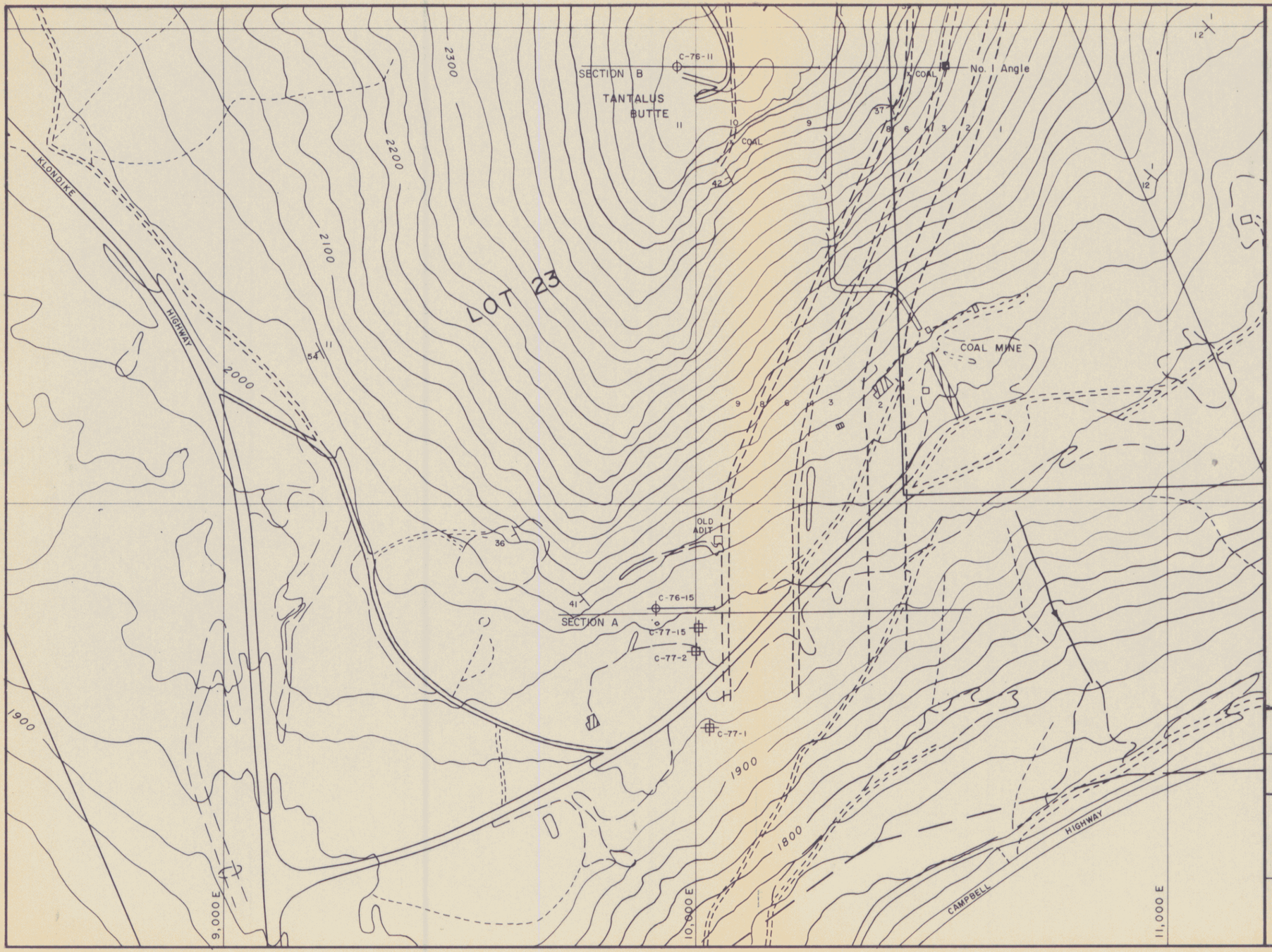

Road ——— Trail = = = = = =

Surface projection of Main Entry

Location of raise or angle

Diamond Drill Hole

Rotary Drill Hole

LOWER CRETACEOUS AND/OR UPPER JURASSIC

TANTALUS FORMATION

11	Conglomerate and pebbly sandstone
10	No. 1 Coal Seam
9	Conglomerate and pebbly sandstone.
8	No. 2 Coal Seam
7	Brown mudstones and siltstones
6	Conglomerate and pebbly sandstone
5	Brown and dark grey siltstones and mudstones
4	No. 3 Coal Seam
3	Thin-bedded, Light grey sandstones and siltstones
2	Dark brown and dark grey mudstones, black carbonaceous mudstones and thin coal seams
1	Conglomerate, pebbly sandstone and coarse grained sandstone

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

TANTALUS BUTTE COAL MINE
CARMACKS, Y. T.
DRILLING IN MINE YARD AREA

DATE: APR 28, 1978
SCALE: 1"= 200'
DRAWN BY: C. L. C.

0 100 200 300 400
SCALE IN FEET

To Accompany Report by R.P. HILL, FEB., 1978
FIGURE 1

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overburden before underground development for extraction of coal could begin. It was considered that these high initial costs would result in coal which would still be lower in price than an equivalent quantity of fuel oil, but substantially more expensive than opencast coal obtained by further development in the open pit area (M. O. Hampton, personal communication, 1977). It was therefore decided that work on a new adit would not commence until the potential of the open pit area was better known.

3.2 Open Pit Area

During April twelve rotary-percussion holes were drilled south of the present open pit, in order to test the writer's hypothesis that No. 3 Seam in the pit occupied a tight syncline extending southwards (Hill, 1977). Aggregate drilled depth was 1,824 feet, at an average all-inclusive cost of $19.37 per foot. Since the rig being used was restricted to vertical holes, and the hypothetical syncline was presumed to be rather tight with steeply-dipping limbs, holes were drilled on 40 to 50 foot spacings on lines 100 to 150 feet apart. Locations of these holes (C-77-3 to C-77-14 inclusive) are shown on Map 1 and the accompanying cross-sections.

In retrospect, several of these holes could have been drilled deeper to eliminate alternative interpretations. However, the results are considered to have confirmed the writer's hypothesis, and established the presence of a tight, asymmetrical syncline. Observations within the pit indicate that the syncline is complicated by steeply-dipping strike faults. The fold plunges about 10^{o} to the south; the coal seam is greatly thickened in the hinge zone and somewhat attenuated in the limbs (see Map 1 and accompanying sections). Rock "lenses"

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were intersected within the thickened portions of the seam, and these may be fault slices or blocks of footwall sandstone emplaced tectonically, or rock partings (e.g. channel fillings) originally present within the seam.

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4. LINECUTTING AND GEOPHYSICS

4.1 Linecutting

In order to facilitate geophysical test procedures on Carmacks North several cut lines perpendicular to strike were required. It had been proposed that the tests should be conducted on three lines one hundred feet apart and four thousand feet long. It was therefore considered desirable to erect a line grid-system which would accommodate these requirements, and which could later be extended to locate lines for any further geophysics or drilling. The original 1971 C.E.M. grid was considered unsuitable because of inconsistent orientation and spacing of the lines.

The new grid was erected by selecting Line 60+00 feet north to fall east-west through drill-holes C-77-5 to C-77-8 inclusive (see Map 1), thus causing Line 0+00 to fall at the extreme southern end of the property. A north-south baseline was located by selecting an arbitrary point of origin (0+00) about 15 feet east of hole C-77-8 on Line 60+00. Line 58, 59 and 60 were chosen for the geophysical tests in order to compare the profiles with the drill-hole data, and were cut from 18+00 feet west to 22+00 feet east.

4.2 Geophysics

The geophysical testing consisted of the following:

(a) Induced Polarisation (Gradient-array Resistivity and Chargeability), on Lines 58 and 60 from 5+00W to 5+00E. No response was apparent over the known coal subcrops on the limbs of the syncline.

(b) Bouguer Gravity, on Line 58 from 5+00W to 5+00E. A slight, constant gravity gradient, apparently unrelated to known bedrock geology, was found over the length of the profile.

(c) Very low frequency (V.L.F.) electromagnetic, using the EM-16 system, on Lines 58 and 60 from 5+00W to 20+00E. There appeared to be no particular response over the known coal seams, but a very pronounced anomaly was encountered at about 17+00E. This anomaly is as yet unexplained, but it does occur in the general vicinity of the expected Laberge/Tantalus contact.

(d) Side-looking dipole-dipole resistivity on Line 59 towards Line 60, from 5+00W to 10+00E. A rather irregular profile was obtained, but the response appeared quite closely linked to known or suspected bedrock geology. Two moderate peaks at 1+70W and 0+50E appeared to coincide approximately with No. 3 Seam subcrops in the west and east limbs of the syncline respectively. A third, larger peak was located slightly to the west (at 3+50W) at approximately the expected position of No. 3 Seam in the west limb of the postulated accompanying anticline (see Hill, 1977; p. 16). Two still larger peaks, at 2+25E and 4+25E, appear to coincide quite closely with thick coal seams which were subsequently discovered by drilling and trenching. These anomalies are shown on Cross-Section 60+00.

Of the various geophysical methods tried, the side-looking resistivity appears to be the only method which might be useful for detecting and tracing coal seams in this area. A more detailed treatment of these results is expected in a separate report by Peter E. Walcott.

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5. SUMMER ROTARY DRILLING PROGRAMME

5.1 Drilling

Drilling in the open pit area was resumed in June, the initial objectives being to trace the syncline further south and to determine whether or not an anticline was present west of the syncline.

During this project, a dust-collector was employed in an attempt to sample rotary cuttings from the coal intersections for analysis, in order to give an approximate determination of coal quality. Sampling and analytical techniques are described in Section 5.2. Since the sampling method proved far from satisfactory, it was decided that geophysical logs should be run also (see Section 5.3).

Five holes, 80 to 200 feet apart, were drilled on two lines 200 feet apart (C-77-16 to 20 inclusive - see Map 1 and Sections 57+00 and 59+00). The presence of the accompanying anticline was apparently confirmed, and the trend length of the syncline south of the pit was extended to about 600 feet. Evidence of seam splitting was found in several of the holes, hence the "rock lenses" encountered in the April drilling may be of sedimentary origin (partings or channel-fillings) rather than tectonic slices or blocks. This indicates that the term "Main Seam", if used at all, must be confined to that thick portion of No. 3 Seam which was mined underground.

After these five holes were completed, it became apparent that the existing interpretation of 1976 diamond drill-hole data on Section D (Hill, 1977) was not correct. A rotary-percussion hole (C-77-21) was drilled on this section, sited to hit the synclinal axis at depth. A revised interpretation of Section D is presented in this report as

Section 54+00.

During July, it was suggested that whilst the drill was on site it would be advantageous to drill several holes in the "undulating plateau" area east and northeast of the open pit. No trenching or drilling had ever been done here, an area without a single outcrop. The rationale for this decision was based on two hypothyses:

1. since the topography of the area was rather subdued, it was more likely to be underlain by recessive rocks such as mudstones and siltstones (and hence, possibly, coal) rather than by Tantalus conglomerates, which invariably produce prominent features;

2. the presence of a tight, faulted fold structure within the pit suggested the possibility of repeated fold and/or fault structures in this area also, and any such structures might yield substantial additional surface-minable reserves.

The first hole (C-77-22, see Map 1 and Section 60+00) intersected four coal horizons from 6 to 31 feet thick between 26 feet and 108 feet depth, and the second hole (C-77-23) intersected 14 feet from 42 feet depth. As a result of this success, it was decided to drill off a large part of the "plateau" on regular spacings. Three lines eight hundred feet apart were chosen, the first being Line 60+00 for purposes of comparison with the geophysical data. Initially, holes were spaced at 200 foot intervals along the lines, but inability to trace lithologies between adjacent holes led to the siting of several intermediate holes, locally reducing the spacing to 100 feet.

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In addition, two holes were drilled north of the pit to test possible continuity of the known synclinal structure. Of 22 holes drilled in this area (C-77-22 to 42 inclusive), 15 intersected appreciable thicknesses of coal. Geological interpretations are discussed in Section 7. As it turned out, the plateau area is underlain largely by Tantalus conglomerates, but with interbedded coal/mudstone horizons.

The Summer drill programme resulted in 27 holes with an aggregate depth of 8,724 feet at an average all-inclusive cost of $15.39 per foot. Aggregate drilled depth in 1977 was 11,406.5 feet at an overall average all-inclusive cost of $16.62 per foot, or slightly more than half the cost of the previous year's diamond drill programme.

5.2 Sampling and Analytical Procedures

(a) Sample Collection

During the summer drilling programme, a standard dust-collector was used in an attempt to sample coal cuttings for analysis. It was hoped that by analysing the cuttings, some approximate coal quality data could be obtained. Such data would be useful for two purposes:

1. determining which areas of coal were suitable and could be economically mined;

2. distinguishing between different seams, hence assisting with stratigraphic correlation.

The method was fairly successful at collecting the cuttings,

since a fairly large sample (10 to 20 lb.) could be collected over a given 5-foot interval. However, there were considerable difficulties encountered which cast doubts on the usefulness of this method as a means of obtaining reliable and representative coal quality data. These difficulties, and attempts made to circumvent them, are outlined below.

1. It proved to be extremely difficult to anchor the collector into the ground around the hole; as a result perhaps 30 to 40% of air and cuttings by-passed the collector altogether and were lost. Welding the collector to a short piece of casing did not help much. This difficulty could probably be overcome if the collector were modified to enable it to be attached to a standard length of casing after the casing is installed in the hole; however, the necessity of installing casing in every hole would likely increase costs substantially.

2. Cuttings were slow in arriving at the surface, particularly when drilling at depth. Thus it was impossible to obtain accurate footages for changes in lithology or for coal intersections. (Geophysical logs later showed that the driller's footage was often in error by as much as three feet.)

3. In deeper holes, it appeared that denser particles remained suspended in the air column longer, and were discharged more slowly, than lighter particles. Hence if collection was begun at the first appearance of coal dust, a great deal of extraneous cuttings were collected along with the coal. In order to get around this problem, the hole was blown out as soon as coal cuttings were observed, and then after each 5-foot

interval of drilling in coal the cuttings could be blown into the collector. This procedure proved reasonably effective, except that the cuttings from the first couple of feet of a coal intersection were lost and hence could not be sampled. This method was, however, particularly time-consuming (especially as a great many coaly intersections were only a few inches or a foot or so thick and no sample could be obtained), and was later abandoned.

4. It proved impossible to collect cuttings from below water table since all that came out of the hole was black slime.

(b) Sample Analysis

In order to get around the problem of extraneous cuttings in the coal samples, coal and rock were separated by float-sinking all samples prior to analysis. On the advice of the analytical laboratory (Cyclone Engineering) a specific gravity of 1.80 was chosen as a suitable cut-off point. Unfortunately this method also resulted in removal from the samples of mudstone partings occurring within the coal seams. Thus ash values obtained cannot be taken as actual values of the coal in situ, and these results are not directly comparable with analyses obtained for 1976 core samples. However, internal correlation among the samples can be undertaken since all samples were treated similarly. The percentage recovery of coal at S.G. 1.80 may be taken as a very approximate guide to local proportions of coal to rock within the seam.

After float-sinking, each sample was split into two parts. Half was analysed separately, and the other half combined into seam composites. Proximate analyses, calorific values (B.T.U./lb.), F.S.I. and sulphur determinations were made on each of 108

individual samples and 25 seam composites. The results are presented in Table 1.

Initial inspection of the analytical data suggested that four samples (C-66, C-81, C-90 and C-106), being from near to surface, were oxidised. Indication was that most of the remainder could be placed in one of three groups:

1. a group with high moisture values (approx. 8 to 11%),
2. a group with high ash values (approx. 17 to 25%),
3. a large group with relatively much lower moisture and ash values.

At face value, this would tend to suggest correlation with Seams 1, 2 and 3 respectively (see Hill, 1977, p. 25). However, difficulties arose when applying this assumed correlation to a geological interpretation; e.g.

1. the seams in some holes appeared to lie in the wrong order, necessitating complex structural interpretations;
2. lack of previous data from No. 4 seam for comparison;
3. a few samples fell outside all three groups, and some could be placed in more than one group.

