

August 26, 1987

Curragh Resources
2200 Lakeshore Blvd.
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Toronto, Ontario MBV 1A4

Attention: Mr. Marvin Pelley

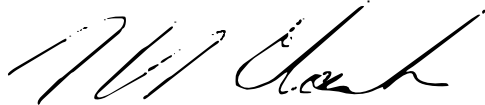
Dear Sir:

I have carried out a technical review on the long range mine plan developed by Curragh Resources and Kilborn. Within a two week period I have endeavoured to identify deficiencies in the plan that may adversely affect the development of the Vangorda and Grum pits. Suggestions that will improve the capital and operating costs have been stated as well.

I have examined the geology, metallurgy, mine plans, capital costs and operating costs. The results of my work are provided as follows.

Respectfully submitted,

H. S. Clarke Mining Consultants Ltd.



H. S. Clarke, P.Eng.
President

TECHNICAL REVIEW
CURRAGH RESOURCES
FARO, YUKON

Table of Contents

		Page
SECTION 1	Geology	1
SECTION 2	Metallurgy	2
SECTION 3	Geotechnical	3
SECTION 4	Mine Drainage	5
SECTION 5	Mine Plan	6
SECTION 6	Operating Costs	11
SECTION 7	Capital Costs	14
SECTION 8	Summary	18
APPENDICES		
APPENDIX 1	Overburden Removal	
APPENDIX 2	Haul Cycles	
APPENDIX 3	Equipment Rates	
APPENDIX 4	Capital Costs	

SECTION 1 - GEOLOGY

1.0 GEOLOGY

The Grum deposit has been adequately explored by drilling and an adit. However, the Vangorda deposit has a weak information base. The information base is particularly weak where the rotary holes are located. The Vangorda deposit requires drilling on a 30m by 30m pattern for at least the first year and a half of mining reserves.

||| The open pit potential of the Swim area should be tested. The discovery of additional open pit reserves may affect the ore transportation method and the development sequence of the Vangorda and Grum pits.

The proposed waste dump areas require drilling prior to their use.

The effect of reducing the cutoff grade to 3% combined lead and zinc should be examined. The lowgrade stockpiles may be increased by two to three million tonnes without lowering the overall grade significantly.

SECTION 2 - METALLURGY

2.0 METALLURGY

A considerable amount of low grade ore will be stockpiled over the life of the mine plan. The effect of oxidized ores on mill recoveries has not been recognized in the mine plan. The extent of oxidation over several years could be qualified by testing the bulk samples extracted from the Grum adit.

The cost of milling the graphitic type A ore from the Grum pit has been excluded from the mine plan. In addition, the extra cost of grinding the fine ore from the Vangorda and Grum pits has been excluded.

Further investigation is required on the economic relationship between fine grinding, mill recoveries and mill productivities.

SECTION 3 - GEOTECHNICAL

3.0 GEOTECHNICAL

The pit designs incorporate reasonable rock slopes. However, the till slopes of 35° for 30m to 100m highwalls are too steep. A more reasonable slope would be 27° .

Bore holes in the Grum pit indicate that the till has a plastic limit of 15% to 20% moisture. The natural bed moisture indicated is usually 3% to 5% lower than the plastic limit. In some instances the natural bed moisture exceeds the plastic limit. Under ideal laboratory conditions the internal angle of friction for compacted till was 35° . A less aggressive design slope is recommended for this till.

A 27° slope can be seeded. Vegetation on the till slope will control surface drainage and slumping. Since the till has a natural bed moisture near the plastic limit a considerable amount of surface slumping can be expected. An adequate access berm will be required to clean up the surface failures.

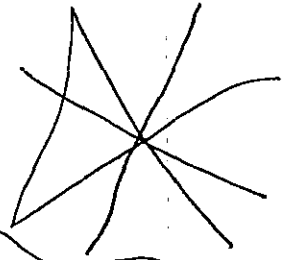
The strength of the till wall can be increased by controlling surface drainage and lowering the groundwater level.

