GOVERNMENT OF CANADA

NORTHERN AFFAIRS PROGRAM

WHITEHORSE, YK

CURRAGH INC.

REVISED VANGORDA WASTE DUMP PLAN



EVALUATION REPORT

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GOVERNMENT OF CANADA

NORTHERN AFFAIRS PROGRAM WHITEHORSE, YK

CURRAGH INC.

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EVALUATION REPORT

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SECTION 1.0

INTRODUCTION

REVISED VANGORDA WASTE DUMP PLAN

1.0 INTRODUCTION

Robert J. Rodger, P. Eng. was retained by the Government Consulting Group on behalf of the Department of Indian and Northern Affairs (DIAND) Northern Affairs: Program -Whitehorse to review the cost estimates for the Vangorda Waste Rock Containment Facility revised plan submitted by Curragh Inc.

The terms of reference for this review, as presented on February 25, 1993 are as follows:

"review Curragh's modified design of the facility and update by amendment the costing report by PBK Engineering Ltd in 1990".

The study was based on a review of the documents (listed in Appendix I) made available by the Northern Affairs Program.

Verification of the dump stability was not part of the terms of reference of this report, and stability analysis was not conducted on the revised dump. Most of the waste mined from the Vangorda open pit and delivered to the waste dump has the potential to generate acid. Assessment of the impact of the revisions of the dump on water quality was not part of the terms of reference of this report, and no assessment was undertaken of water quality.

It should be noted that the terms of reference did not include review of costs associated with the Vangorda open pit mine closure, site rehabilitation or other closure costs. Therefore, these aspects are not covered in this report.

1.1 VANGORDA OPEN PIT

However, additional waste implies a larger pit. There is no indication in the Curragh Inc. report of the changes in pit dimensions or shape. The southeast end of the final pit was located originally in sulphide bearing rock. This section of the pit was to be filled with waste to an elevation of 1125 m and the sulphide rock in the pit walls was to be covered with till. The balance of the pit was left filled with water to the 1122.5 m elevation. All of these could change with a different pit configuration.

REVISED VANGORDA WASTE DUMP FLAN

SECTION 2.0

REVIEW OF REVISED WASTE DUMP PLAN COSTS

2.0 REVIEW OF REVISED DUMP PLAN COSTS

Curragh Inc. has encountered additional volumes of waste during mining of the Vangorda open pit. As a result, the original waste dump design is no longer able to meet production requirements. Two options were reviewed by Steffen Robertson Kirsten (Canada) Inc. (SRK) for additional. space. One option considered expanding the surface area and increasing the height of the dump from 30 m to 52 m, while the second option considered increasing only the height of the dump to 67 m within the original waste dump configuration. The second option was selected as the most desirable.

In order to construct the waste dump under option 2, it would be necessary to place some of the phyllite waste over the sulphide cell. Curragh Inc. does not expect this to have an impact on the quality of water draining from the dump. It is assumed in this report that this is so.

From its analysis of the stability of the final dump, SRK concluded that the dump would be stable.

The proposed layout (Fig. 4 of the SRK report) does not show access ramps to the waste dump. It is assumed, therefore, that the access ramps would be reworked to eliminate them from the final dump outline.

Comparison of the volumes excavated from the Vangorda open pit are shown in table 2.1

Curragh Inc.

Vangorda Open Pit

Table 2.1 Comparison of Volumes (million bcm)

	<u>Original</u>	Revised
Overburden	2.00	3.95
Sulphide Waste	1.20	0.95
Phyllite	3.10	4.20
Total	6.30	8.10

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From the information originally provided by Curragh Inc., most of the waste mined from the Vangorda open pit and delivered to the waste dump has the potential to generate acid. The two types of waste were to be stored in separate cells within the waste dump, and the cells were to be separated by an internal till berm. Till berms were to be constructed in stages around the perimeter of the dump, prior to waste dumping for that stage. The waste dump was to be constructed over the life of the pit, starting in May

The report outlining the modified design includes a plan which shows the waste dump as built, as of February 1991. That plan indicates that there has been segregation of the sulphide and phyllite waste into separate cells and these cells are separated by an internal till berm, at least on the south side. The design prepared by SRK provided for construction of the dump in 5 m lifts, with the till berm for the subsequent lift constructed prior to placement of the waste rock on that lift. At least some of the waste rock does not appear to have been placed in 5 m lifts. In the February 1991 plan, the till berms around the perimeter of the dump are at about the same elevation as the sulphide waste, but lower than the elevation of the phyllite waste.

The inspection report prepared for DIAND by Geo-Engineering (M.S.T.) Ltd. contains a photograph of the Vangorda Waste Dump as of June 1992. The photograph shows that the waste rock is substantially higher than the till berms.

2.1 COST REVIEW

1990.

2.1.1 Original Waste Dump

The original review of Curragh Inc. Vangorda Plateau Development Closure Plan was undertaken by PBK Engineering Ltd. (Project # 90086) during June 1990.