(c) Processing of Analytical Data

In an attempt to determine more definitively how many distinct seams were represented by the samples, a firm of consultant mathematicians (Tetrad Computer Applications Ltd.) was engaged to investigate statistical methods of handling the analytical data using computers. It was decided that the most appropriate test method would be Cluster Analysis. This method involves

TABLE 1

RESULTS OF ANALYSES - SAMPLES AND COMPOSITES, 1977 ROTARY CUTTINGS

Hole No.	Footage (Driller's)	Sample No.	Composite No.	Moist. %	Ash %	Volatiles %	Fixed Carbon %	Fixed Carbon % (DMMF)	S %	B.T.U. per lb. (raw)	B.T.U. per lb. (MMMF)	% Recovery @ SG 1.8	F.S.I.
C-77-16	209 - 214	C-50	R- 1	4.42	9.45	30.76	55.37	64.95	0.39	12,370	13,787	65.52	2
	215 - 223	C-51	R- 1	4.23	11.51	30.53	53.73	64.53	0.24	12,040	13,756	64.53	2
		Composite	R- 1	4.14	9.92	30.75	55.19	64.91	0.38	12,300	13,787	66.37	2
C-77-16	230 - 236	C-52	R- 2	5.82	8.38	26.66	59.14	69.58	0.40	12,210	13,436	92.64	½
	237 - 243	C-53	R- 2	3.90	12.30	26.39	57.41	69.40	0.26	11,890	13,719	90.89	2
		Composite	R- 2	4.08	10.12	26.78	59.02	69.53	0.30	12,220	13,728	90.90	½
C-77-18	237 - 241	C-54	R- 3	3.78	13.45	32.84	49.93	61.22	0.44	12,100	14,171	65.33	2
C-77-18	263 - 271	C-55	R- 4	3.16	16.73	30.38	49.73	63.24	0.44	11,510	14,063	68.25	½
C-77-19	107 - 112	C-56	R- 5	3.52	5.68	31.74	59.06	65.45	0.32	13,090	13,955	84.46	1½
	112 - 117	C-57	R- 5	3.21	9.06	31.09	56.64	65.15	0.21	12,550	13,917	87.86	½
	117 - 124	C-58	R- 5	3.19	8.42	29.71	58.68	66.95	0.21	12,580	13,845	87.94	½
		Composite	R- 5	3.24	7.02	30.92	58.82	66.01	0.23	12,910	13,976	85.05	1
C-77-20	239 - 244	C-59	R- 6	3.27	7.87	32.62	56.24	63.87	0.54	13,050	14,279	80.09	1
	244 - 250	C-60	R- 6	3.33	9.54	28.24	58.89	68.26	0.28	12,460	13,900	86.40	1½
	250 - 253	C-61	R- 6	4.24	12.91	28.66	54.19	65.31	0.31	11,750	13,663	75.46	½
		Composite	R- 6	3.15	9.29	29.56	58.00	66.92	0.43	12,680	14,107	78.63	1
C-77-20	308 - 310	C-62	R- 7	3.20	9.30	28.69	58.81	67.87	0.33	12,460	13,861	88.93	1½
	310 - 314	C-63	R- 7	3.50	8.49	33.09	54.92	62.94	0.24	12,480	13,747	14.78	1½
	314 - 319	C-64	R- 7	3.99	10.90	30.43	54.68	64.97	0.24	12,240	13,880	85.12	2
	319 - 324	C-65	R- 7	2.88	9.24	28.17	59.71	68.58	0.24	12,280	13,648	84.54	2
		Composite	R- 7	3.00	9.19	31.63	56.18	64.59	0.29	12,420	13,797	84.94	1½
C-77-22	30 - 35	C-66	R- 8	4.78	21.76	32.75	40.71	56.81	0.20	8,810	11,520	68.28	0
	35 - 44	C-67	R- 8	4.40	19.99	29.97	45.64	61.73	0.23	10,320	13,168	66.12	0
	47 - 52	C-68	R- 8	3.40	20.11	30.87	45.62	61.03	0.41	10,820	13,836	51.03	1
	52 - 57	C-69	R- 8	2.93	20.24	28.96	47.87	63.78	0.51	10,870	13,928	60.08	1½
		Composite	R- 8	3.94	20.12	29.84	46.10	62.09	0.26	10,330	13,205	65.93	0
C-77-22	64 - 70	C-70	R- 9	3.21	12.95	29.85	53.99	65.30	0.37	11,940	13,893	50.69	2
	70 - 73	C-71	R- 9	3.41	13.45	31.92	51.22	62.47	0.25	11,830	13,848	69.15	1½
		Composite	R- 9	3.29	13.10	31.73	51.88	62.90	0.28	11,930	13,905	56.12	1½
C-77-22	105 - 110	C-72	R-10	4.31	19.45	29.61	46.63	62.48	0.17	10,610	13,437	60.05	½
C-77-23	44 - 49	C-73	R-11	8.03	4.15	31.77	56.05	64.16	0.40	10,450	10,945	96.56	0
	49 - 54	C-74	R-11	9.01	5.37	34.60	51.02	59.97	0.40	9,800	10,401	98.27	0
	54 - 58	C-75	R-11	11.20	9.00	32.82	46.98	59.47	0.27	9,100	10,081	66.95	0
		Composite	R-11	8.99	5.45	33.33	52.23	61.43	0.32	9,850	10,469	85.79	0
C-77-23	66 - 71	C-76	R-12	10.08	12.30	30.45	47.17	61.66	0.45	9,160	10,567	58.26	0
	71 - 74	C-77	R-12	9.10	17.89	29.31	43.70	60.69	0.53	8,740	10,839	36.43	0
		Composite	R-12	9.34	14.58	29.98	46.10	61.66	0.49	9,090	10,794	45.92	0

TABLE 1 - page 2

Hole No.	Footage (Driller's)	Sample No.	Composite No.	Moist. %	Ash %	Volatiles %	Fixed Carbon %	Fixed Carbon % (DMMF)	S %	B.T.U. per lb. (raw)	B.T.U. per lb. (MMMF)	% Recovery @ SG 1.8	F.S.I.
C-77-27	276 - 281	C-78	R-13	3.54	13.66	28.51	54.29	66.57	0.48	11,850	13,928	60.46	1½
	281 - 286	C-79	R-13	2.88	4.67	31.19	61.26	66.65	0.50	13,490	14,221	87.24	1
	286 - 290	C-80	R-13	2.68	15.81	28.95	52.56	65.61	0.41	12,050	14,546	58.11	½
		Composite	R-13	2.77	9.43	30.48	57.32	65.94	0.38	12,720	14,174	66.07	1
C-77-34	21 - 26	C-81	R-14	9.31	25.29	27.72	37.68	59.54	0.30	7,030	9,673	64.12	0
	26 - 31	C-82	R-14	11.42	17.63	32.00	38.95	56.09	0.34	8,090	9,995	44.95	0
		Composite	R-14	9.64	22.55	29.81	38.00	57.65	0.30	7,620	10,075	56.74	0
C-77-34	33 - 38	C-83	R-15	10.95	22.68	28.46	37.91	58.84	0.43	7,720	10,228	64.76	0
	38 - 43	C-84	R-15	8.97	13.91	30.05	47.07	62.02	0.37	9,400	11,067	69.78	0
	43 - 48	C-85	R-15	9.68	25.56	26.62	38.14	60.90	0.29	7,500	10,363	63.07	0
	48 - 51	C-86	R-15	8.70	10.69	31.68	48.93	61.44	0.36	9,780	11,061	89.86	0
		Composite	R-15	9.04	15.95	30.62	44.39	60.29	0.36	9,060	10,950	67.67	0
C-77-34	71 - 77	C-87	R-16	9.41	16.61	29.55	44.43	61.26	0.40	8,890	10,838	77.76	0
C-77-34	168 - 174	C-88	R-17	3.17	20.99	25.81	50.03	67.57	0.36	10,770	13,940	80.05	½
	174 - 179	C-89	R-17	2.78	19.46	29.50	48.26	63.40	0.28	10,930	13,848	48.23	½
		Composite	R-17	2.86	19.97	27.55	49.62	65.74	0.30	10,870	13,869	62.61	½
C-77-35	46 - 53	C-90	R-18	7.34	20.37	35.79	36.50	51.71	0.29	8,360	10,721	70.63	0
C-77-35	203 - 208	C-91	R-19	7.23	6.08	29.40	58.95	68.53	0.54	11,960	12,812	97.00	½
	208 - 213	C-92	R-19	5.57	4.50	30.47	59.46	66.48	0.39	12,360	13,000	97.16	0
		Composite	R-19	6.03	5.65	28.38	59.94	68.31	0.37	12,170	12,969	97.08	0
C-77-38	189 - 194	C-93	R-20	6.13	13.83	29.32	50.72	64.37	0.42	11,220	13,201	76.59	½
	194 - 196	C-94	R-20	5.79	16.02	29.10	49.19	64.03	0.26	10,250	12,400	71.32	0
		Composite	R-20	5.83	15.02	29.20	49.95	64.16	0.29	10,960	13,090	67.68	0
C-77-39	178 - 183	C-95	R-21	3.55	18.26	32.78	45.41	59.25	0.29	10,800	13,462	73.02	1
C-77-39	266 - 271	C-96	R-22	4.06	13.30	30.62	52.02	63.84	0.27	11,760	13,741	78.36	½
	271 - 276	C-97	R-22	3.18	11.71	31.00	54.11	64.37	0.36	12,300	14,092	74.59	1
	276 - 281	C-98	R-22	5.15	13.19	30.67	50.99	63.39	0.53	11,580	13,519	76.16	½
	281 - 286	C-99	R-22	4.28	12.23	29.54	53.95	65.53	0.55	11,940	13,773	81.12	1½
		Composite	R-22	3.71	12.38	30.12	53.79	64.96	0.37	12,010	13,875	75.14	1½
C-77-39	292 - 296	C-100	R-23	4.15	16.29	27.55	52.01	66.61	0.55	11,180	13,583	82.33	½
	296 - 302	C-101	R-23	3.30	9.74	30.71	56.25	65.35	0.33	12,640	14,136	79.72	1
	302 - 307	C-102	R-23	5.24	12.49	29.15	53.12	65.45	0.35	11,520	13,326	70.69	½
	307 - 311	C-103	R-23	3.66	15.58	28.91	51.85	65.29	0.29	11,800	14,197	71.95	1½
		Composite	R-23	3.17	12.96	30.74	52.53	63.97	0.37	11,750	13,673	72.14	½
C-77-40	116 - 121	C-104	R-24	5.18	7.24	28.62	58.96	67.90	0.49	12,200	13,247	90.19	0
	121 - 126	C-105	R-24	3.47	10.06	29.92	56.55	66.10	0.34	12,500	14,034	79.81	½
		Composite	R-24	4.01	8.89	29.47	57.63	67.89	0.38	12,470	13,805	82.97	0
C-77-41	22 - 27	C-106	R-25	9.87	25.65	27.02	37.46	60.13	0.42	7,120	9,851	35.27	0
	27 - 32	C-107	R-25	8.91	24.07	26.35	40.67	62.61	0.45	7,970	10,775	56.65	0
	32 - 36	C-108	R-25	9.10	22.12	28.82	39.96	59.75	0.43	7,730	10,160	68.26	0
		Composite	R-25	9.50	24.26	25.63	40.61	63.33	0.45	7,800	10,574	52.51	0

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plotting each sample in n-dimensional space (where n is the number of variables), thus identifying natural groupings or "clusters".

After several trial iterations of the cluster analysis on the 104 unoxidised samples, it was discovered that several of the variables could be discarded. Percentage of sulphur was eliminated since values were uniformly very low and did not contribute to the clustering process. Fixed Carbon (raw) and B.T.U./lb. (raw) were eliminated since they were partially dependent variables, i.e. depending upon ash content. It was found that percent ash and percent recovery at S.G. 1.8 were both random variables and did not contribute to the clustering process, i.e. they vary continuously within each seam.

The most meaningful clustering was achieved by using the variables Moisture, Volatiles (raw), Fixed Carbon (d.m.m.f.), B.T.U./lb. (m.m.m.f.) and F.S.I. It was found that with a single exception (sample C-93), all the samples could be grouped into three well-defined clusters which could be interpreted, consistent with available geological evidence, to represent three different seams. These clusters are listed in Table 2.

In order to compare the analytical data for 1977 rotary cuttings with those for 1976 core samples, it was necessary to recalculate the latter at specific gravity 1.8. This could be done approximately for those composites for which washability data was available, on the assumption that the value of Fixed Carbon (d.m.m.f.) is independent of specific gravity (in as

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TABLE 2

Cluster Listing - Individual Samples
Analytical Data for 1977 Rotary Cuttings

Cluster	Sample	Moisture	Volatiles	FCDMMF	BTUMMMF	FSI
1	C- 50	4.42	30.76	64.95	13,787	2.0
1	C- 99	4.28	29.54	65.53	13,773	1.5
1	C- 51	4.23	30.53	64.53	13,756	2.0
1	C- 63	3.50	33.09	62.94	13,747	1.5
1	C- 96	4.06	30.62	63.84	13,741	0.5
1	C- 53	3.90	26.39	69.40	13,719	2.0
1	C- 61	4.24	28.66	66.31	13,663	0.5
1	C- 65	2.88	28.17	68.58	13,648	2.0
1	C- 56	3.52	31.74	65.45	13,955	1.5
1	C- 88	3.17	25.81	67.57	13,940	0.5
1	C- 57	3.21	31.09	65.15	13,917	0.5
1	C- 69	2.93	28.96	63.78	13,928	1.5
1	C- 78	3.54	28.51	66.57	13,928	1.5
1	C- 60	3.33	28.24	68.26	13,900	1.5
1	C- 70	3.21	29.85	65.30	13,893	2.0
1	C- 58	3.19	29.71	66.95	13,845	0.5
1	C- 71	3.41	31.92	62.47	13,848	1.5
1	C- 89	2.78	29.50	63.40	13,848	0.5
1	C- 68	3.40	30.87	61.03	13,836	1.0
1	C- 62	3.20	28.69	67.87	13,861	1.5
1	C- 64	3.99	30.43	64.97	13,880	2.0
1	C- 52	5.82	26.66	69.58	13,436	0.5
1	C- 72	4.31	29.61	62.48	13,437	0.5
1	C- 95	3.55	32.78	59.25	13,462	1.0
1	C- 98	5.15	30.67	63.39	13,519	0.5
1	C-100	4.15	27.55	66.61	13,583	0.5
1	C- 67	4.40	29.97	61.73	13,168	0.0
1	C- 93	6.13	29.32	64.37	13,201	0.5
1	C-102	5.24	29.15	65.45	13,326	0.5
1	C-104	5.18	28.62	67.90	13,247	0.0
1	C- 54	3.78	32.84	61.22	14,171	2.0
1	C-101	3.30	30.71	65.35	14,136	1.0
1	C- 55	3.16	30.38	63.24	14,063	0.5
1	C- 97	3.18	31.00	64.37	14,092	1.0
1	C-105	3.47	29.92	66.10	14,034	0.5
1	C- 59	3.27	32.62	63.87	14,279	1.0
1	C- 79	2.88	31.19	66.65	14,221	1.0
1	C-103	3.66	28.91	65.29	14,197	1.5
1	C- 80	2.68	28.95	65.61	14,546	0.5
1	Mean	3.7872	29.8444	65.0592	13,808.5	1.05128
2	C- 91	7.23	29.40	68.53	12,812	0.5
2	C- 92	5.57	30.47	66.48	13,000	0.0
2	C- 94	5.79	29.10	64.03	12,400	0.0
2	Mean	6.1967	29.6567	66.3467	12,737.3	0.16667
3	C- 73	8.03	31.77	64.16	10,945	0.0
3	C- 84	8.97	30.05	62.02	11,067	0.0
3	C- 86	8.70	31.68	61.44	11,061	0.0
3	C- 77	9.10	29.31	60.69	10,839	0.0
3	C- 87	9.41	29.55	61.26	10,838	0.0
3	C-107	8.91	26.35	62.61	10,775	0.0
3	C- 74	9.01	34.60	59.97	10,401	0.0
3	C- 85	9.68	26.62	60.90	10,363	0.0
3	C- 76	10.08	30.45	61.66	10,567	0.0
3	C- 75	11.20	32.82	59.47	10,081	0.0
3	C- 82	11.42	32.00	56.09	9,995	0.0
3	C- 83	10.95	28.46	58.84	10,228	0.0
3	C-108	9.10	28.82	59.75	10,160	0.0
3	Mean	9.5815	30.1908	60.6815	10,563.1	0.0

much as mineral-matter-free coal would have specific gravity less than 1.8). Using the Paar Formulae in reverse with experimental results for ash and moisture on a cumulative basis to S.G. 1.8, approximate values for Fixed Carbon and Volatiles at S.G. 1.8 were derived. Recalculated data for 1976 composites are shown in Table 3. Attempts were than made to cluster 1976 and 1977 composites together.

At first composite T-6 persistently grouped on its own. Re-examination of the analytical data, in particular its high apparent ash content and inability to wash to 8% ash, led to the supposition that T-6 is strongly oxidised, and this composite was thrown out. All other composites fell in three well-defined clusters. With one exception, all 1977 composites fell in the same cluster as their individual components. Composite R-8 has four components; one is strongly oxidised while the other three fell in cluster 1, resulting in a composite which fell in cluster 2. This composite was therefore thrown out. The clusters of the remaining composites are listed in Table 4.

Several points arose from the clustering of composites, including:

1. The lack of a fourth cluster may indicate either that no samples from No. 4 Seam were analysed, and this is possibly due to impersistence of this seam, or that No. 4 Seam is indistinguishable from No. 3 Seam.

2. If, in fact, composite T-6 is strongly oxidised, it is probably safe to assume that cluster 4 represents unoxidised coal from No. 1 Seam.

TABLE 3

Analytical Data for 1976 Composites Recalculated at S.G. 1.8

Seam	Hole No.	Footage	Composite No.	Moist. %	Ash %	Volatiles %	Fixed Carbon %	Fixed Carbon (DMMF)	BTU/lb. (raw)	BTU/lb. (MMMF)	% Recovery @ SG 1.8	F.S.I.
3	Open Pit	Channel	C-1	2.36	6.72	30.91	60.01	66.40	12,930	13,942	96.25	½
3	Open Pit	Stockpile	C-2	2.20	8.90	32.90	56.00	63.50	12,290	13,597	87.59	0
2	C-76-1	386.0 - 394.0	T-1	4.35	7.30	35.69	52.66	60.14	12,050	13,097	92.79	0
3	C-76-1	668.5 - 681.5	T-2	1.58	11.47	30.17	56.78	66.00	12,770	14,576	95.21	1
3R	C-76-3	311.0 - 320.0	T-3	1.47	30.62	34.20	33.71	51.50	9,770	14,597	29.76	1
3	C-76-3	350.0 - 363.0	T-4	1.86	10.29	30.93	56.92	65.40	12,490	14,052	82.29	½
1	C-76-5	47.0 - 60.0	T-6	10.73	20.53	35.46	33.28	49.60	6,940	8,917	55.82	0
3	C-76-5	891.0 - 915.0	T-11	1.44	12.28	33.91	52.37	61.40	12,280	14,158	80.70	1

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TABLE 4

Cluster Listing - 1976 and 1977 Composites

Cluster	Composite	Moist. %	Volatiles %	FCDMMF	BTUMMMF	FSI
1	R- 1	4.14	30.75	64.91	13,787	2.0
1	R- 7	3.00	31.63	64.59	13,797	1.5
1	R-24	4.01	27.47	67.89	13,805	0.0
1	R- 5	3.24	30.92	66.01	13,976	1.0
1	C- 1	2.36	30.91	66.40	13,942	0.5
1	R- 9	3.29	31.73	62.90	13,905	1.5
1	R-17	2.86	27.55	65.74	13,869	0.5
1	R-22	3.71	30.12	64.96	13,875	1.5
1	R- 3	3.78	32.84	61.22	14,171	2.0
1	R-13	2.77	30.48	65.94	14,174	1.0
1	T-11	1.44	33.91	61.40	14,158	1.0
1	R- 4	3.16	30.38	63.24	14,063	0.5
1	T- 4	1.86	30.93	65.40	14,052	0.5
1	R- 6	3.15	29.56	66.92	14,107	1.0
1	R- 2	4.08	26.78	69.53	13,728	0.5
1	R-23	3.17	30.74	63.97	13,673	0.5
1	C- 2	2.20	32.90	63.50	13,597	0.0
1	R-10	4.31	29.61	62.48	13,437	0.5
1	R-21	3.55	32.78	59.25	13,462	1.0
1	T- 2	1.58	30.17	66.00	14,576	1.0
1	T- 3	1.47	34.20	51.50	14,597	1.0
1	Mean	3.01	30.78	63.99	13,940	0.91
2	R-20	5.83	29.20	64.16	13,090	0.0
2	T- 1	4.35	35.69	60.14	13,097	0.0
2	R-19	6.03	28.38	68.31	12,969	0.0
2	Mean	5.40	31.09	64.20	13,052	0.0
3	R-11	8.99	33.33	61.43	10,469	0.0
3	R-25	9.50	25.63	63.33	10,574	0.0
3	R-12	9.34	29.98	61.66	10,794	0.0
3	R-16	9.41	29.55	61.26	10,838	0.0
3	R-15	9.04	30.62	60.29	10,950	0.0
3	R-14	9.64	29.81	57.65	10,075	0.0
3	Mean	9.32	29.82	60.94	10,617	0.0

Taking the above points into consideration, the 1977 composites have been tentatively assigned to seams as follows:

Composite	Seam	Composite	Seam
R- 1	3	R-14	1
R- 2	3	R-15	1
R- 3	3	R-16	1
R- 4	3	R-17	3
R- 5	3	R-18	? (oxidised)
R- 6	3	R-19	2
R- 7	3	R-20	2
R- 8	?3 (partly oxidised)	R-21	3R
R- 9	3	R-22	3
R-10	3	R-23	3
R-11	1	R-24	3
R-12	1	R-25	1
R-13	3		

These seam assignments have been used in the geological interpretation which follows (Section 7). At the time of writing, other mathematical methods designed to test the statistical significance of the clusters obtained were under investigation. One factor which should not be overlooked is that many of the intersections assigned above to No. 1 Seam are from close to surface. It is therefore possible that one, several, or even all of them may represent oxidised coal from No. 2 or No. 3 Seams. This possibility should be investigated.