The S.G. of the till is 2.35. This is high for till and indicates this material is dense and may be difficult to dig. Kilborn used an S.G. of 2.1 in their estimates.



Very Interesting

SECTION 4 - MINE DRAINAGE



4.0 MINE DRAINAGE

In the Grum pit consideration should be given to draining the adit as a means of controlling the groundwater. The use of wells to intercept gravel aquifers within the till layer should be investigated.

The drainage of surface water and the construction of diversion ditches should be started as soon as possible in the Grum and Vangorda pits. Early control of surface water will help reduce the moisture content of the gravel and tills.

The Vangorda Creek should be diverted on a temporary basis through the Vangorda pit on a wider bench or around the perimeter of the pit. The waste dump should be located east of the Vangorda Creek. After mining is completed the Vangorda Creek can fill up the pit and return to its original channel. This method will avoid the high cost of constructing a permanent diversion dam and other diversion structures.

The filling of the Vangorda pit with water will prevent the generation of acid water.

SECTION 5 - MINE PLAN

5.1 POWER DISTRIBUTION

A 25 Kv or 35 Kv distribution system has to provide power to the Grum and Vangorda pits at the same time. Therefore, two 35 Kv/4 Kv substations are required. After mining is completed at Vangorda the surplus powerline and substation can be moved to the Grum pit. The additional power line may allow the looping of the Grum pit.

5.2 OVERBURDEN REMOVAL

The Kilborn estimate of cost to remove the overburden by using 657E scrapers is \$0.63 per tonne. The 657E scrapers have a high bearing pressure and may be unsuitable for this project.

I completed a check estimate using the 657E scraper. The check estimate indicates a cost of \$1.03 per tonne.

In addition, I also completed an estimate for removing this overburden with a P&H 15 C.Y. shovel and new 120 ton trucks. The estimated cost includes depreciation and interest on the investment. The truck-shovel cost is \$0.69 per tonne. If existing truck-shovel equipment was used the cost would be \$0.58 per tonne. The truck-

shovel method would save \$0.34 per tonne (\$14,000,000 over seven years) using new equipment. The detailed calculation sheets are in the appendix.

5.3 CONTRACT MINING

If a contractor is used to remove the overburden on a firm price basis the suggestions listed below should be addressed.

- good technical specifications, plans and drawings will result in a lower price,
- a test site or open excavation of the till should be provided for the contractor's and owner's inspection. The contractor can take samples and assess the strength characteristics of the till himself,
- the spare Wabco trucks could be made available to the contractor,
- the owner should identify what he will provide such as fuel, power, accommodation, mine plans, quantity control etc.,
- suitable road material such as gravel should be stockpiled,
- and the owner should have a suitable organization to supervise and design the work to be completed by the contractor.

5.4 HAULING ORE

Two haulroad locations have been designed for the Vangorda and Grum pits. One route is 2.4 Km longer and has more favourable grades. Haul cycles were calculated for both roads. The shorter and more adverse route has a cycle time that is 2 minutes less than the longer route. Detailed calculations are in the appendix.

If another shovel is purchased the M191 shovel may become a spare in the future. The M191 could be used as a low cost loading shovel on the ore stockpile located at the Grum pit.

Tractor-trailer type trucks should be considered for the 14 Km haul to the mill.

5.5 WASTE DUMPS

The till material may be unstable after it is placed in a waste dump. Therefore, the till should be dumped separately from the rock when this is economically possible. This action will prevent the rock dumps from slumping and increasing dump costs.

5.6 EQUIPMENT PRODUCTIVITIES

The four 15 C.Y. shovels should be able to load 32,000,000 tonnes per year. Productivities of

34,000,000 tonnes are possible if availability and utilization are high. However, the ore shovels are currently under utilized because of the low number of trucks on the ore haul. If this practice continues productivities of 30 to 31 million tonnes per year will be achieved. This will cause a shortfall of 4,000,000 tonnes per year in the long range plan. The rehandle stockpile located at the Grum pit should help to reduce the shortfall when the Vangorda pit is operating. In the Grum pit the ore zones are thin. Low bench heights and selective mining of the ore will be required. Some of the cuts planned for the Grum pit are narrow. These conditions will restrict shovel productivities. Therefore, consideration should be given to the use of front end loaders or hydraulic excavators for the selective mining of ore. The ore could be hauled directly to the mill. This procedure would reduce the rehandling of the ore at the stockpile.