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5.3 Geophysical Logging

Because of apparent poor accuracy in determining depths of lithological contacts from rotary cuttings, and because of difficulties encountered in sampling the cuttings, it was decided that geophysical logs should be run on all holes. Natural gamma-ray, long-spaced density and single-point resistivity logs (hereinafter collectively referred to as "E-logs") were selected as being the most suitable logs for this application. All logs were run at a logging speed of 20 feet per minute and recorded at a chart speed of 10 feet per minute, giving a record at 10 feet to the inch. Since this drilling programme was essentially initial exploration, it was considered unnecessary to run detailed logs over the coal intersections at this time. Using the long-spaced density log, a precision of about $\pm$ 2 inches is obtained for lithological depths.

First of all, an attempt was made to log the 1976 diamond drill holes, since comparison between core log and E-log response would assist the operator in calibrating his instruments. Unfortunately, hole C-76-11 was the only one on Carmacks North which was still sufficiently open for the passage of the logging tool; E-logs were obtained to 395 feet depth (drill depth 887 feet). Most of the rotary holes drilled in April 1977 were plugged, since overburden, which was frozen when the holes were drilled, had melted and flowed in. An attempt was made in July to drill them out again for logging, but this was abandoned after it was discovered that the holes would have to be re-drilled with mud and then casing installed in order to keep them open.

Gamma and Density logs were obtained for close to the full depth of most of the rotary holes drilled in June-July 1977. It turned out

that in most areas the top of the water table was more than 300 feet deep; and since borehole fluid is required to obtain resistivity logs, this log was only obtained for short lengths near the bottom of a few of the holes.

Examination of the E-logs showed that intersections determined from rotary cuttings were in error by up to three feet. In addition some lithologic intervals including a few coal seams, which had been missed on logging the cuttings, were identified on the logs. One difficulty was encountered, however; some holes (e.g. C-77-20) yielded excellent logs with sharply-defined peaks while others yielded very poorly-defined logs. It was interpreted that the poor definition on some logs was a result of those holes intersecting bedding at high angles. This was apparently confirmed later by trenching.

Cuttings logs and/or E-logs, depending upon availability, were used to compile the Rotary Drill Records presented in Appendix I.

5.4 Trenching

In order to assist with geological interpretation of the drill-hole data in the "plateau" area, M. O. Hampton, Senior Coal Engineer, employed a D-7 bulldozer to dig trenches near those holes which had intersected thick coal seams close to surface. Seven new trenches were dug (Nos. 28 to 34 inclusive - see Map 1), and Trench No. 17 was lengthened. Detailed trench logs for all except No. 31 were prepared by the writer (see Figure 2). Trench No. 31 was not located or described in detail because of lack of time.

In all the trenches, dips were very steep (65 to 85^{o}); in Trench No. 33, bedding was overturned for part of its length. These steep dips

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are apparently the reason for very thick coal intersections in some of the drill-holes, and for poorly-defined peaks on some of the E-logs. Information from the trenches proved invaluable for geologic interpretation in this area (see Section 7).

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6. PHOTOGRAMMETRY AND LEASE SURVEY

Contour maps used for the 1976 exploration programme were 1" = 400' pencil manuscripts drawn from Government aerial photographs (approximate scale 1" = 1,000') taken in 1969. Contour interval was 50 feet, and horizontal control was taken from the N.T.S. 1:50,000 map. For the 1977 programme it was considered that further detailed work, particularly in the open pit area, would require much more accurate and more detailed basemaps - at 1" = 100' scale with 5 foot contour interval. Thus it was decided that new aerial photographs should be flown, and accurate horizontal and vertical control established. A new map of the open pit area could be produced, and maps of other areas as required.

In the past, all underground surveying at Tantalus Butte Mine has been tied to an arbitrary grid system established by Yukon Coal Company. Some discrepancies have arisen when trying to tie in underground surveys to surface data, and the actual location of the grid lines varies from map to map. The original monuments establishing the grid have all been destroyed. Projection of this grid up to ten miles to the south to cover the Carmacks South property has resulted in survey errors of ten feet or so, largely due to the fact that distances and angles on the mine grid system were not resolved to sea level. In order to remove these difficulties, it was decided that the mine grid system should be abandoned (except for local surveys within the mine), and that all past and future surface control surveys should be tied to the Territorial Plane Coordinate System (T.P.C.S.). This should allow easy conversion to the U.T.M. system if metrication takes place.

In order to obtain maximum advantage from the new photography, targets were placed at most of the 1976 diamond drill-holes, at many of the

original lot and coal mining lease cornerposts, and at several survey control stations.

Aerial photography covering both properties at approximate scales of 1" = 1,000' and 1" = 2,000' was flown in July, after most of the new access roads and drillsites in the open pit area had been built and part of the line grid systems had been cut. The new pencil manuscript of the open pit area was received in December 1977, and coordinates for the 1976 drill-holes, lease posts and survey control stations were received in March 1978.

Using coordinates for lease posts obtained photogrammetrically, a revised map showing actual locations of all the leases was prepared (see Map 2). This map shows that the leases staked by Dynasty Explorations in 1969 on Carmacks North are in fact located some distance to the north of where they were presumed to be. The revised map has been submitted to the Mining Recorder in Whitehorse for his approval, and for possible amendment of the lease documents.

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7. GEOLOGICAL COMPILATION OF OPEN PIT AREA

After the new topographic map of the open pit area was received in December 1977, a re-compilation of all geological data was begun. Original field notes and sketches obtained during the 1972 and 1973 trenching programmes were located and examined, and summary logs for 1973 underground diamond drill-holes were examined. All these and more recent geological data were plotted on the map with the aid of the new aerial photographs. Selected survey stations in the underground workings were converted to T.P.C.S. co-ordinates and geodetic datum, allowing the surface projection of the workings to be plotted on the map.

Accurate cross-sections at a scale of 1 inch to 50 feet were drawn where drill-hole information was available. These are Sections 48+50, 50+00, 54+00, 57+00, 59+00, 60+00, 61+50, 68+00 and 76+00. The irregular line-spacing is accounted for by the fact that several holes were drilled before the line grid system was established. It is intended that future exploratory drilling should be carried out on lines 800 feet apart, to be reduced successively to 400-foot and 200-foot spacing by in-fill drilling. Lithological interpretations for the drill-holes (as presented in Appendix I) were plotted on the sections, and coal intersections were assigned tentatively to Seams 1 to 4 on the basis of quality data obtained from 1976 core samples and 1977 rotary cuttings.

The southerly continuation of the synclinal structure in the open pit, and the accompanying westerly anticline, are apparently confirmed. These structures probably extend at least as far south as Section 48+50, where they are responsible for the structural complications which have caused so much difficulty in the underground workings in recent years. The structures appear to be complicated by local splitting of No. 3 Seam, although the

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situation may also be accounted for by a thrust fault emplaced prior to folding. The coal seams appear markedly thickened in the hinge zones and attenuated in the limbs of the folds.

The structure in the area to the east of the open pit is not sufficiently well known to allow completion of the compilation. Where seen in trenches, the rocks have westerly dips of between 65 and 75^{o}. In general, the structure in this area appears to be dominated by vertical or steeply-east or west-dipping normal and reverse faults; this interpretation depends upon the assignment of coal intersections to particular seams as outlined above. On the basis of extrapolating the stratigraphy established further south (by trenching and diamond drilling) into this area, the approximate locations of the seams not intersected by rotary holes can be inferred. This is particularly well shown on Section 60+00; if indeed the stratigraphic intervals between the seams in this area are approximately the same as seen in 1976 diamond drill-holes, then it is perfectly possible that even by drilling on closely-spaced centres (200 feet), several seams were missed. This interpretation needs to be tested, by trenching or (preferably) by diamond drilling selected easterly-inclined holes.

Because of uncertainties about the structure and stratigraphy in this area, it is not possible to arrive at accurate reserve figures, although it may be stated that several hundred thousand tons are inferred by the geological model. Much of this coal is likely to have ash contents, including inter-bedded mudstone partings, in the range 10 to 50% (see values for recovery at specific gravity 1.8 in Table 1). In addition, most of the coal within about 50 feet of the surface appears to be moderately to strongly oxidised.

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8. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that appreciable reserves of coal are indicated in the area around the open pit, and this area should, for the time being, be given preference over a new portal at river level or any development at Carmacks South.

Further exploration work is required in the open pit area since not enough information is currently available to permit mining to commence. The information required may be summarised as follows:

1. Verification of the geological structure east of the open pit, shown here on Sections 60+00, 68+00 and 76+00. In the event that the present interpretation proves incorrect, formulation of a new interpretation would be required.
2. More precise information on attitude, thickness and lateral extent of each seam.
3. More reliable quality data, particularly:
   (a) depth of oxidised zone and degree of oxidation,
   (b) thickness of rock partings within seam (i.e. proportion of coal to rock),
   (c) accurate characterisation of each seam according to calorific value and rank.

This information could probably best be obtained by selective diamond drilling on the existing sections, with holes sited to intersect as much of the stratigraphy as possible. Two holes on each of Sections 60+00, 68+00 and 76+00 are recommended, with each hole inclined 50^{o} to the east. Further rotary drilling is not recommended unless a rig capable of drilling inclined holes is made available and geophysical logs are obtained.

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PART B

CARMACKS SOUTH

1. INTRODUCTION AND SUMMARY

Only minimal exploration work was carried out on Carmacks South during 1977. Efforts were concentrated on finding a geophysical method which could be used to trace the coal horizon to the southeast beneath thick overburden. An extensive area was covered with EM-16. This method did not detect the coal itself, but did detect linear anomalies which probably represent structural features, and these may allow the coal seam to be traced some distance.

Several coal samples from 1976 drill core were sent for petrographic analysis to determine why some had high F.S.I. values while others had very low values. The results show that the low F.S.I. values are the result of oxidation of the coal. Geophysical logs were obtained from some of the 1976 diamond drill holes.

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2. PETROGRAPHIC ANALYSIS

After the 1976 diamond drilling program on Carmacks South, some inconsistencies were observed in the analytical data. While all samples had raw essentially similar proximate analyses and calorific values, some had free-swelling-index (F.S.I.) values in the range 4 to 7 while others had values in the range 1/2 to 1 (see Hill, 1977, Table 7). In an attempt to explain this variation, several samples were sent to Robertson Research (North America) Ltd. for petrographic analysis.

The samples selected for analysis were composites T-5 and T-7 and their individual components. A maceral analysis was performed upon each component and composite, and the mean maximum reflectance of vitrinite ($\overline{R}_o max$) was determined for the composites. The resulted are presented in Table 5, and show that all the samples are of very similar coal type and rank.

After recalculating the mineral-matter percentage for ash and sulphur values obtained in the proximate analyses, it is possible to predict approximate F.S.I. values based upon coal type and rank. Predicted values, together with the observed values for F.S.I., are also shown in Table 5.

Predicted F.S.I. values for samples C-24 and C-25, and their composite T-7, compare favourably with the measured values. However, measured values for samples C-12 to C-18, and their composite T-5, are much lower than predicted values. This difference is ascribed to the affects of oxidation of the vitrinite in these samples. While oxidation does affect caking characteristics (F.S.I.), we are advised that these results should not be taken as an indication that this coal will not produce coke.

TABLE 5

PETROGRAPHIC ANALYSIS OF COMPOSITES T-5 AND T-7

SAMPLE	C-12	C-13	C-14	C-15	C-16	C-17	C-18	Calc. Comp. of C-12 to C-18 incl.	T-5 Comp.	C-24	C-25	Calc. Comp. of C-24 and C-25	T-7 Comp.
WEIGHT % IN COMPOSITE	16.85	15.14	14.36	13.57	8.83	13.47	17.78	100.00	100.00	38.71	61.29	100.00	100.00
ASH %	16.24	26.35	11.23	28.51	21.57	21.63	28.92	22.17	23.06	19.49	23.75	22.11	21.91
SULPHUR %	-	-	-	-	-	-	-	-	0.63	-	-	-	0.53
Maceral Analysis (as measured)													
Vitrinite	60.40	63.40	43.00	42.40	54.70	66.40	57.90	55.80	50.00	63.20	47.50	53.60	56.90
Exinite	0.40	0.00	0.00	0.00	0.00	0.20	0.20	0.10	0.00	0.10	0.00	00.00	0.00
Fusinite	0.80	0.20	0.20	1.00	0.40	0.90	0.40	0.60	0.20	0.50	0.40	0.40	0.20
Semifusinite	28.20	26.60	44.40	29.90	26.80	20.70	10.90	26.30	29.20	20.80	28.50	25.50	27.70
Micrinite	5.50	4.20	5.10	2.10	3.80	3.70	4.20	4.20	4.80	3.50	5.90	5.00	3.40
Mineral Matter	4.70	5.60	7.30	24.60	14.30	8.10	26.40	13.10	15.80	11.90	17.70	15.50	11.80
Vitrinite reflectivity	-	-	-	-	-	-	-	-	1.19%	-	-	-	1.23
Recalculated maceral data using Parr's formula for mineral matter													
Vitrinite	57.60	57.50	43.50	47.10	56.30	63.60	66.20	56.40	51.90	64.00	50.20	55.80	56.80
Exinite	0.40	0.00	0.00	0.00	0.00	0.20	0.20	0.10	0.00	0.10	0.00	0.00	0.00
Fusinite	0.80	0.20	0.20	1.10	0.40	0.90	0.50	0.60	0.20	0.50	0.40	0.40	0.20
Semifusinite	27.00	24.10	44.90	33.40	27.60	19.80	12.50	26.60	30.30	21.10	30.10	26.50	27.60
Micrinite	5.30	3.80	5.20	2.40	3.90	3.60	4.80	4.20	5.00	3.60	6.30	5.20	3.40
Mineral Matter	8.90	14.40	6.20	15.70	11.80	11.90	15.80	12.10	12.60	10.70	13.00	12.10	12.00
Free Swelling Index (FSI)													
(a) Observed value	1	1	½	1	½	1	½	½-1	½	7	4½	5½	6
(b) Predicted value	7-7½	7-7½	5	6	7	8½	9	7	6	8½	6	7	7

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3. LINECUTTING AND GEOPHYSICS

3.1 Linecutting

In order to facilitate geophysical test procedures on Carmacks South, several cut lines perpendicular to strike were required. It had been proposed that the tests should be conducted on pairs of lines two hundred feet apart and four thousand feet long. It was therefore decided to erect a line grid-system which could accommodate these requirements, and which could later be extended to locate lines for any further geophysics or drilling.

The new grid was erected by selecting line 40+00 feet south to coincide with cross-section B (Hill, 1977) at approximately 050° azimuth, thus causing line 0+00 to fall at the extreme northern end of the property. The baseline was arbitrarily drawn in at azimuth 140°, to bisect approximately the known syncline (see Map 3). Three pairs of lines were selected for the geophysical tests and were cut as follows:

(a) Lines 40 and 42, since a thick coal section was exposed in the trench and the structure was fairly well known from drill holes C-76-4 and C-76-7;

(b) Lines 90 and 92, situated just beyond the known strike length of coal proved in trenches;

(c) Lines 110 and 112, situated approximately 2,500 feet beyond the known strike length of coal proved in trenches, in an area where overburden was presumed to be thick.

In addition to the lines mentioned above, the baseline was cut from line 40 to line 250, an offset at 20+00 west was cut from line 70 to

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line 200, and an offset at 20+00 east from line 90 to line 140.

3.2 Geophysical Testing

The initial geophysical testing consisted of the following:

(a) Induced polarisation (Gradient-array Resistivity and Chargeability) on lines 40 and 42 from 13+00 west to 24+00 west. A large, prominent anomaly was evident over the thick coal seam exposed in the trench. Gradient-array resistivity was also run on line 85 from 14+00 west to 21+00 west and on line 90 from 11+00 west to 24+00 west, but on these lines no large anomalies were found in the expected position over the coal seam.

(b) Bouguer Gravity, one line 42 from 14+00 west to 24+00 west. A fairly even gravity gradient was found over the length of the profile.

(c) Very low frequency (V.L.F.) electromagnetic, using the EM-16 system, on lines 40 and 42 from 14+00 west to 24+00 west, on line 92 from 5+00 east to 24+00 west, and on lines 110 and 112 from 10+00 east to 20+00 west.

In each case, very irregular profiles were obtained. On lines 40 and 42, a prominent anomaly was located approximately 250 feet to the west of the coal seam outcrop.

(d) Side-looking dipole-dipole resistivity on lines 41+00 and 41+50 from 16+00 west to 23+00 west. This method produced a much larger and more prominent anomaly than that revealed by gradient-array resistivity on the same lines.

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Of the various geophysical methods tried, the side-looking resistivity appears to be the only method which might be useful for detecting and tracing actual coal seam subcrops in this area.

3.3 EM-16 Survey

Since the test of EM-16 on lines 40 and 42 gave a prominent anomaly about 250 feet west of the coal seam, it was decided to run some more lines using this method to see if the anomaly could be traced parallel to the coal seam for any distance. The system was run on flagged lines through the bush; initially lines 30 to 90 were run on 200-foot line spacings, from 10+00 west to 30+00 west.

The results of the initial survey showed that the anomaly under investigation did, in fact, appear to lie approximately parallel to the coal seam at a distance of about 200 feet to the west. A second, larger, anomaly was located about 500 feet to the east of the coal seam, and again approximately parallel to it. While neither anomaly can readily be related to identifiable geological features, and the method does not detect the coal itself, it is evident that EM-16 has provided a kind of mapping technique which defines layering and/or structure in the sequence.