Check haul cycles were calculated for the waste and ore hauls. The truck productivities used in the mine plan are reasonable for this type of operation.

The truck requirements increase and decrease drastically in some years. This situation results in abrupt changes in manpower. The truck requirements may be levelized by further planning and study. However, the purchase of a new shovel and 170 ton trucks for overburden removal is the best solution to this problem. The capacity of the shovel can also be

designed to handle any shortfall in production from the existing shovel fleet.

The Euclid trucks are currently carrying 134 tonnes of waste. Alterations should be made to the boxes to allow the trucks to operate at full capacity.

When the Vangorda pit starts production an additional drill should be purchased. A Robins type drill (RR10) could be used for pioneering and production work. Used RR10 drills in good condition are available for \$200,000 to \$300,000. It will be difficult for the two Marion drills to provide the necessary productivity when the Vangorda pit is in the development stage.

An additional dozer will be required for two to three years to build roads and pioneer the Vangorda and Grum pits.

SECTION 6 - OPERATING COSTS

6.1 OVERBURDEN REMOVAL

The Kilborn estimate of \$0.63 per tonne is too low. An allowance of \$1.20 per tonne would be reasonable.

6.2 DRILLING AND BLASTING

Current blasting costs are about \$0.05 per tonne above budget. The higher costs are mainly the result of using slurry explosives for blasting.

6.3 SHOVEL OPERATION

The Marion shovel costs are above normal by about \$50 per hour. The P&H operating costs are close to what other operations are experiencing.

6.4 HAULAGE TRUCKS

The truck operating costs are reasonable for this type of operation.

6.5 FRONT END LOADER

The front end loader costs are above normal by about \$50 per hour. This may reflect the age of the loaders plus the lack of attention that loaders sometimes receive.

6.6 DOZERS

The dozer operating costs are reasonable for this type of operation.

6.7 RUBBER TIRED DOZERS

The rubber tired dozer costs are reasonable. However, the current applied rates for ground engaging tools and maintenance parts are about \$10 per hour too low.

6.8 GRADERS

The current applied rates for the Graders are \$50 per hour too high. The actual costs are probably lower. This situation may be the result of incorrect distribution of maintenance costs in the shop.

6.9 GENERAL OVERHEAD

The operation of the Vangorda and Grum pits will increase overhead costs. Additional supervision will be required to operate the pits. A second shop facility will require a larger number of maintenance employees. Power and heating costs will increase. The separation of the two mining areas by 17 Km will increase fuel and light vehicle costs. The general overhead costs should be increased to cover the expenses mentioned above.

6.10 DEWATERING

The dewatering costs will increase when the Vangorda and Grum pits start operating.

6.11 UNDERGROUND MINING COSTS

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The Canadian Mine Development underground feasibility study is based on high productivities. Approximately 40 men will be employed to produce 1500 tonnes per day or 27 tonnes per manshift (based on an 8 hour shift). The cost of production is estimated to be \$27 per tonne. If this work is contracted out on a firm price basis the costs will probably be about \$35 per tonne. This would provide a reasonable markup for profit and risk.

When development drilling is carried out in the underground mining area the drill holes should be cemented. This action will prevent groundwater from entering the mine workings.

6.12 MILL OPERATIONS

The mill operating costs are reasonable with the exception of the grinding costs. The unit grinding costs may increase 20% when the Vangorda and Grum ores are mined. The effect of milling Vangorda and Grum ores on costs should be investigated further.