As a result of the initial success, the survey was extended south to line 150 between baseline 0+00 and 20+00 west, and on lines 100 to 140 between baseline and 20+00 east. The E.M. profiles and contoured values for the entire survey are shown in Figures 3 and 4 respectively at a scale of 1 inch to 800 feet. From the contoured data, it seems likely that the pair of anomalies referred to above can be traced more or less continuously at least as far south as line 134. If these anomalies are accepted as layering or structural

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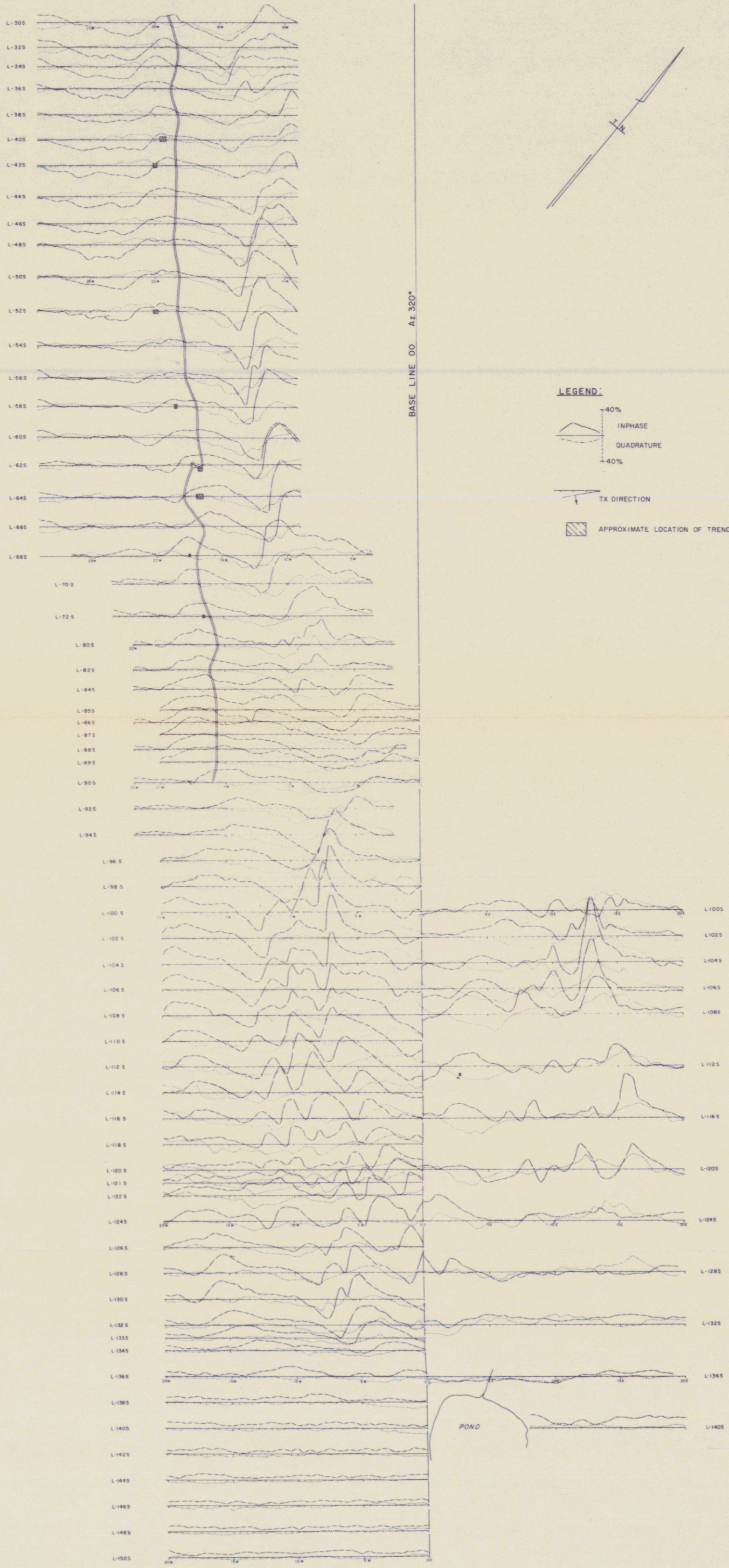

LEGEND:

TX DIRECTION

APPROXIMATE LOCATION OF TRENCHES CONTAINING COAL

FIGURE 3

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT
VLF
ELECTROMAGNETIC SURVEY
PROFILES OF INPHASE & QUADRATURE READINGS

MAP No
TO ACCOMPANY A REPORT BY PETER E WALCOTT DATED- JAN 1978

PETER E WALCOTT & ASSOC LTD
JUNE - OCTOBER , 1977

REVISED BY

SCALE IN FEET
200 0 200 400

NTS 115-I-1
DRAWN BY RWR
DATE

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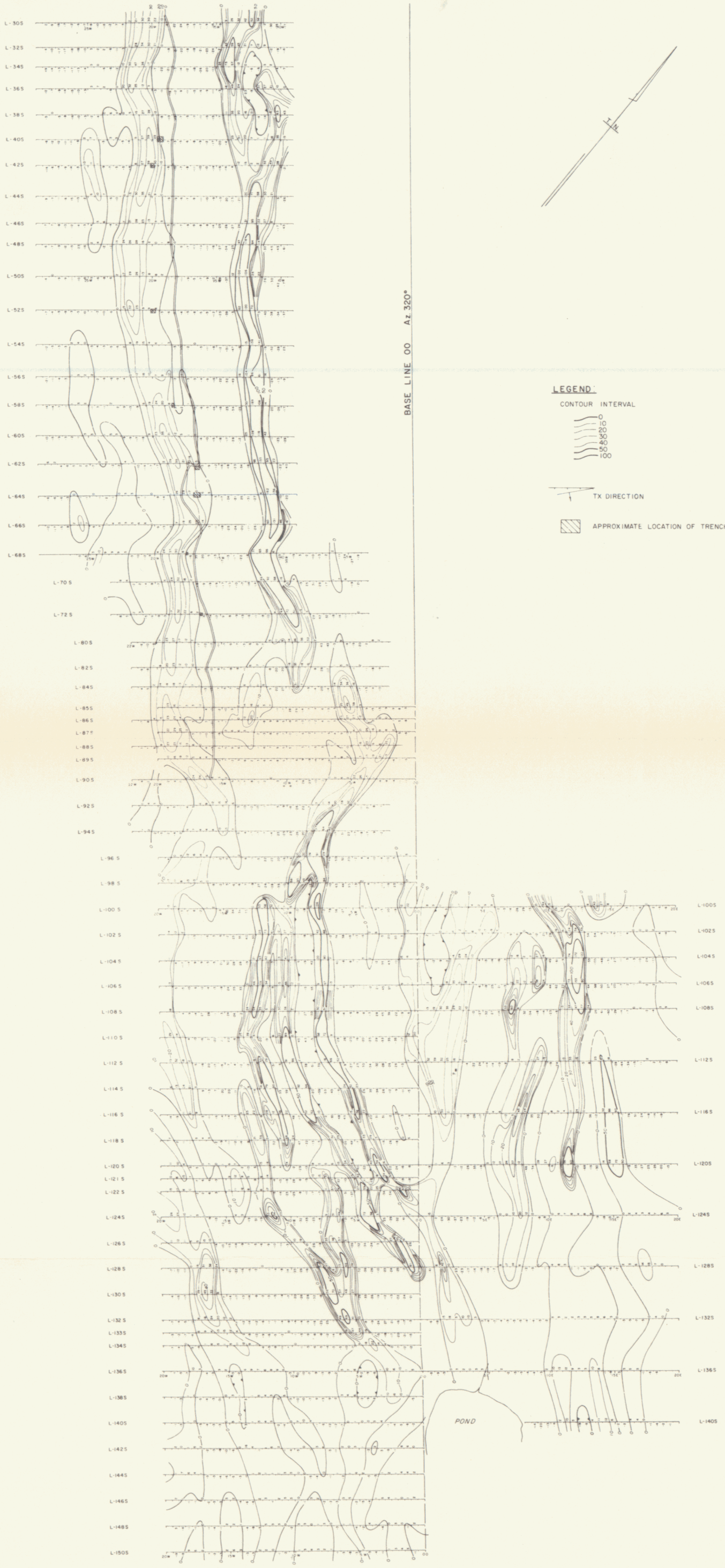

FIGURE 4

CYPRUS ANVIL MINING CORPORATION	
CARMACKS COAL PROJECT	
VLF ELECTROMAGNETIC SURVEY CONTOURS OF FRASER FILTERED IN PHASE READINGS	
MAP No TO ACCOMPANY A REPORT BY PETER E. WALCOTT DATED- JAN. 1978	PETER E WALCOTT & ASSOC. LTD. JUNE - OCTOBER , 1977
REVISED BY	SCALE IN FEET 200 0 200 400
	NTS 115-1-1 DRAWN BY: RWR DATE

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features in the sequence, then it is possible to infer an approximate coal seam subcrop trace. Unfortunately, south of line 140, E.M. response becomes rather flat, presumably the result of much increased overburden thickness. It is possible that the syncline closure occurs here, but this remains to be seen. Attempts to extend the surveyed area towards the south, and further west between lines 90 and 140, were thwarted when the E.M. transmitting station was shut down.

The geological map of Carmacks South, amended to reflect the interpretation of the EM-16 survey described above, is shown on Map 3 . This interpretation should be tested by drilling. A more comprehensive treatment of the geophysical tests and EM-16 survey is expected in a forthcoming report by Peter E. Walcott.

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4. GEOPHYSICAL LOGGING

While the logging unit was in Carmacks for the rotary drilling programme, it was decided to attempt to obtain E-logs for the 1976 diamond drill holes on Carmacks South. Several of these holes were plugged, but partial E-logs were obtained for the following:

Hole	Drilled Depth	Logged Depth	Water Table Depth
C-76- 7	817'	800'	448'
C-76-10	967	960	520
C-76-12	524	380	289
C-76-16	212	206	196

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5. CONCLUSIONS AND RECOMMENDATIONS

Petrographic analysis of selected samples has shown that all the coal intersected in drill-holes is coking coal, but that localised oxidation has reduced F.S.I. values. Carmacks South can therefore still be regarded as a potential source of metallurgical coal. Further sampling from a larger area is required to determine whether the high ash values determined in 1976 are representative of the whole property.

Very low frequency electromagnetic (EM-16) appears to be a good method of tracing structures, and hence the survey should be extended to the east, west and south in the hope of tracing the syncline closure and other structures. Once this survey is completed, it should be possible to outline drill targets aimed at defining more precisely the area underlain by coal.

Probably the most useful way to drill this property would be to drill on cross-sections 1,600 feet apart with holes 800 feet apart on the sections. This method would ensure that the synclinal closure area would be located more precisely. Holes at the western ends of these sections should be inclined at 50 or 60^{o} to the southwest in anticipation of steep or overturned dips. It is suggested that lines 110 and 126 are the most appropriate for this type of drilling but, after extension of the EM-16 survey, other lines may suggest themselves. Proposed hole locations are shown on Map 3. It is recommended that diamond drilling should be utilized for the present until such time that the stratigraphy and structure are sufficiently well known to be able to predict location and depth of the coal horizon.

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References

HAMPTON, M.O. (1977) Preliminary Development Proposal for Tantalus Butte Coal Mine. Cyprus Anvil Mining Corporation, Faro.

HILL, R.P. (1977) Report on Preliminary Evaluation, Carmacks Coal Project. Cyprus Anvil Mining Corporation, Vancouver.

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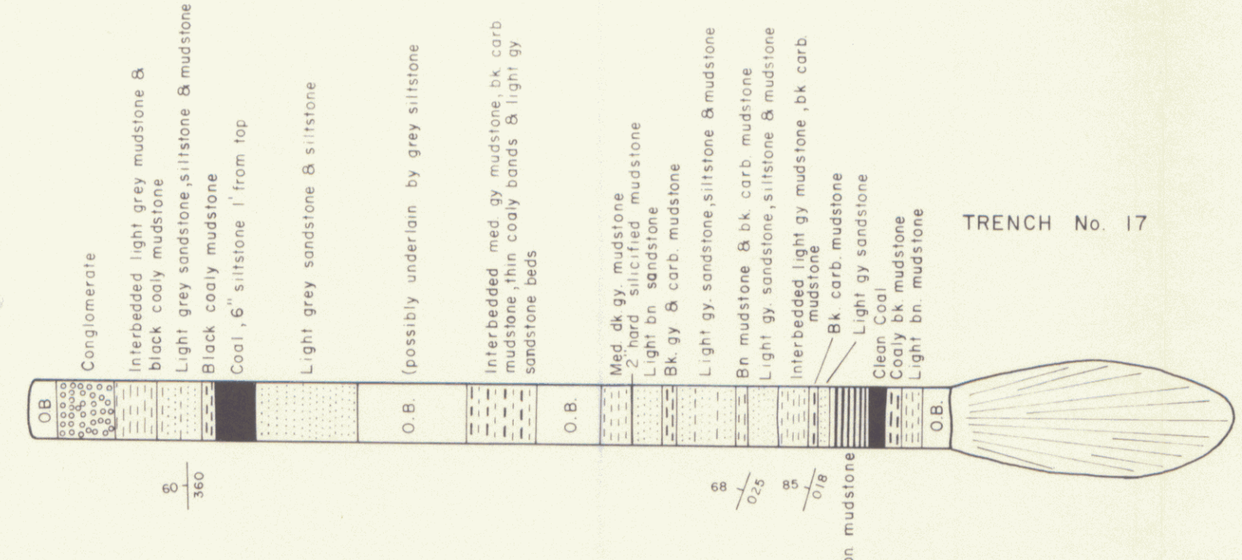

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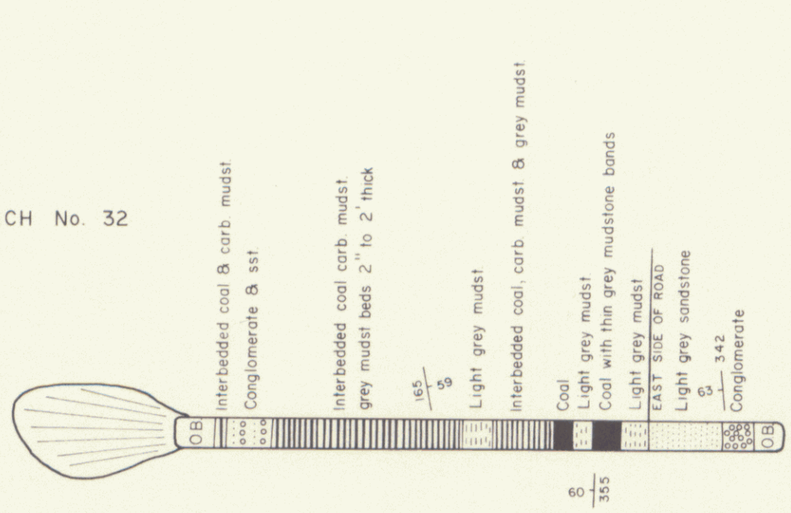

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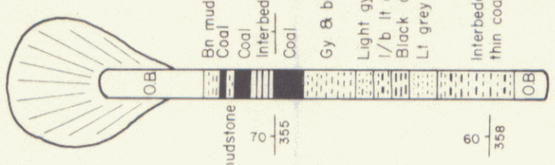

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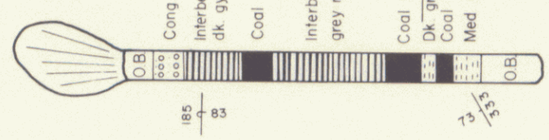

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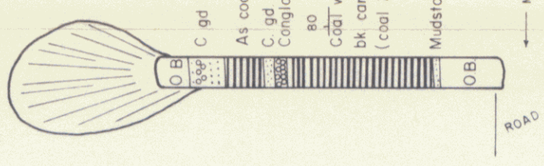

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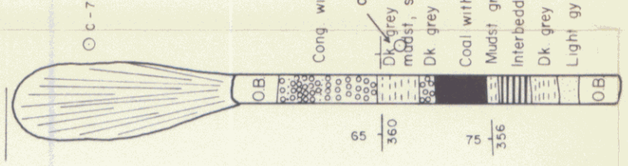

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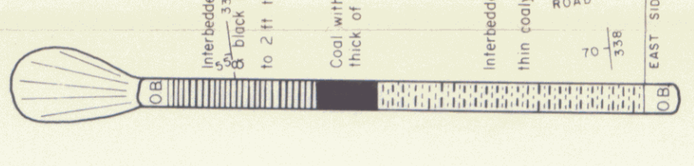


TRENCH No. 34

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

CARMACKS NORTH TRENCH PLANS

MAP REF: 115 - I - 1

DATE: APRIL 9, 1978
REVISED:

0 50 100

DRAWN BY: C. L. C.

Scale: 1" = 50 ft

FIGURE: 2

LEGEND

Survey control point	Aerial photo target
Road	Cat trail
Cut line	Cleared areas
Trench outline with spoil	Subsidence hole
Surface projection of main entry and working area	Airtrac drill-hole
Underground access	Diamond drill-hole
	Rotary drill-hole

SYMBOLS

- Contact (Defined, Assumed)
- Bedding (Inclined, Vertical, Overturned)
- Anticline Axial Trace
- Syncline Axial Trace
- Fault at surface, showing dip of plane and sense of movement, where known (Approximate, Assumed)
- Fault underground (Approximate)

UPPER JURASSIC-LOWER CRETACEOUS TANTALUS FORMATION

11	Conglomerate and pebbly sandstone
10	No. 1 Coal Seam
9	Conglomerate and pebbly sandstone
8	No. 2 Coal Seam
7	Brown mudstones and siltstones
6	Conglomerate and pebbly sandstone
5	Brown and dark grey siltstones and mudstones
4	No. 3 Coal Seam
3	Thin-bedded light grey sandstone and siltstones
2	Dark brown and dark grey mudstones, black carbonaceous mudstones and thin coal seams
1	Conglomerate, pebbly sandstone and coarse grained sandstone

TRUE NORTH 1° 06'
Grid North
Magnetic North
32° 22'

Approximate Magnetic Declination 1978 - 32° 22' East
Annual change decreasing 3.0'

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

CARMACKS NORTH

GEOLOGICAL MAP OF OPEN PIT AREA

To Accompany Report By R.P. HILL, April 1978

PHOTOGRAPHY: July 1977
PROJECTION: Transverse Mercator
COORDINATES: Territorial Plane (feet)

SCALE IN FEET
100 0 100 200
CONTOUR INTERVAL: 5 FEET
Except 10 Feet within open pit

N.T.S. 115-I-1
DRAWN BY: R.W.R
DATE: MAY, 1978
MAP No. 1

Lot 9
Gr. 903

Lot 4
Gr. 903
FIVE FINGERS MINE

Lot 5
Gr. 903

Lot 6
Gr. 903

Lot 8
Gr. 903

7

Lot 14
Gr. 903

C.M.L
No.
2964

FIVE FINGERS

FIVE FINGER MOUNTAIN
△ 2942'

2963
553.8A

2966
111.6A

2956
581.1 A

2955
615.5 A

2952
622.1 A

2959
597.0 A

2950
576.7A

24

23

CARMACKS NORTH

Yukon River

CARMACKS

42

12

10

11

2954
424.1 A

2983
392.5A

2975

26

2976
30.0A

2968
303.1 A

2982
627.3A

2951
490.4A

2977
67.7 A

2949
615.9 A

2965

2953
615.9A

2978
52.4A

2980
31.8A

2979
30.7A

2969
614.8A

2967
654.9 A

2981
561.8A

2974
614.7A

2972
651.0A

2971
617.7A

2973
621.2A

2970
611.2A

Nordenskiold River

BERDOE MOUNTAIN
△ 3540'

CARMACKS SOUTH

2000
2500
3000
210,000 E
220,000 E
230,000 E
200,000 E
190,000 E
22,620,000 N
22,610,000 N
22,600,000 N
22,590,000 N
22,580,000 N

N

CYPRUS ANVIL MINING CORPORATION

092032

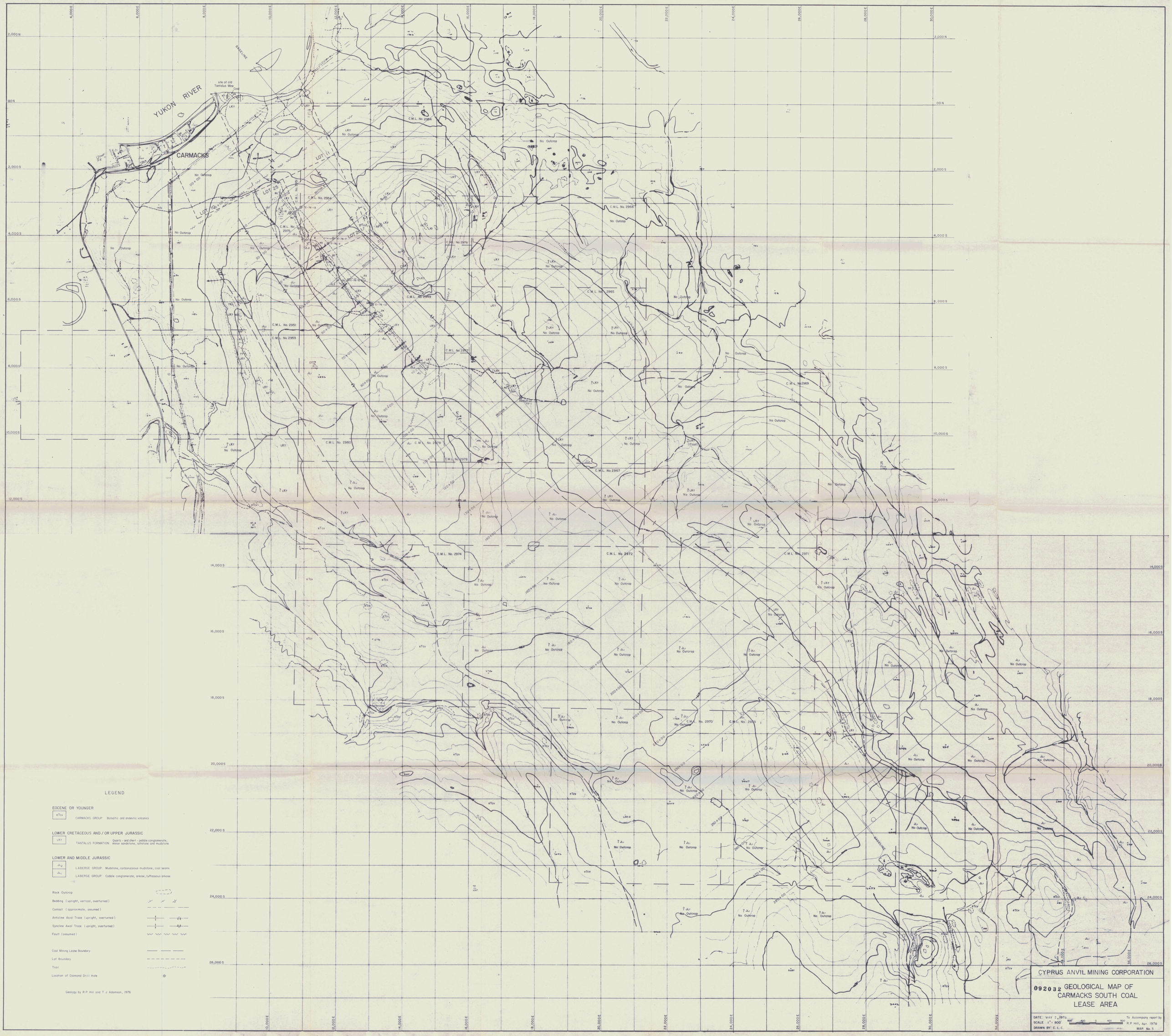
COAL LEASES IN CARMACKS AREA, Y.T.

DATE: FEB 9, 1977
SCALE: 1" = 1/2 Mi
DRAWN BY: C. L. C.

1/2 1/4 0 1/2

MAP No. 2

REVISED APR. 28, 1978



LEGEND

EOCENE OR YOUNGER

eTcv — CARMACKS GROUP: Basaltic and andesitic volcanics

LOWER CRETACEOUS AND / OR UPPER JURASSIC

LKT — TANTALUS FORMATION: Quartz - and chert - pebble conglomerate; minor sandstone, siltstone and mudstone

LOWER AND MIDDLE JURASSIC

JL2 — LABERGE GROUP: Mudstone, carbonaceous mudstone; coal seams

JL1 — LABERGE GROUP: Cobble conglomerate, arkose; tuffaceous arkose

Rock Outcrop

Bedding (upright, vertical, overturned)

Contact (approximate, assumed)

Anticline Axial Trace (upright, overturned)

Syncline Axial Trace (upright, overturned)

Fault (assumed)

Coal Mining Lease Boundary

Lot Boundary

Trail

Location of Diamond Drill Hole

Geology by R.P. Hill and T.J. Adamson, 1976

CYPRUS ANVIL MINING CORPORATION

092032 GEOLOGICAL MAP OF CARMACKS SOUTH COAL LEASE AREA

DATE: MAY 2, 1976a
SCALE: 1" = 800'
DRAWN BY: C. L. C.

To Accompany report by R.P. Hill, Apr. 1976
MAP No. 1

APPENDIX I

1977 ROTARY DRILL RECORDS

CARMACKS NORTH

092022

ROTARY DRILL RECORD

HOLE NO.: C-77-1 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: Lot 23
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 5-11, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 242 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION:
T.P.C.S. COORDINATES: North East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 242 feet
OVERBURDEN DEPTH: 242 feet
WATER TABLE DEPTH: N/A

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	242	Overburden. -			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-2 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: Lot 23
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 12-14, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 300 feet
DEPTH LOGGED: 300 feet
LOGS RUN: Gamma, LS Density, Resistivity
GRID LOCATION:
T.P.C.S. COORDINATES: North East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 300 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 127 feet
WATER TABLE DEPTH: 257 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	127	Overburden.			
127	282	Pebble conglomerate with sandstone			
		interbeds.			
282	287	Black coaly mudstone.			
287	300	Brown mudstone.			
		092032			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-3

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 17, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 84.5 feet
DEPTH LOGGED: 56 feet
LOGS RUN: Gamma, Density
GRID LOCATION: Line 61+30, 1+30W
T.P.C.S. COORDINATES: 22,611,570 North -216,090 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 84.5 feet
OVERBURDEN DEPTH: 28 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	28.0	Overburden.			
28.0	51.5	Medium grey mudstones and siltstones.			
51.5	55.5	COAL (4').			
55.5	84.5	Light grey sandstone with brown mud-			
		stone interbeds.			
		Note - E-logs of coal intersection			
		obscured by water in bottom of			
		hole.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-4 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 17, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 185 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 61+30, 0+50W
T.P.C.S. COORDINATES: 22,611,570 North -216,010 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 185 feet
OVERBURDEN DEPTH: 23 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	23	Overburden.			
23	72	Brown and grey mudstones and siltstones			
		with a few carbonaceous mudstone			
		partings.			
72	97	COAL (25 feet).			
97	115	Light grey sandstone.			
115	150	COAL (35 feet).			
150	185	Light grey sandstone with interbeds of			
		brown siltstone and mudstone.			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-5

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 17, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 85 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 60+00, 1+40W
T.P.C.S. COORDINATES: 22,611,440 North -216,100 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R.P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 85 feet
OVERBURDEN DEPTH: 24.5 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	24.5	Overburden.			
24.5	34.0	Medium brown and medium grey mudstone			
		and siltstone.			
34.0	56.0	Dirty COAL with mudstone partings (22').			
56.0	65.0	Brown mudstone.			
65.0	85.0	Grey sandstone.			
		2032			

ROTARY DRILL RECORD

HOLE NO.: C-77-6 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 18, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 243 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 60+00, 1+00W
T.P.C.S. COORDINATES: 22,611,440 North -216,065 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 243 feet
OVERBURDEN DEPTH: 26 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
0	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	26	Overburden.			
26	85	Medium brown mudstone, and grey silt-			
		stone and mudstone. One foot of coal			
		at about 30 ft. depth.			
85	87	Coaly mudstone. -			
87	149	Grey and brown siltstones and mudstone.			
149	229	COAL (80 feet).			
229	235	Brown mudstone.			
235	243	Dark brownish-grey sandstone.			
		092032			

ROTARY DRILL RECORD

HOLE NO.: C-77-7 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 18, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 243 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 60+00, 0+60W
T.P.C.S. COORDINATES: 22,611,440 North -216,035 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 243 feet
OVERBURDEN DEPTH: 25 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	25	Overburden.			
25	145	Grey and brown mudstones and siltstones			
145	183	COAL (38 feet).			
183	243	Grey sandstone (6" coal at 219 feet).			

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ROTARY DRILL RECORD

HOLE NO.: C-77-8 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 19, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 163 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 60+00, 0+20W
T.P.C.S. COORDINATES: 22,611,440 North -215,980 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 163 feet
OVERBURDEN DEPTH: 25 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90^0

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	25	Overburden.			
25	91	Brown and grey mudstones and siltstones			
91	119	COAL (28 feet).			
119	121	Brown mudstone.			
121	157	Brownish grey sandstone.			
157	163	Pebble conglomerate.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-9 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 19, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 103 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 61+30, 0+10W
T.P.C.S. COORDINATES: 22,611,570 North -215,970 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 103 feet
OVERBURDEN DEPTH: 5 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	5	Overburden.			
5	36	Grey and brown mudstones and siltstones.			
36	53	COAL (17 feet).			
53	103	Grey siltstone and sandstone.			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-10

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 19, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 83 feet
DEPTH LOGGED: 80 feet
LOGS RUN: Natural Gamma and L.S. Density
GRID LOCATION: Line 62+40, 1+30W
T.P.C.S. COORDINATES: 22,611,680 North -216,090 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 80 feet
CUTTINGS LOGS FROM 80 to 83 feet
OVERBURDEN DEPTH: 26 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	26.0	Overburden.			
26.0	39.0	Grey and brown mudstones.			
39.0	47.3	Grey siltstones.			
47.3	53.3	COAL (6.0 feet).			
53.3	83.0	Grey siltstone and sandstone.			

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ROTARY DRILL RECORD

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 19, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 103 feet
DEPTH LOGGED: 95 feet
LOGS RUN: Natural Gamma, L.S. Density
GRID LOCATION: Line 62+40, 0+90W
T.P.C.S. COORDINATES: 22,611,680 North -216,050 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 95 feet
CUTTINGS LOGS FROM 95 to 103 feet
OVERBURDEN DEPTH: 12 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	12.0	Overburden.			
12.0	25.0	Grey and brown siltstones.			
25.0	28.0	Sandstone.			
28.0	40.0	Grey and brown mudstones, grading down			
		into:			
40.0	49.3	Siltstones.			
49.3	55.0	COAL (5.7 feet).			
55.0	65.3	Grey sandstone and siltstone.			
65.3	76.5	COAL (11.2 feet).			
76.5	78.3	Carbonaceous mudstone (1.8 feet).			
78.3	84.0	COAL (5.7 feet).			
84.0	103.0	Light grey siltstone and sandstone.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-12 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 20, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 183 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 60+00, 0+30E
T.P.C.S. COORDINATES: 22,611,440 North -215,930 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 183 feet
OVERBURDEN DEPTH: 24 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	24	Overburden.			
24	183	Brown mudstone and grey siltstone.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-13 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 20, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 184 feet
DEPTH LOGGED: 183 feet
LOGS RUN: Gamma, L.S.D., Resistivity
GRID LOCATION: Line 58+90, 0+20W
T.P.C.S. COORDINATES: 22,611,330 North -215,980 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 183 feet
CUTTINGS LOGS FROM 183 to 184 feet
OVERBURDEN DEPTH: 24 feet
WATER TABLE DEPTH: 133 feet

DEPTH	AZIMUTH	DIP
-	-	-90^0

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	24.0	Overburden.			
24.0	28.0	Grey siltstone.			
28.0	46.0	COAL (18.0 feet).			
46.0	55.0	Brown mudstone.			
55.0	62.0	Grey siltstone.			
62.0	65.0	Grey sandstone.			
65.0	70.0	Grey siltstone.			
70.0	73.0	Grey sandstone (? Marker bed).			
73.0	86.0	Grey siltstone.			
86.0	101.0	Brown mudstone.			
101.0	108.0	Dirty COAL (7.0 feet).			
108.0	116.2	Brown siltstones.			
116.2	158.0	COAL with mudstone partings (41.8 feet)			
158.0	175.5	Brown siltstone and mudstone.			
175.5	184.0	?Pebble conglomerate with sandstone interbeds.			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-14 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: April 20, 1977
LOGGING CONTRACTOR: -
DATE LOGGED: -
DEPTH DRILLED: 164 feet
DEPTH LOGGED: -
LOGS RUN: None
GRID LOCATION: Line 58+90, 0+20E
T.P.C.S. COORDINATES: 22,611,330 North -215,940 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: -
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM to
CUTTINGS LOGS FROM 0 to 164 feet
OVERBURDEN DEPTH: 34 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	34	Overburden.			
34	40	COAL (6 feet).			
40	164	Grey sandstone with brown and grey mudstone and siltstone partings.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-15 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
LEASE/LOT/CLAIM NO.: Lot 23
DRILLING CONTRACTOR: Midnight Sun
LOGGING CONTRACTOR: Data Probe
DEPTH DRILLED: 317 feet
LOGS RUN: Gamma, L.S. Density
T.P.C.S. COORDINATES: North
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 147 feet
CUTTINGS LOGS FROM 147 to 317 feet
OVERBURDEN DEPTH: 98 feet

PROPERTY: Carmacks North
PROVINCE/TERRITORY: Yukon
DATE(S) DRILLED: April 21-22, 1977
DATE LOGGED: July 13, 1977
DEPTH LOGGED: 147 feet
GRID LOCATION:
East Elevation:

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

WATER TABLE DEPTH: -

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	98	Overburden.			
98	252	Pebble conglomerate with sandstone and			
		mudstone interbands.			
252	275	Interbanded mudstones, carbonaceous			
		mudstones and thin coal bands.			
275	293	Sandstone with conglomerate and mud-			
		stone interbeds.			
293	303	Dirty COAL (10 feet).			
303	317	Grey sandstone.			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-16

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 22, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 272 feet
DEPTH LOGGED: 139 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 59+00, 1+00W
T.P.C.S. COORDINATES: 22,611,340 North -216,060 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 139 feet
CUTTINGS LOGS FROM 139 to 272 feet
OVERBURDEN DEPTH: 8 feet
WATER TABLE DEPTH: Not known.

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	8.0	Overburden.			
8.0	78.0	Pebble conglomerate with sandstone			
		interbeds.			
78.0	84.0	Coaly mudstone.			
84.0	124.3	Brown siltstone and mudstone.			
124.3	131.3	COAL (7 feet).			
131.3	139.0	Black carbonaceous mudstone.			
139.0	209.0	Grey sandstone, passing down into grey			
		siltstone and mudstone.			
209.0	224.0	COAL (15 feet).	209	214	C-50
224.0	226.0	Black carbonaceous mudstone.	215	223	C-51
226.0	246.0	COAL (20 feet).	230	236	C-52
246.0	272.0	Rock type uncertain.	237	243	C-53
		092032			

ROTARY DRILL RECORD

HOLE NO.: C-77-17

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 22, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 243 feet
DEPTH LOGGED: 201 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 59+00, 1+80W
T.P.C.S. COORDINATES: 22,611,340 North -216,140 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 201 feet
CUTTINGS LOGS FROM 201 to 243 feet
OVERBURDEN DEPTH: 8 feet
WATER TABLE DEPTH: 165 feet

DEPTH	AZIMUTH	DIP
-	-	-90^{0}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES FROM	SAMPLES TO	SAMPLES NO.
0.0	8.0	Overburden.			
8.0	70.0	Pebble conglomerate with sandstone interbeds.			
70.0	72.5	Dirty COAL (2.5 feet).			
72.5	74.5	Dark brown and dark grey mudstones.			
74.5	79.0	Dirty COAL (4.5 feet).			
79.0	134.0	Light grey siltstone with sandstone and mudstone interbeds.			
134.0	136.0	Dense sandstone (?MARKER).			
136.0	150.0	Light grey siltstone with sandstone and mudstone interbeds.			
150.0	179.0	Dark brown and dark grey siltstones with sandstone interbeds.			
179.0	184.7	COAL (5.7 feet).			
184.7	201.0	Mudstones and siltstones.			
		N.B. Logs show cave from 190 to 195', then a pronounced increase in density from 195 to 201' which is difficult to interpret (could be conglomerate).		092032	

ROTARY DRILL RECORD

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
201.0	202.0	Coaly mudstone.			
202.0	209.0	Mudstone and siltstone.			
209.0	211.0	Coaly mudstone.			
211.0	243.0	Mudstone and siltstone.			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-18

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 23-24, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 364 feet
DEPTH LOGGED: 362 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 57+00, 5+00W
T.P.C.S. COORDINATES: 22,611,140 North -216,460 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 362 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 8 feet
WATER TABLE DEPTH: 272 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	8.0	Overburden.			
8.0	198.0	Pebble conglomerate with sandstone inter-			
		beds.			
198.0	202.0	Carbonaceous mudstone.			
202.0	232.5	Interbedded dark brown and dark grey mud-			
		stones and carbonaceous mudstone.			
232.5	236.0	Soft, coaly mudstone.			
236.0	237.0	Mudstone.			
237.0	243.5	COAL (6.5 feet).	237	241	C-54
243.5	258.5	Black carbonaceous mudstone with coaly			
		partings.			
258.5	267.3	COAL (8.8 feet)	263	271	C-55
267.3	277.5	Dark grey mudstones and siltstones.	(Driller's interval)		
277.5	280.2	Dirty COAL (2.7 feet).			
280.2	288.0	Dark grey mudstone.			
288.0	315.0	Medium grey siltstone.			
315.0	338.5	Light grey sandstone. 052032			
338.5	341.9	Dirty COAL (3.4 feet).			
341.9	350.0	Siltstone and mudstone.			