SECTION 7 - CAPITAL COSTS

7.0 CAPITAL COSTS

The design status of the proposed structures is conceptual. Additional engineering work is required before final quantities can be determined. This is particularly important for estimating the capital cost of the haulroad. The current estimate of road costs probably has an accuracy of $\pm 50\%$. Financial and manpower resources should be provided for detailed designs. A project team should be organized to supervise the design and construction activities.

7.1 POWER

An additional substation is required for the Vangorda pit.

7.2 BUILDINGS

An allowance of \$1,850,000 should provide a satisfactory service facility. When the service facility is designed the cost of providing services such as sewer, water, power and parking has to be included in the \$1,850,000.

7.3 VANGORDA CREEK DIVERSION

An allowance of \$200,000 is not sufficient for the

construction of a permanent dam and diversion structure. If a temporary diversion structure is built, the \$200,000 allowance may be adequate.

7.4 GRUM WATER CONTROL

The water control work should start in 1988 rather than 1989. The \$1,000,000 allowance should provide reasonably good drainage. However, further geotechnical studies are required on the Grum pit before an accurate estimate of costs can be made.

7.5 WATER CONTROL PONDS

An allowance of \$2,000,000 for two settling ponds is reasonable.

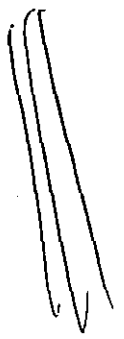
7.6 SHOVEL REBUILDS

The annual shovel operating hours have not been reduced to reflect the time required to spend \$1,000,000 per shovel on rebuilds.

A new shovel will probably have to be purchased to handle the overburden and any shortfall in production from the existing shovel fleet.

7.7 HAUL TRUCKS

New 170 ton trucks could be purchased in 1988 or 1989 if it is decided to purchase a new shovel.



The Wabco trucks will require some overhaul work at 30,000 to 35,000 hours. The Wabco trucks have recorded about 20,000 hours of work per truck at the present time.

7.8 BLASTHOLE DRILL

An additional drill should be purchased for the pioneering work at the Vangorda and Grum pits.

7.9 DOZERS

An additional dozer will be required on a short term basis for building roads and pioneering the Vangorda and Grum pits.

The replacement schedule for the dozers is 5 years rather than 3 years. A shorter replacement schedule will improve operating costs.

7.10 FRONT END LOADERS

The replacement schedule for the loaders may have to be shortened. This situation would occur if the loaders were used as the prime loading machine on the ore.

7.11 MISCELLANEOUS EQUIPMENT

There has been no allowance to replace miscellaneous equipment such as fuel trucks, mechanic trucks, pump trucks and water trucks.

7.12 SALVAGE VALUE

If equipment such as dozers, graders and front end loaders are replaced at 15,000 hrs, 20,000 hrs. and 15,000 hrs. respectively; an allowance for salvage value should be made in the capital cost estimate.

7.13 MILL EXPENDITURES

When the crusher modifications are carried out consideration should be given in the design to the utilization of tractor-trailers. Other haulage vehicles alternatives should be considered as well.

7.14 EXPLORATION

The first year and a half of mining reserves in the Vangorda pit should be drilled well in advance of mining activities.

Regional exploration in the Swim area should be advanced to 1988. Some funds could be spent to determine if there is any open pit potential in this area.

SECTION 8 - SUMMARY

8.0 SUMMARY

The development and mining of the Vangorda and Grum ore deposits is technically feasible.

The main risk associated with this project is the stability of the till highwalls. Geotechnical studies are required to accurately determine the optimum till slope. A properly executed drainage plan will be critical for the long term stability of the till highwalls.

The current operating costs can probably be reduced about \$0.20 per tonne. When the Vangorda pit starts operating in 1989 operating costs will increase as a result of the longer ore haul and diversification of the mine into a two pit operation.

Additional mining equipment will be required for the mining of the Vangorda and Grum pits. The cost of the additional mining equipment and possible cost overruns on construction may increase the total capital requirements by \$15,000,000. However, a major portion of this increase will be offset by savings on operating costs.