ROTARY DRILL RECORD

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
350.0	355.0	Coaly mudstone.			
355.0	364.0	Pebble conglomerate.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-19

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 24, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 284 feet
DEPTH LOGGED: 276 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 57+00, 3+00W
T.P.C.S. COORDINATES: 22,611,140 North -216,260 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 276 feet
CUTTINGS LOGS FROM 276 to 284 feet
OVERBURDEN DEPTH: 7.5 feet
WATER TABLE DEPTH: 237 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.5	Overburden.			
7.5	51.7	Pebble conglomerate with sandstone			
		interbeds.			
51.7	57.6	Coaly mudstone.			
57.6	59.4	Light grey mudstone.			
59.4	64.3	Coaly mudstone.			
64.3	74.0	Dark brown mudstone.			
74.0	78.0	Dense sandstone (?MARKER).			
78.0	81.0	Grey siltstone.			
81.0	83.0	Coaly mudstone.			
83.0	101.3	Light grey siltstones.			
101.3	103.3	Dirty COAL (2.0 feet).			
103.3	104.6	Dark grey mudstone.			
104.6	120.3	COAL with mudstone partings (15.7 feet).	107	112	C-56
120.3	122.0	Soft, coaly mudstone.	112	117	C-57
122.0	147.0	Dark brown and dark grey siltstones and	117	124	C-58
		mudstones.	(Driller's intersections)		
147.0	184.0	Interbedded sandstones and siltstones.			
		092032			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
184.0	200.0	Light grey siltstones with dark grey mudstone partings.			
200.0	206.5	Carbonaceous mudstone.			
206.5	233.0	Light grey siltstones with dark grey mudstone partings.			
233.0	239.0	Black coaly mudstone.			
239.0	242.0	Interbedded dark grey mudstone and carbonaceous mudstone.			
242.0	267.0	Light grey siltstone.			
267.0	270.0	Carbonaceous mudstone.			
270.0	284.0	Pebble conglomerate.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-20

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 24-25, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 384 feet
DEPTH LOGGED: 368 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 57+00, 1+00W
T.P.C.S. COORDINATES: 22,611,140 North -216,060 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 368 feet
CUTTINGS LOGS FROM 368 to 384 feet
OVERBURDEN DEPTH: 7 feet
WATER TABLE DEPTH: 178 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.0	Overburden.			
7.0	137.5	Pebble conglomerate with sandstone			
		interbeds.			
137.5	189.0	Dark brown and dark grey siltstone with			
		mudstone partings.			
189.0	205.0	Mudstone.			
205.0	211.0	Siltstone.			
211.0	220.0	Mudstone.			
220.0	232.6	Siltstone.	(Driller's Footages)		
232.6	252.7	COAL (20.1 feet).	239	244	C-59
252.7	256.4	Dark grey and dark brown mudstone with	244	250	C-60
		carbonaceous mudstone partings.	250	253	C-61
256.4	262.9	COAL (6.5 feet).			
262.9	281.0	Dark brown and dark grey mudstone,			
		passing down into:			
281.0	299.6	Medium grey siltstones with sandy			
		interbeds.			
299.6	326.8	COAL (27.2 feet).	308	310	C-62
326.8	338.0	Medium grey siltstones.	310	314	C-63

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
338.0	342.5	Sandstone.	314	319	C-64
342.5	361.0	Medium grey siltstones.	319	324	C-65
361.0	384.0	Pebble conglomerate with sandstone interbeds.			
		Note: Resolution and definition on the E-logs among the best obtained for any hole. Could be used as standard for interpretations of Tantalus lithologies. (Probably indicates that hole is approximately normal to bedding.)			

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ROTARY DRILL RECORD

HOLE NO.: C-77-21

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2950
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 26-27, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 628 feet
DEPTH LOGGED: 548 feet
LOGS RUN: Gamma, Resistivity, L.S. Density
GRID LOCATION: Line 53+70, 1+30W
T.P.C.S. COORDINATES: 22,610,810 North -216,090 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 548 feet
CUTTINGS LOGS FROM 548 to 628 feet
OVERBURDEN DEPTH: 4 feet
WATER TABLE DEPTH: 372 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	4.0	Overburden.			
4.0	332.5	Pebble conglomerate with sandstone inter-			
		beds. Soft, fractured zones at approx.			
		160' & 230' where air and cuttings lost.			
332.5	334.1	Mudstone.			
334.1	335.8	Dirty COAL (1.7 feet).			
335.8	351.0	Interbedded mudstone and black			
		carbonaceous mudstone.			
351.0	356.1	Dirty COAL (5.1 feet).			
356.1	360.2	Black carbonaceous mudstone.			
360.2	375.0	COAL (14.8 feet).			
375.0	383.1	Black carbonaceous mudstone.			
383.1	401.9	COAL (18.8 feet).			
401.9	628.0	Lithology uncertain - appears to be			
		interbedded siltstones and sandstones,			
		possibly passing down into pebble			
		conglomerate somewhere below 548 feet.			
		092032			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-22

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 28, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 304 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 60+00, 2+10E
T.P.C.S. COORDINATES: 22,611,440 North -215,745 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH:

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES FROM	SAMPLES TO	SAMPLES NO.
0.0	9.0	Overburden.			
9.0	26.0	Interbedded Coal, carbonaceous mudstone			
		and mudstone.	(Drillers footages)		
26.0	56.5	Dirty COAL (31.5 feet)	30	35	C-66
56.5	60.0	Dark brown mudstone with coaly partings.	35	44	C-67
			47	52	C-68
60.0	68.4	COAL (8.4 feet).	52	57	C-69
68.4	71.1	Dark grey and dark brown mudstone.	64	70	C-70
			70	73	C-71
71.1	79.1	Dirty COAL (8.0 feet).			
79.1	101.7	Interbedded mudstone, carbonaceous mud-			
		stone and coal.			
101.7	108.0	COAL (6.3 feet).	105	110	C-72
108.0	121.5	Dark grey mudstone.			
121.5	146.7	Light grey siltstone with mudstone			
		partings.			
146.7	152.7	Coaly mudstone with mudstone partings.			
152.7	183.3	Light grey siltstone with mudstone			
		partings.			
183.3	194.8	Interbedded black coaly mudstone and			
		mudstone. 092032			

ROTARY DRILL RECORD

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
194.8	246.0	Light grey siltstone with interbeds of dark grey mudstone.			
246.0	282.0	Conglomerate with sandstone interbeds.			
282.0	284.5	Mudstone.			
284.5	286.0	Dense sandstone (?MARKER).			
286.0	304.0	Siltstone.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-23

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 28-29, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 304 feet
DEPTH LOGGED: 296 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 60+00, 4+05E
T.P.C.S. COORDINATES: 22,611,440 North -215,555 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 296 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 4 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	4.0	Overburden.			
4.0	27.0	Dark grey and dark brown mudstone and			
		siltstone.			
27.0	35.0	?Conglomerate (or sandstone).			
35.0	42.1	Dark grey and dark brown mudstone.	(Driller's footages)		
42.1	56.6	COAL (14.5 feet)	44	49	C-73
56.6	60.0	Sandstone.	49	54	C-74
60.0	63.5	Dark grey mudstone.	54	58	C-75
63.5	67.8	Dirty COAL, passing down into:	66	71	C-76
67.8	75.5	Coaly mudstone, passing down into:	71	74	C-77
75.5	84.4	Light grey siltstone and mudstone.			
84.4	100.8	Interbedded mudstone and coaly mudstone.			
100.8	120.0	Mudstone.			
120.0	304.0	?Conglomerate (or sandstone) with mud-			
		stone interbands.			
		Note: (1) gradual increase in rock den-			
		sity over the interval 220-250 ft.			
		(2) may not be Tantalus lithologies			
		throughout. 092032			

ROTARY DRILL RECORD

PRELIMINARY

HOLE NO.: C-77-24

COMPANY: Cyprus Anvil Mining Corporation

PROPERTY: Carmacks North

LEASE/LOT/CLAIM NO.: C.M.L. #2959

PROVINCE/TERRITORY: Yukon

DRILLING CONTRACTOR: Midnight Sun

DATE(S) DRILLED: June 29, 1977

LOGGING CONTRACTOR: Data Probe

DATE LOGGED: July 13, 1977

DEPTH DRILLED: 304 feet

DEPTH LOGGED: 298 feet

LOGS RUN: Gamma, L.S. Density

GRID LOCATION: Line 60+00, 6+05E

T.P.C.S. COORDINATES: 22,611,440 North -215,355 East Elevation:

LOCATION SURVEYED: No

DOWN-HOLE SURVEY METHODS: None

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

CUTTINGS LOGGED BY: R. P. Hill

E-LOGS INTERPRETED BY: R. P. Hill

SAMPLES ANALYSED BY: -

DEPTHS DETERMINED FROM:

E-LOGS FROM 0 to 298 feet

CUTTINGS LOGS FROM to

OVERBURDEN DEPTH: 9 feet

WATER TABLE DEPTH: None

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	9	Overburden.			
9	195	?Conglomerate with sandstone interbeds.			
195	206	?Sandstone.			
206	237	Dark gr y to black mudstone.			
237	304	Light grey sandstone, siltstone and			
		mudstone, passing down into pebble			
		conglomerate at approx. 292 feet.			
		Note: Lithologies uncertain. May			
		not be Tantalus.			

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ROTARY DRILL RECORD

PRELIMINARY

HOLE NO.: C-77-25

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2950
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: June 29, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 304 feet
DEPTH LOGGED: 300 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 60+00, 8+05E
T.P.C.S. COORDINATES: 22,611,440 North -215,150 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 300 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH: 280 feet

DEPTH	AZIMUTH	DIP
-	-	-90^{0}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	9	Overburden.			
9	304	Probably pebble conglomerate with			
		sandstone interbeds throughout.			
		(May be non-Tantalus lithologies).			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-26

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 6, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 304 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 73+70, 1+60W
T.P.C.S. COORDINATES: 22,612,805 North -216,125 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 12 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	12.0	Overburden.			
12.0	15.0	Coaly mudstone.			
15.0	21.7	COAL (6.7 feet).			
21.7	51.9	Interbedded mudstone and carbonaceous mudstone.			
51.9	57.4	COAL (5.5 feet).			
57.4	65.5	Mudstone and siltstone.			
65.5	68.3	Dirty COAL (2.8 feet).			
68.3	97.5	Mudstone and siltstone.			
97.5	99.0	Dense sandstone (?MARKER).			
99.0	102.5	Siltstone and mudstone.			
102.5	104.0	Dense sandstone (?MARKER).			
104.0	115.5	Siltstone and mudstone.			
115.5	117.5	Dense sandstone (?MARKER).			
117.5	123.6	Siltstone and mudstone.			
123.6	143.5	Interbedded coal, coaly mudstone and mudstone (coal about 30%).			
143.5	155.0	Siltstone and mudstone.	092032		
155.0	157.0	Dense sandstone (?MARKER).			

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
157.0	168.5	Siltstone and mudstone.			
168.5	170.5	Dense sandstone (?MARKER).			
170.5	182.0	Siltstone and mudstone.			
182.0	188.5	?Coaly mudstone.			
188.5	190.5	Dense sandstone (?MARKER).			
190.5	201.8	Siltstone and mudstone.			
201.8	217.5	Interbedded mudstone and coaly mudstone.			
217.5	227.0	Siltstone and mudstone.			
227.0	228.5	Dense sandstone (?MARKER).			
228.5	252.0	Interbedded coal, coaly mudstone and mudstone.			
252.0	274.0	Siltstone and mudstone.			
274.0	304.0	Pebble conglomerate with sandstone interbeds.			
		Note: Gamma log poorly defined and density log erratic, hence lithological interpretation open to question.			
		092032			

ROTARY DRILL RECORD

HOLE NO.: C-77-27

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 6-7, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 13, 1977
DEPTH DRILLED: 344 feet
DEPTH LOGGED: 335 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 60+00, 3+05E
T.P.C.S. COORDINATES: 22,611,440 North -215,655 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 335 feet
CUTTINGS LOGS FROM 335 to 344 feet
OVERBURDEN DEPTH: 18 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	18.0	Overburden.			
18.0	234.0	Pebble conglomerate with sandstone			
		interbeds.			
234.0	237.0	Dense sandstone (?MARKER).			
237.0	276.5	Pebble conglomerate with sandstone			
		interbeds.	(Driller's Footage)		
276.5	286.2	COAL (9.7 feet).	276	281	C-78
286.2	287.2	Mudstone.	281	286	C-79
287.2	289.8	Dirty COAL (2.6 feet).	286	290	C-80
289.8	315.0	Interbedded mudstone and coaly mudstone			
315.0	326.0	Mudstone.			
326.0	344.0	Light grey siltstone.			
		092032			

ROTARY DRILL RECORD

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 7-8, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 364 feet
DEPTH LOGGED: 369 feet (!)
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 68+00, 1+65E
T.P.C.S. COORDINATES: 22,612,240 North -215,800 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 369 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 5 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES FROM	SAMPLES TO	SAMPLES NO.
0.0	5.0	Overburden.			
5.0	42.0	Dark grey and dark brown mudstones and siltstones.			
42.0	44.0	Dense sandstone (?MARKER).			
44.0	57.5	Dark grey and dark brown mudstones and siltstones.			
57.5	59.0	Dense sandstone (?MARKER).			
59.0	68.5	Dark grey and dark brown mudstones and siltstones.			
68.5	72.3	COAL (3.8 feet).			
72.3	74.2	Dark grey mudstone.			
74.2	77.0	COAL (2.8 feet).			
77.0	92.0	Mudstone, possibly coaly.			
92.0	94.5	Mudstone.			
94.5	103.0	Mudstone, possibly with coaly bands.			
103.0	190.0	Siltstone and/or mudstone.			
190.0	302.2	Pebble conglomerate with sandstone and mudstone interbeds.			
302.2	308.4	COAL (6.2 feet).			

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ROTARY DRILL RECORD

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
308.4	319.1	Interbedded coal, coaly mudstone and			
		mudstone.			
319.1	369.0	Medium grey mudstone and siltstone.			
		Note: E-logs poorly defined.			
		Lithological interpretation open			
		to question.			

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ROTARY DRILL RECORD

PRELIMINARY

HOLE NO.: C-77-29

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 8, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 297 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 67+90, 2+70E
T.P.C.S. COORDINATES: 22,612,235 North -215,695 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 297 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 7 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90^{o}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.0	Overburden.			
7.0	89.0	Dark brown and dark grey siltstones			
		with interbeds of mudstone and sand-			
		stone.			
89.0	182.0	Pebble conglomerate with sandstone			
		interbeds.			
182.0	189.7	COAL (7.7 feet).			
189.7	192.6	Mudstone.			
192.6	194.4	Dirty COAL (1.8 feet).			
194.4	270.0	Light grey siltstone with sandstone			
		interbeds.			
270.0	303.0	Pebble conglomerate.			

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PRELIMINARY

ROTARY DRILL RECORD

HOLE NO.: C-77-30

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 9, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 289 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 67+80, 3+70E
T.P.C.S. COORDINATES: 22,612,220 North -215,595 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 289 feet
CUTTINGS LOGS FROM 289 to 303 feet
OVERBURDEN DEPTH: 4 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	4	Overburden.			
4	80	Siltstones with mudstone and sandstone interbeds.			
80	125	Pebble conglomerate with sandstone interbeds.			
125	133	Mudstones.			
133	303	Pebble conglomerate with sandstone and mudstone interbeds.			
		Note: May include non-Tantalus lithologies.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-31 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 9, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 67+60, 5+70E
T.P.C.S. COORDINATES: 22,612,195 North -215,395 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: R. P. Hill
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 5 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	5	Overburden.			
5	303	Pebble conglomerate with sandstone,			
		siltstone and mudstone interbeds.			
		Note: Lithology uncertain - may be			
		non-Tantalus lithologies.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-32 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 10, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 301 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 67+30, 7+70E
T.P.C.S. COORDINATES: 22,612,165 North -215,195 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 301 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 5 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0	5	Overburden.			
5	282	?Pebble conglomerate with sandstone,			
		siltstone and mudstone interbeds,			
		2" of coal at approx. 192 feet.			
282	303	Siltstone.			
		Note: Lithologies uncertain - may			
		not be Tantalus.			

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ROTARY DRILL RECORD

PRELIMINARY HOLE NO.: C-77-33

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 10, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 299 feet
LOGS RUN: Gamma and L.S. Density
GRID LOCATION: Line 68+00, 0+50E
T.P.C.S. COORDINATES: 22,612,250 North -215,910 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 299 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 19 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	19.0	Overburden.			
19.0	65.0	Siltstone with sandstone and mudstone interbeds.			
65.0	71.5	Mudstone.			
71.5	73.0	Sandstone.			
73.0	91.0	Mudstone and coaly mudstone.			
91.0	92.5	Dense sandstone (?MARKER).			
92.5	103.0	Mudstone.			
103.0	112.0	Siltstone.			
112.0	148.0	Interbedded coal, coaly mudstone and mudstone.			
148.0	162.0	Mudstone.			
162.0	165.0	Dense sandstone (?MARKER).			
165.0	189.5	Mudstones and siltstones.			
189.5	191.5	Dense sandstone (?MARKER).			
191.5	213.0	Mudstones and siltstones.			
213.0	214.5	Dense sandstone (?MARKER).			
214.5	216.4	Siltstone. 092032			
216.4	222.5	Dirty COAL (6.1 feet).			

ROTARY DRILL RECORD

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
222.5	236.5	Mudstone and siltstone.			
236.5	244.6	Interbedded coal, coaly mudstone and mudstone.			
244.6	258.0	Coaly mudstone.			
258.0	265.6	Mudstone and siltstone.			
265.6	274.7	COAL with mudstone partings (9.1 feet).			
274.7	282.0	Mudstone and siltstone.			
282.0	286.0	Coaly mudstone.			
286.0	303.0	Mudstones and siltstones, passing down into sandstone.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-34

COMPANY: Cyprus Anvil Mining Corp.
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 11, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 14, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 299 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 76+00, 1+15W
T.P.C.S. COORDINATES: 22,613,035 North -216,080 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 299 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 7 feet
WATER TABLE DEPTH: None

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.0	Overburden.			
7.0	20.0	Sandstone.	(Driller's footage)		
20.0	29.6	COAL (9.6 feet).	21	26	C-81
29.6	32.5	Mudstone.	26	31	C-82
32.5	51.8	COAL with mudstone interbeds (19.3 ft.).	33	38	C-83
51.8	55.8	Mudstone.	38	43	C-84
55.8	60.3	Dirty COAL (4.5 feet).	43	48	C-85
60.3	62.4	Mudstone.	48	51	C-86
62.4	65.1	Coaly mudstone.			
65.1	69.9	Mudstone.			
69.9	76.5	COAL (6.6 feet).	71	77	C-87
76.5	106.0	Interbedded siltstones and mudstones.			
106.0	107.0	Dense sandstone (?MARKER).			
107.0	110.0	Mudstone.			
110.0	118.5	Coaly mudstone.			
118.5	121.0	Mudstone.			
121.0	122.5	Dense sandstone (?MARKER).			
122.5	127.5	Siltstone and mudstone. 092032			
127.5	128.5	Dense sandstone (?MARKER).			

ROTARY DRILL RECORD

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
128.5	133.0	Siltstone and mudstone.			
133.0	146.0	Interbedded coal, coaly mudstone and			
		mudstone.			
146.0	152.0	Siltstone and mudstone.			
152.0	158.0	Interbedded coal, coaly mudstone and			
		mudstone.			
158.0	167.3	Siltstone and sandstone.			
167.3	180.8	COAL with coaly mudstone partings	168	174	C-88
		(13.5 feet).	174	179	C-89
180.8	183.0	Siltstone.			
183.0	185.2	Dirty COAL (2.2 feet).			
185.2	203.0	Mudstones and siltstones.			
203.0	205.0	Dense sandstone (?MARKER).			
205.0	218.0	Mudstones and siltstones.			
218.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-35 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 11, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 260 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 76+00, 0+15W
T.P.C.S. COORDINATES: 22,613,035 North -215,980 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 260 feet
CUTTINGS LOGS FROM 260 to 303 feet
OVERBURDEN DEPTH: 3 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	3.0	Overburden.			
3.0	4.5	Mudstone.			
4.5	8.8	COAL (4.3 feet).			
8.8	24.0	Interbedded coal, coaly mudstone and			
		mudstone.			
24.0	45.8	Siltstones and mudstones.	(Driller's footages)		
45.8	53.8	COAL with mudstone partings (8.0 feet).	46	53	C-90
53.8	56.6	Mudstone.			
56.6	59.2	Coaly mudstone.			
59.2	92.0	Mudstones and siltstones.			
92.0	200.0	Pebble conglomerate with sandstone			
		interbeds.			
200.0	201.8	Mudstone.			
201.8	213.2	COAL (11.4 feet).	203	208	C-91
213.2	217.0	Coaly mudstone.	208	213	C-92
217.0	234.6	Mudstone and siltstone.			
234.6	236.6	Coaly mudstone.			
236.6	260.0	?Pebble conglomerate with sandstone			
		interbeds.	092032		
260.0	303.0	Lithology uncertain.			

ROTARY DRILL RECORD

PRELIMINARY
HOLE NO.: C-77-36

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 12, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 295 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+75, 1+90E
T.P.C.S. COORDINATES: 22,612,515 North -215,780 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 295 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	9.0	Overburden.			
9.0	24.7	Lithology uncertain - possibly pebble			
		conglomerate.			
24.7	26.3	Coaly mudstone.			
26.3	33.5	Mudstone and siltstone.			
33.5	35.4	Coaly mudstone.			
35.4	53.0	Mudstone - HIGHLY RADIOACTIVE ZONE.			
53.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			
		Note: May not be Tantalus lithologies.			

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ROTARY DRILL RECORD

HOLE NO.: C-77-37 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 12, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+60, 3+90E
T.P.C.S. COORDINATES: 22,613,000North -215,580 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 8 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES FROM	SAMPLES TO	SAMPLES NO.
0.0	8.0	Overburden.			
8.0	62.5	Pebble conglomerate with sandstone interbeds.			
62.5	98.0	Mudstones and siltstones.			
98.0	225.0	Pebble conglomerate with sandstone interbeds.			
225.0	254.0	Siltstones and sandstones.			
254.0	279.0	Pebble conglomerate with sandstone interbeds.			
279.0	303.0	Lithology uncertain - possibly sandstone and siltstone.			
		Note: May include non-Tantalus lithologies.			
		092032			

ROTARY DRILL RECORD

PRELIMINARY
HOLE NO.: C-77-38

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 13, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 298 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+40, 5+85E
T.P.C.S. COORDINATES: 22,612,985 North -215,380 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 298 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	9.0	Overburden.			
9.0	101.5	Pebble conglomerate with sandstone interbeds.			
101.5	129.0	Sandstone and siltstone.			
129.0	166.0	Pebble conglomerate with sandstone interbeds.			
166.0	176.0	Sandstone and siltstone.			
176.0	188.3	Mudstone.			
188.3	196.2	COAL (7.9 feet).	189	194	C-93
196.2	203.0	Mudstone.	194	196	C-94
203.0	303.0	Pebble conglomerate with sandstone interbeds.			

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ROTARY DRILL RECORD

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 13, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 382 feet
DEPTH LOGGED: 376 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+30, 7+85E
T.P.C.S. COORDINATES: 22,612,970 North -215,180 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 376 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 5 feet
WATER TABLE DEPTH: 324 feet

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	5.0	Overburden.			
5.0	6.8	Coaly mudstone.			
6.8	17.0	Mudstone.			
17.0	165.0	Pebble conglomerate with sandstone			
		interbeds.			
165.0	172.3	Mudstone and siltstone.			
172.3	175.6	Dirty COAL (3.3 feet).			
175.6	176.7	Siltstone.			
176.7	183.0	COAL (6.3 feet).	178	183	C-95
183.0	186.8	Mudstone.			
186.8	192.2	COAL (5.4 feet).			
192.2	204.5	Mudstone and siltstone.			
204.5	205.5	Dense sandstone (?MARKER).			
205.5	210.7	Mudstone.			
210.7	215.0	COAL (4.3 feet).			
215.0	218.9	Siltstone.			
218.9	222.0	COAL (3.1 feet).			
222.0	225.0	Mudstone and siltstone.			
225.0	228.5	Carbonaceous mudstone. 092032			

ROTARY DRILL RECORD

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
228.5	234.8	Mudstone and siltstone.			
234.8	235.9	Carbonaceous mudstone.			
235.9	243.5	Mudstone and siltstone.			
243.5	247.5	Carbonaceous mudstone.			
247.5	250.0	Mudstone.			
250.0	253.0	Dense sandstone (?MARKER).			
253.0	261.0	Interbedded coal and coaly mudstone.			
261.0	263.6	Mudstone.	(Driller's footages)		
263.6	284.6	COAL (21.0 feet).	266	271	C-96
284.6	290.6	Mudstone.	271	276	C-97
290.6	311.1	COAL (20.5 feet).	276	281	C-98
311.1	314.0	Mudstone.	281	286	C-99
314.0	315.0	Dense sandstone (?MARKER).	292	296	C-100
315.0	323.0	Coaly mudstone.	296	302	C-101
323.0	348.0	Mudstone and siltstones.	302	307	C-102
348.0	382.0	Pebble conglomerate with sandstone	307	311	C-103
		interbeds.			

092032

ROTARY DRILL RECORD

HOLE NO.: C-77-40 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 14, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 301 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+80, 0+90E
T.P.C.S. COORDINATES: 22,613,020 North -215,880 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 301 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 9 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90^{0}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	9.0	Overburden.			
9.0	15.0	Mudstones.			
15.0	29.0	Siltstones.			
29.0	116.1	Pebble conglomerate with sandstone			
		interbeds.			
116.1	123.3	COAL (7.2 feet)	116	121	C-104
123.3	126.0	Coaly mudstone.	121	126	C-105
126.0	139.0	Mudstones and siltstones.			
139.0	166.0	Siltstones and sandstones.			
166.0	207.0	Pebble conglomerate with sandstone			
		interbeds.			
207.0	214.0	Siltstones.			
214.0	216.0	Dense sandstone (?Marker).			
216.0	222.0	Siltstones.			
222.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			
		-			

092032

ROTARY DRILL RECORD

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 14, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 300 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 75+10, 9+85E
T.P.C.S. COORDINATES: 22,612,950 North -214,980 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: Cyclone Engineering
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 300 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 12 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90^{0}

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	12.0	Overburden.			
12.0	14.0	Carbonaceous mudstone.			
14.0	22.3	Mudstone.			
22.3	36.0	COAL (13.7 feet).	22	27	C-106
36.0	46.5	Mudstone	27	32	C-107
46.5	57.0	Siltstone.	32	36	C-108
57.0	80.0	Sandstone and siltstone, passing down			
		into :			
80.0	114.5	Pebble conglomerate with sandstone			
		interbeds.			
114.5	116.5	Carbonaceous mudstone.			
116.5	121.0	Mudstone.			
121.0	132.6	Pebble conglomerate.			
132.6	135.0	Carbonaceous mudstone.			
135.0	139.0	Mudstone.			
139.0	160.0	Siltstone.			
160.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			

092032

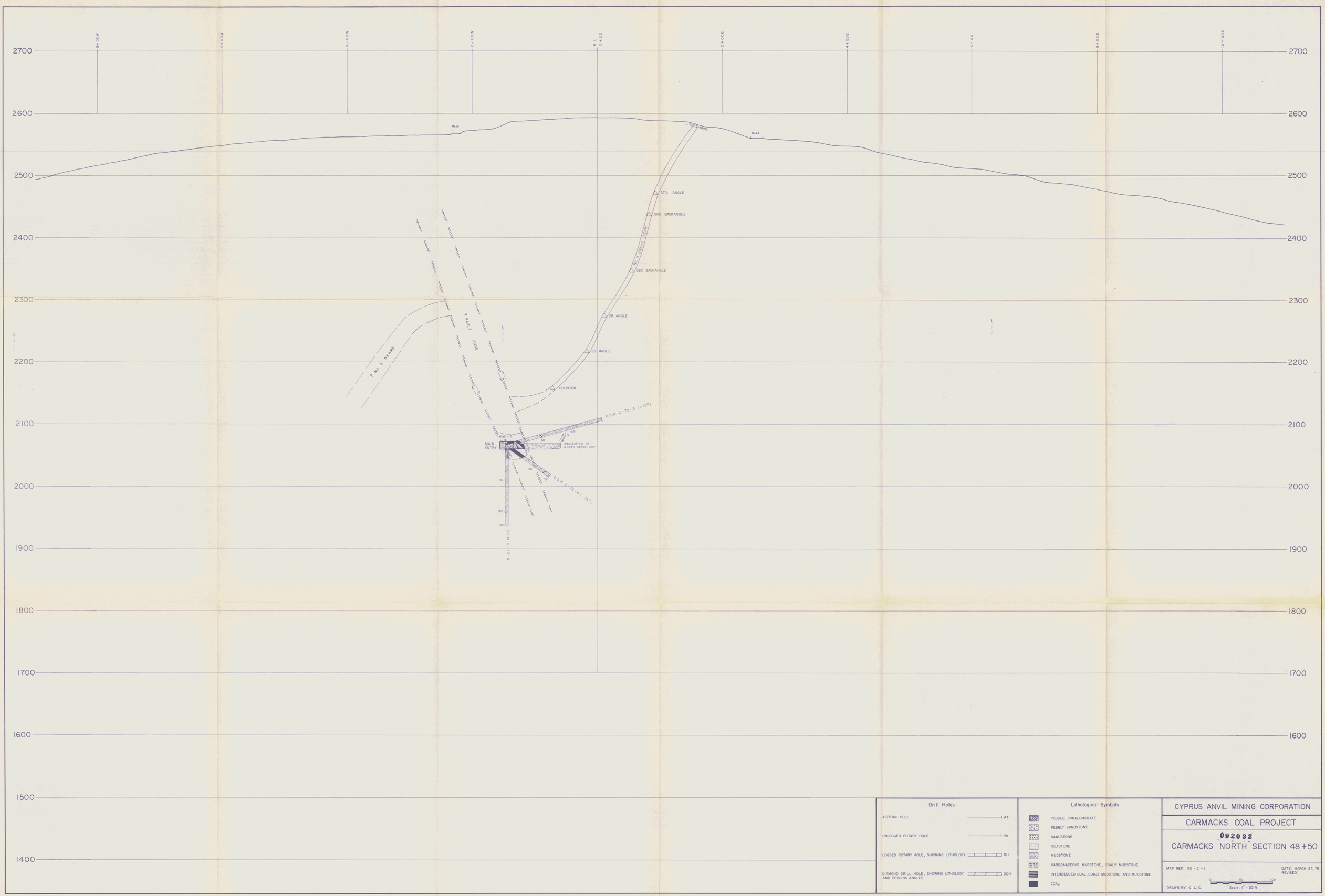
ROTARY DRILL RECORD

HOLE NO.: C-77-42 Page 1 of 1

COMPANY: Cyprus Anvil Mining Corporation
PROPERTY: Carmacks North
LEASE/LOT/CLAIM NO.: C.M.L. #2959
PROVINCE/TERRITORY: Yukon
DRILLING CONTRACTOR: Midnight Sun
DATE(S) DRILLED: July 14, 1977
LOGGING CONTRACTOR: Data Probe
DATE LOGGED: July 22, 1977
DEPTH DRILLED: 303 feet
DEPTH LOGGED: 301 feet
LOGS RUN: Gamma, L.S. Density
GRID LOCATION: Line 77+80, 0+40W
T.P.C.S. COORDINATES: 22,613,220 North -216,005 East Elevation:
LOCATION SURVEYED: No
DOWN-HOLE SURVEY METHODS: None
CUTTINGS LOGGED BY: Driller
E-LOGS INTERPRETED BY: R. P. Hill
SAMPLES ANALYSED BY: -
DEPTHS DETERMINED FROM:
E-LOGS FROM 0 to 301 feet
CUTTINGS LOGS FROM to
OVERBURDEN DEPTH: 7 feet
WATER TABLE DEPTH: -

DEPTH	AZIMUTH	DIP
-	-	-90°

FROM	TO	LITHOLOGIC DESCRIPTION AND COMMENTS	SAMPLES		
			FROM	TO	NO.
0.0	7.0	Overburden.			
7.0	21.8	Mudstones and siltstones.			
21.8	43.1	Interbedded coal, coaly mudstone and			
		mudstone.			
43.1	49.0	Mudstone.			
49.0	61.7	COAL (12.7 feet).			
61.7	65.3	Mudstone.			
65.3	67.3	Dirty COAL (2.0 feet).			
67.3	90.0	Mudstones and siltstones.			
90.0	95.0	Sandstones and siltstones.			
95.0	224.0	Pebble conglomerate with sandstone			
		interbeds.			
224.0	233.5	COAL (9.5 feet).			
233.5	240.0	Mudstones.			
240.0	246.0	Siltstones.			
246.0	303.0	Pebble conglomerate with sandstone			
		interbeds.			
		092032			



Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

CARMACKS NORTH SECTION 48+50

MAP REF: 115 - I - 1

DATE: MARCH 27, 78

REVISED:

DRAWN BY: C. L. C.

Scale: 1" = 50 ft.

Drill Holes		Lithological Symbols	
AIRTRAC HOLE	AT	PEBBLE CONGLOMERATE	
UNLOGGED ROTARY HOLE	RH	PEBBLY SANDSTONE	
LOGGED ROTARY HOLE, SHOWING LITHOLOGY	RH	SANDSTONE	
DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES	DDH	SILTSTONE	
		MUDSTONE	
		CARBONACEOUS MUDSTONE, COALY MUDSTONE	
		INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE	
		COAL	

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

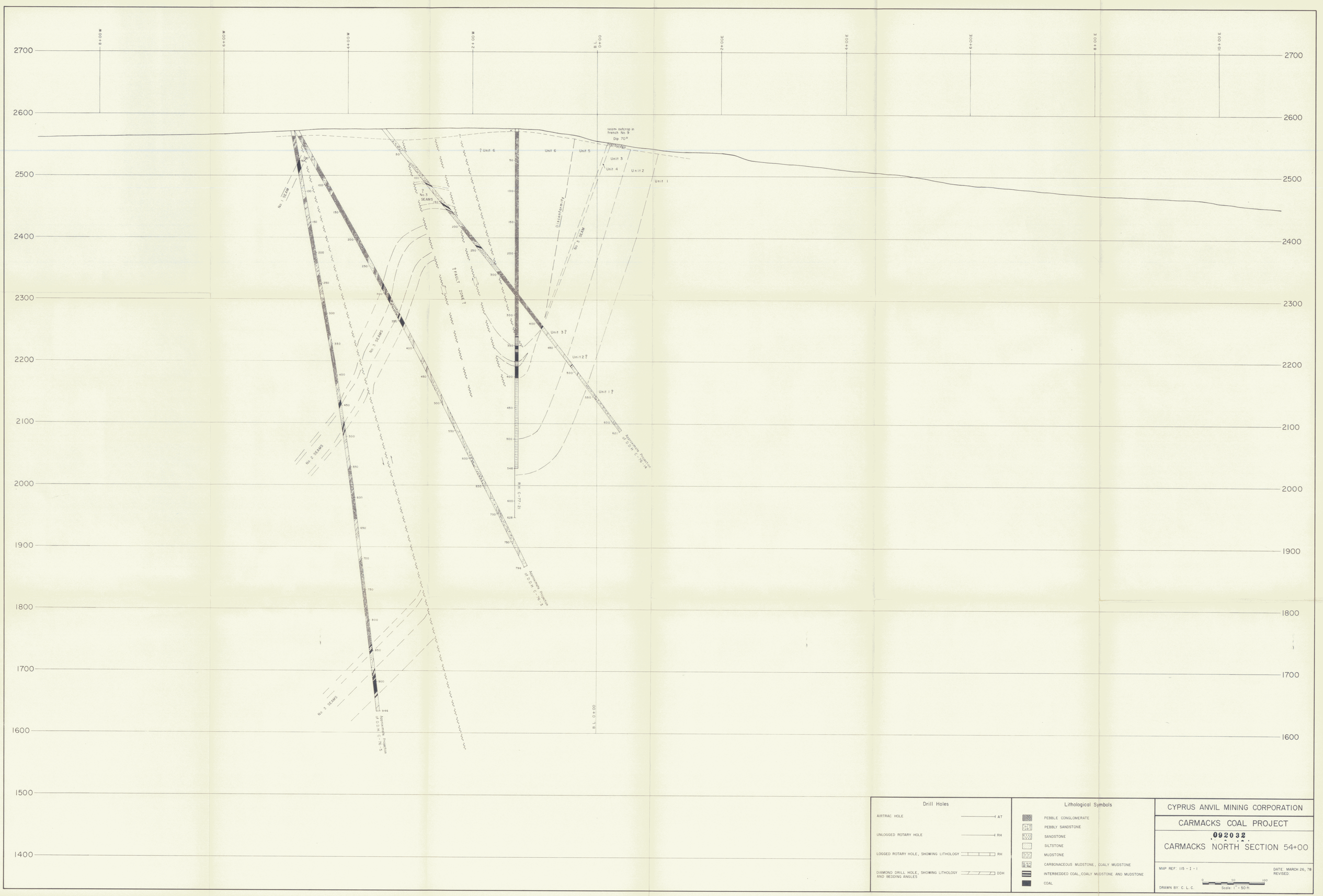
CARMACKS NORTH SECTION 50+00

MAP REF. 115 - I - I

DATE MARCH 26, 78
REVISED

0 50 100
Scale: 1" = 50 ft.

DRAWN BY: C. L. C.



Drill Holes		Lithological Symbols	
AIRTRAC HOLE	AT	PEBBLE CONGLOMERATE	
UNLOGGED ROTARY HOLE	RH	PEBBLY SANDSTONE	
LOGGED ROTARY HOLE, SHOWING LITHOLOGY	RH	SANDSTONE	
DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES	DDH	SILTSTONE	
		MUDSTONE	
		CARBONACEOUS MUDSTONE, COALY MUDSTONE	
		INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE	
		COAL	

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

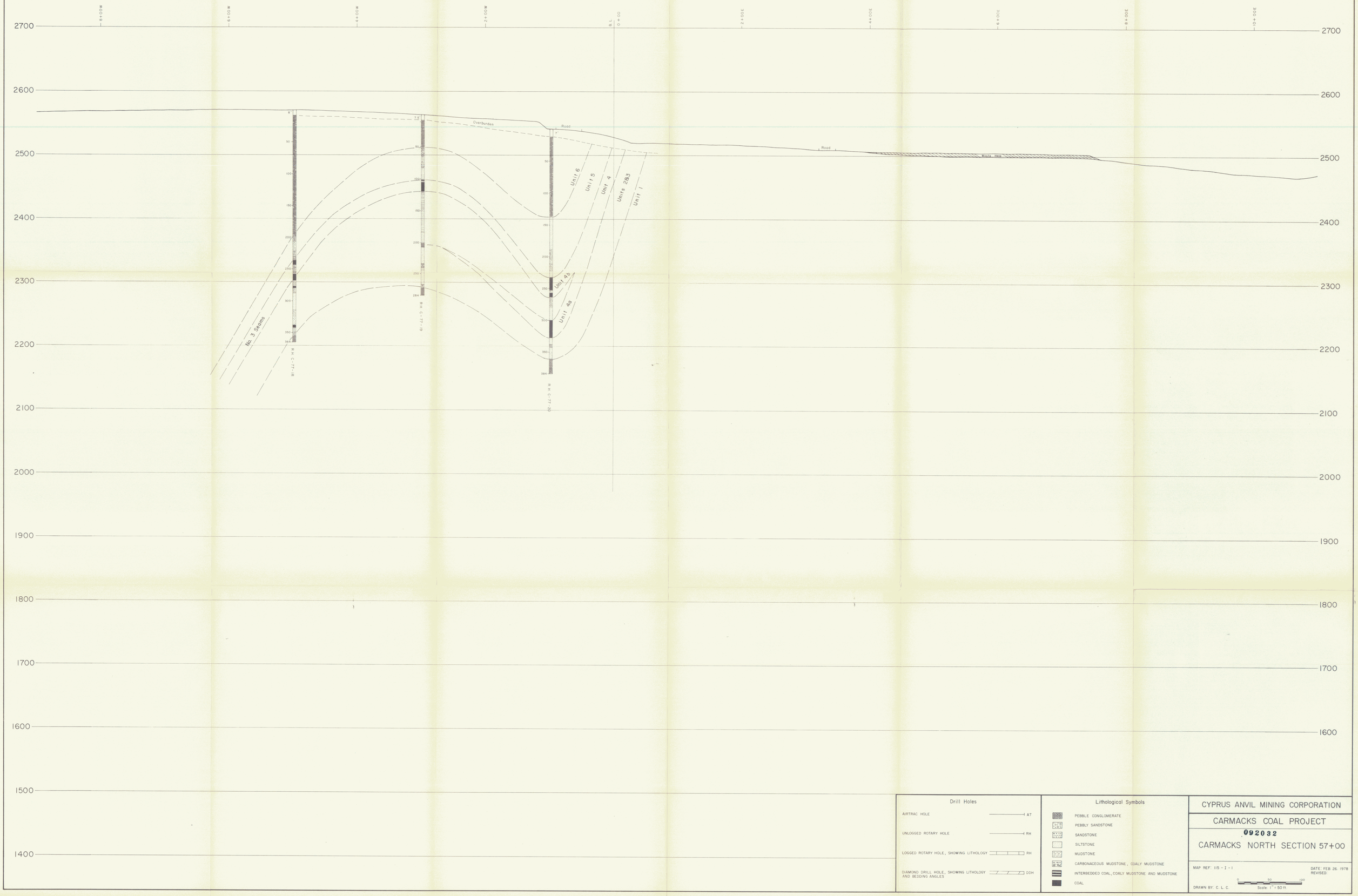
CARMACKS NORTH SECTION 54+00

MAP REF: 115 - I - 1

DATE: MARCH 26, 78
REVISED:

DRAWN BY: C. L. C.

Scale: 1" = 50 ft.



Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

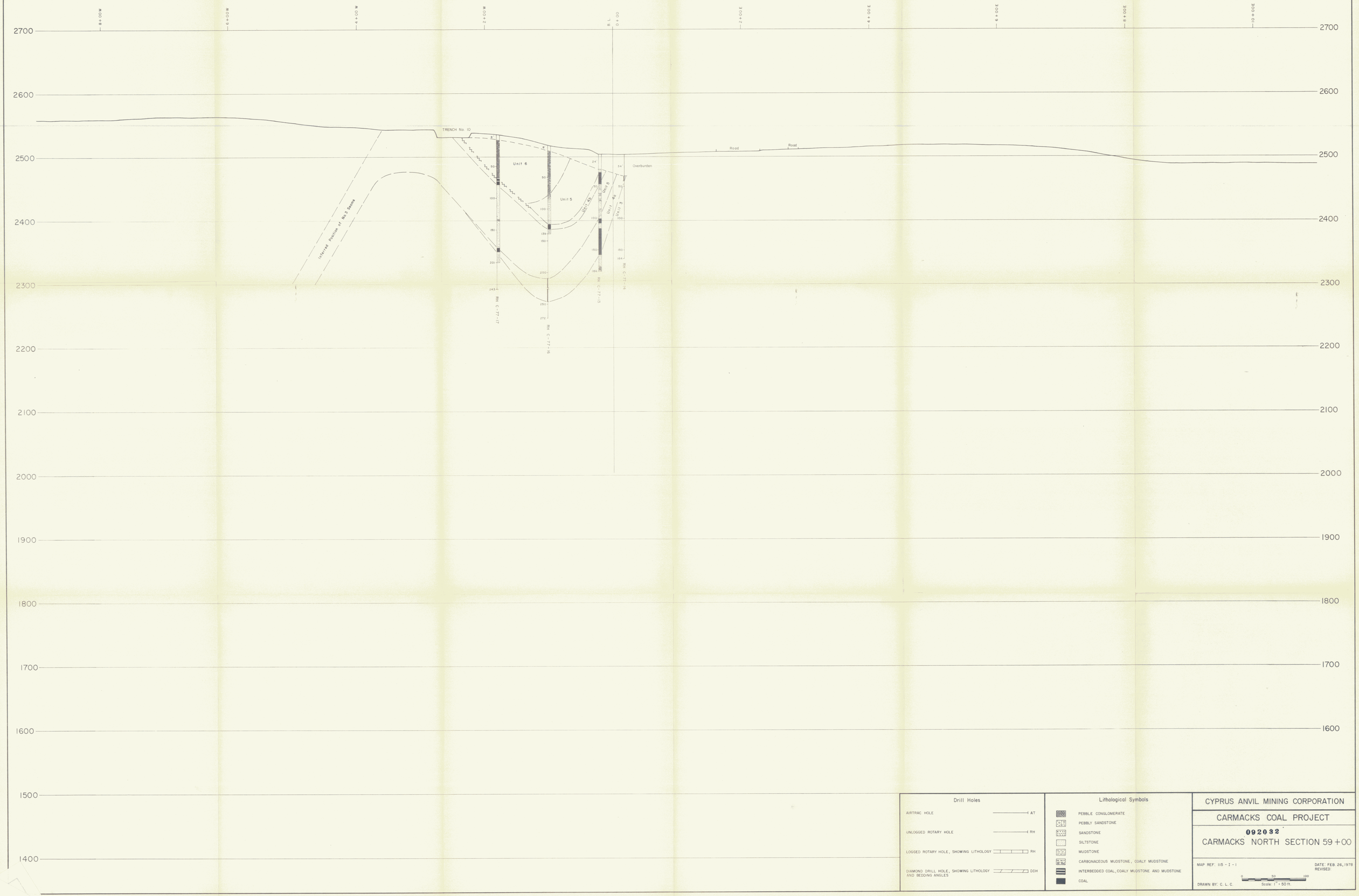
CARMACKS NORTH SECTION 57+00

MAP REF: 115 - I - 1

DATE: FEB 26. 1978
REVISED:

0 50 100
Scale: 1" = 50 ft.

DRAWN BY: C. L. C.


8+00W
6+00W
4+00W
2+00W
B.L.
0+00
2+00E
4+00E
6+00E
8+00E
10+00E
2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400
TRENCH No. 10
Road
Road
Overburden
Unit 6
Unit 5
Unit 4B
Unit 4A
Unit 3
Inferred Position of No.5 Seams
RH C-77-17
RH C-77-16
RH C-77-15
RH C-77-14
Drill Holes
AIRTRAC HOLE
AT
UNLOGGED ROTARY HOLE
RH
LOGGED ROTARY HOLE, SHOWING LITHOLOGY
RH
DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES
DDH
Lithological Symbols
PEBBLE CONGLOMERATE
PEBBLY SANDSTONE
SANDSTONE
SILTSTONE
MUDSTONE
CARBONACEOUS MUDSTONE, COALY MUDSTONE
INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
COAL
CYPRUS ANVIL MINING CORPORATION
CARMACKS COAL PROJECT
092032
CARMACKS NORTH SECTION 59+00
MAP REF. 115 - I - 1
DATE: FEB 26, 1978
REVISED:
0
50
100
Scale: 1" = 50 ft.
DRAWN BY: C. L. C.

W
M 8+00
M 6+00
M 4+00
M 2+00
0+00
B
E
3 2+00
3 4+00
3 6+00
3 8+00
3 10+00

2700
2600
2500
2400
2300
2200
2100
2000
1900
1800
1700
1600
1500
1400

Resistivity Anomaly
Resistivity Anomaly
Resistivity Anomaly
Road To Open Pit
Resistivity Anomaly
Resistivity Anomaly
Trench No. 30
Trench No. 29
ROAD
ROAD
70° Dip
65° Dip
75° Dip
?Fault Scarp
OVERBURDEN
OVERBURDEN
Inferred Approximate Position of No. 3 Seams
? Unit 4a
Unit 5
Unit 5
Unit 3
? Unit 4a
No. 3 Seams
? No. 3 Seam ?
? No. 1 Seam
? No. 4 Seam ?
Inferred Fault
Inferred Fault
Inferred Approximate Position of No. 2 Seams
Inferred Approximate Position of No. 3 Seams
RH C-77-5
RH C-77-6
RH C-77-7
RH C-77-8
RH C-77-12
RH C-77-22
RH C-77-23
RH C-77-24
RH C-77-25
RH C-77-27

Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

CARMACKS NORTH SECTION 60+00

MAP REF: 115 - I - 1

DATE: FEB. 1, 1978
REVISED:

0 50 100
Scale: 1" = 50 ft.

DRAWN BY: C. L. C.

M 00+80 | M 00+60 | M 00+40 | M 00+20 | 0+00 | 3 00+20 | 3 00+40 | 3 00+60 | 3 00+80 | 3 01+00

2700 2600 2500 2400 2300 2200 2100 2000 1900 1800 1700 1600 1500 1400

Road

OPEN PIT

OVERBURDEN 28'

Unit 5

Unit 4

Unit 3

Unit 2

RH C-77-3

RH C-77-6

RH C-77-4

DDH C-77-1

37

Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

CARMACKS NORTH SECTION 61+50

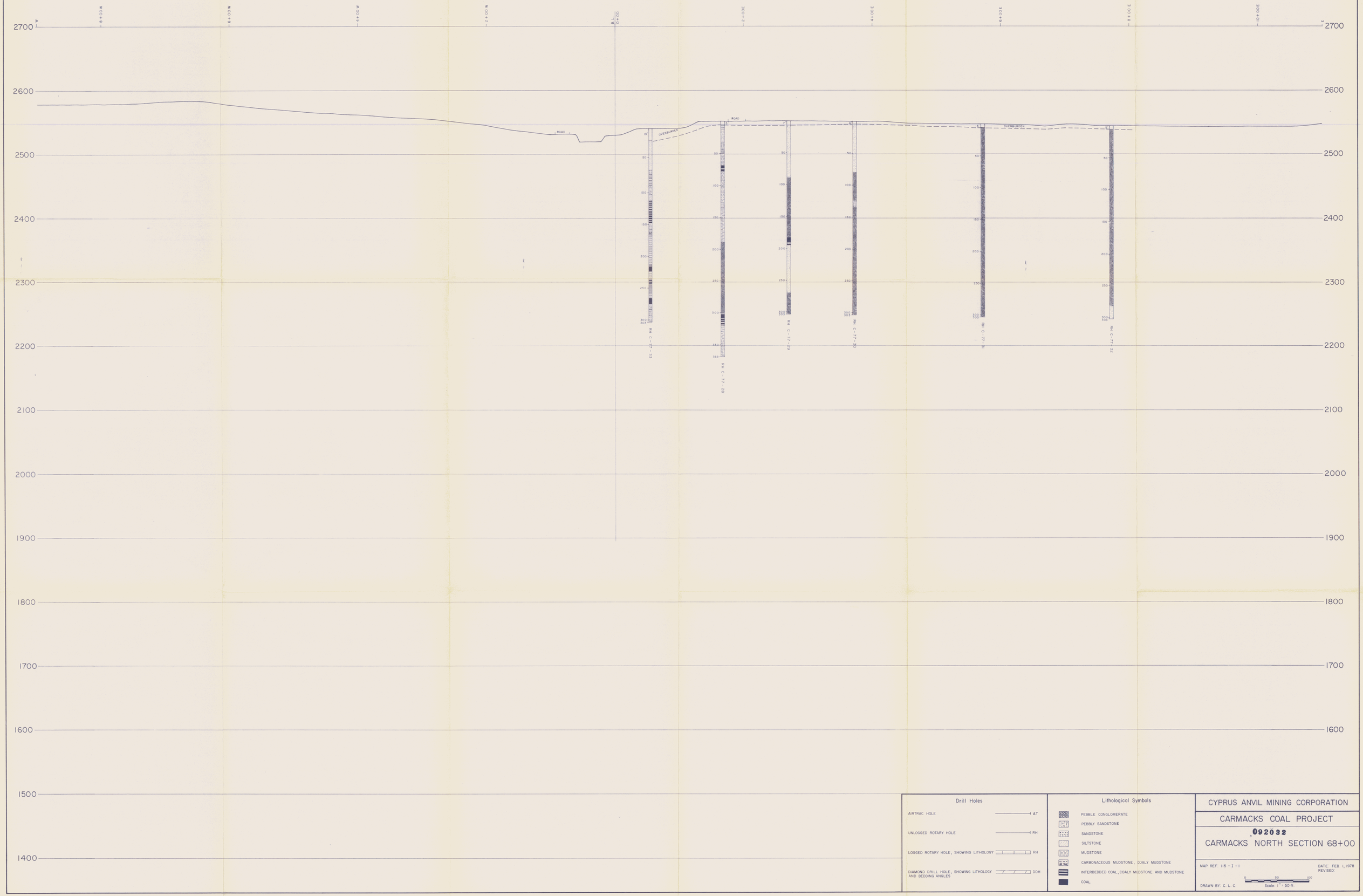
MAP REF: 115 - I - 1

DATE: FEB 22, 1978

REVISED:

DRAWN BY: C. L. C.

Scale: 1" = 50 ft.



Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

CARMACKS NORTH SECTION 68+00

MAP REF: 115 - I - 1

DATE: FEB. 1, 1978
REVISED:

0 50 100
Scale: 1" = 50 ft

DRAWN BY: C. L. C.

W 8+00W 6+00W 4+00W 2+00W 0+00 2+00E 4+00E 6+00E 8+00E 10+00E

STRUCTURE NOT KNOWN IN THIS AREA

ROAD

OVERBURDEN

OVERBURDEN

? No. 1 Seam

? No. 3 Seam

? No. 2 Seam

? No. 1 Seam

? No. 3 Seam

Inferred Approximate Position of No. 1 Seam

? No. 2 Seam

? No. 3 Seams

? No. 1 Seam

Inferred East

RH C-77-34

RH C-77-35

RH C-77-40

RH C-77-36

RH C-77-37

RH C-77-38

RH C-77-39

RH C-77-41

2700 2600 2500 2400 2300 2200 2100 2000 1900 1800 1700 1600 1500 1400

Drill Holes

- AIRTRAC HOLE — AT
- UNLOGGED ROTARY HOLE — RH
- LOGGED ROTARY HOLE, SHOWING LITHOLOGY — RH
- DIAMOND DRILL HOLE, SHOWING LITHOLOGY AND BEDDING ANGLES — DDH

Lithological Symbols

- PEBBLE CONGLOMERATE
- PEBBLY SANDSTONE
- SANDSTONE
- SILTSTONE
- MUDSTONE
- CARBONACEOUS MUDSTONE, COALY MUDSTONE
- INTERBEDDED COAL, COALY MUDSTONE AND MUDSTONE
- COAL

CYPRUS ANVIL MINING CORPORATION

CARMACKS COAL PROJECT

092032

CARMACKS NORTH SECTION 76+00

MAP REF: 115 - I - I

DATE: JAN. 30, 1978

REVISED:

DRAWN BY: C. L. C.

0 50 100

Scale: 1" = 50 ft.