The estimate of closure costs in 1990 constant dollars for the Vangorda waste dump by PBK Engineering Ltd is shown in Table 2.2. The estimates were based on the work, where possible, being undertaken by contractors. As indicated in the PBK report, many of the mitigation measures are undertaken and the costs incurred over the life of the mining operation.

Vangorda Waste Dump

Table 2.2 Original Closure Cost Summary (1990 constant dollars)

	Quantity	Amount
Berms		
Foundation Preparatio	, no	\$ 225,000
Till Placement	2,370,000 m≊	4,148,000
Dump Cover		
Lower Layer	336,600 m≞	673,000
Upper Layer	683,400 m³	1,146,000
Rock Drains		80,000
Selective Waste		15
Placement	4,296,500 m³	430,000
Erosion Protection	56.3 h	a <u>84,000</u>
Total		\$ 6,786,000

2.1.2 Modified Waste Dump

In order to "review Curragh's modified design of the facility and update by amendment the costing report by PBK Engineering Ltd in 1990" in this section of the report, it is assumed that the waste dump has does not require modification, although it is obvious that this is not so.

Berms

The foundation preparation has been completed over the area of the berms. Till has been placed on the lower berms. The quantity of till to be placed on the remaining berms of the dump has been estimated from the plans prepared by SRK.

Rock Drains

The rock drains have been installed under the starter dykes. There is, therefore, no cost estimate for this item.

Collection Ditch

Water draining from the waste dump flows into a collection ditch constructed around the base of the waste dump. The ditch was supposed to direct the water into a collection pond, but difficulties have been encountered because of the flat slope and sloughing. Curragh Inc. plans to install pipe in the ditch between the rock drains to improve collection. The water is pumped from the pond to the water

treatment plant.

Dump Covers

As designed, the till cover over the dump would be placed in two layers. The lower layer, 1.0 m thick, would be compacted to 95% modified Proctor and the upper layer, 2.0 m thick, would be placed over the first layer, and would be compacted only to 90% modified Proctor by the equipment travelling on the dump. The surface area of the dump covers will be smaller in the revised design. The revised plan also indicates that alternatives to the till cover, such as "Claymax", are being considered to reduce till requirements.

Selective Waste Placement

There is a cost incurred by Curragh Inc. in selectively placing the sulphide and phyllite waste rock in separate piles on the dump. For this report, it is assumed that $1,000,000 \text{ m}^3$ of waste remains to be placed on the dump. The incremental cost is estimated to be \$ $0.12/\text{m}^3$.

Erosion Protection

The top of the dump and the cover would slope towards the east to ensure effective drainage. A runoff discharge pipe would handle drainage from the cover. The balance of the dump would be hydroseeded to prevent erosion.

Basis for Estimates

For the modified waste dump plan, the quantities were estimated from the plans prepared by SRK in the modified design report. Where possible, the estimates reflect the quantity remaining.

The estimates in this report are based on the work, where possible, being undertaken by contractors. Unit cost estimates were reviewed on the basis of in-house data, and compared to rates charged by contractors in Northern B. C. and Yukon as well as the rates contained in the DIAND report entitled "Mine Reclamation in the Northwest Territories and Yukon".

A 20 % contingency was applied to the cost estimate. The amount of contingency, applied to the total estimated cost, depends on the level of engineering required and undertaken on a project. In this case, the design is considered to be conceptual. In addition, there are sufficient uncertainties regarding effectiveness of the proposed covers and other factors that the minimum contingency which should be applied is 20 %.

Engineering, procurement and construction management (EFCM) for this type of project would commonly cost 7 % of the project cost after contingency. This is the percentage used in this review. The quantities and costs for the revised plan are shown in Table 2.3 $\,$

Vangorda Waste Dump

Table 2.3 Revised Closure Cost Summary (1993 constant dollars)

	Quantity	Amount
Berms		
Dump Rework		\$ 450,000
Till Placement	1,620,000 m³	4,860,000
Dump Cover		
Lower Layer	105,000 m³	420,000
Upper Layer	210,000 m³	735,000
Selective Waste		
Placement	1,000,000 m³	120,000
Erosion Protection	48.1 ha	90,000
Other		
Instrumentation		20,000
Subtotal		6,695,000
Contingency (20 %)		1,339,000
Subtotal		8,034,000
Construction Management	(7%)	562,000
TOTAL		\$ 8,596,000

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REVISED VANGORDA WASTE DUMP PLAN

SECTION 3.0

ADMINISTRATION, MONITORING AND MAINTENANCE

3.0 ADMINISTRATION, MONITORING AND MAINTENANCE

The SRK report on the modified design for the waste dump outlines instrumentation requirements and a program for monitoring of the dump. To quote:

"Instrumentation should be installed to monitor the stability of the dyke and to evaluate the effectiveness. of the mine rock containment facility. The following points summarize the minimum recommended instrumentation:

- Thermistor strings should be installed in at least one location along the starter dyke to monitor the development of frost, and possibly permafrost, for use in evaluating the stability of the dyke. The thermistor strings should extend into the foundation soils, as well as through the dyke fill;
- four sets of nested standpipe piezometers should be installed in the starter dyke, to monitor the phreatic surface in the dyke for use in evaluating its long-term stability. Each installation should slotted sections. include two one in the foundation soils and one in the fill near the base Both slotted sections should be of the dyke. hydraulically isolated from each other, and from the ground surface, with bentonite seals. We suggest that the deeper pipe be a 50 mm diameter PVC pipe so that water quality samples can be taken to monitor impact on the groundwater regime;
- line of site pins should be installed in all three legs of the starter dyke to monitor overall deformation of the dyke for use in evaluating its stability;
- weirs for measuring flow rates and sampling Two for water quality should be installed in the collection ditch conveying water from the dykes to The first should be the ARD collection pond. located between Stations 8+05 and 13+00 (to collect the total drainage from the phyllite cell alone). The second should be constructed downstream of Station 15+20 (to collect the total combined drainage from both the sulphide and phyllite cells). Each weir should consist of a concrete section, with a steel V-notch section for flow measurements."

In addition to monthly monitoring of the instrumentation. SRK recommends monthly visual inspections of the crest and toe of the dykes. The visual inspection involves checking

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SRK recommends monthly visual inspections of the crest and toe of the dykes. The visual inspection involves checking the dykes and dump for tension cracks, bulges, seeps and erosion, and recording any of these or other occurrences. The visual inspection includes checking the rock drains for blockage and other problems as well as estimating the flows from each drain.

SRK recommends monthly monitoring of the instrumentation and monthly visual inspections, but does not indicate the time frame for this monitoring. Monitoring must be more frequent during the construction period. In addition, post-closure monitoring will depend on the results of monitoring during construction.

Monitoring of the waste dump will form part of the monitoring program for the Vangorda Plateau Development. With operation of the water treatment plant and monitoring of the Vangorda open pit, the Grum open pit and the Grum waste dump, the monitoring of the Vangorda waste dump need not result in any additional cost.

3.1 PHYSICAL MAINTENANCE

Maintenance will be required for the till covers, till berms and collection ditches, all of which could be subject to damage from freeze-thaw cycles, erosion or other problems.

It is probable that the maintenance would require five days work every two years. An estimate of the cost is shown in Table 3.1.

Vangorda Waste Dump

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Table 3.1 Long Term Maintenance Cost Estimate (1993 constant dollars)

Mobilization and Demobilization		\$ 2,000
Equipment (in	cluding operators)	
Loader	50 hr x \$ 150/hr	7,500
Backhoe	50 hr x \$ 120/hr	6,000
Truck	50 hr x \$ 100/hr	5,000
Travel and Su	bsistence	
4 men ×	5 days × \$ 100/day	2,000
Contractor's S	Supervisor	
5 days x	\$ 700/day	3,500
Travel a	nd Subsistence	1,000
Fick-up		2,000
Miscellaneous		2,200
		\$ 31,200
Contingency (20 %)	6,200
Construction (Management (7 %)	2,600
TOTAL		\$ 40,000
ANNUAL COST	\$ 40,000/2	\$ 20,000

REVISED VANGORDA WASTE DUMP PLAN

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SECTION 4.0

SUMMARY OF CLOSURE LIABILITY

4.0 SUMMARY OF CLOSURE LIABILITY

An assessment was undertaken of the closure liability remaining each year, and is presented in Table 4.1. The liability for a particular year represents the liability remaining at the end of that year in the event of a premature closure of the mining operation during the year.

The waste dump has not been constructed as designed. The till berms have not been constructed prior to placement of the waste rock. As a result, the dump must be reworked to achieve the proper slopes and create berms for till placement. The cost of reworking the dump is included in Section 2.1.2.

The estimate for the till berms should be considered indicative only, since there is no indication in the revised plan of the quantities which have been mined from the open pit and placed on the waste dump thus far.

The amount of the liability remaining at the end of each year also depends on the schedule for the Vangorda open pit. In this report, it is assumed that the pit is completed during 1994 and that the till cover is placed in 1995.

It is also assumed that there are no other required remedial measures.

The funding required for post decommissioning monitoring and maintenance is not included in this table.

As indicated in the original Curragh Inc. submission, treatment of the water draining from the dump will be necessary.

VANGORDA REVISED WASTE DUMP

Table 4.1 SUMMARY OF CLOSURE LIABILITY (Thousand 1993 dollars)

DESCRIPTION	1993	1994	1995
Berm Construction	4,000	5,310	0
Cover Construction	\$1,400	\$1,155	o
Erosion Protection	90	90	0
Instrumentation	20	20	
MONITORING			
SUBTOTAL	5,510	6,575	0
CONTINGENCY (20 %)	1,102	1,315	o
SUBTOTAL	6,612	7,890	0
EPCM (7 %)	463	552	0
TOTAL LIABILITY	\$7,075	\$8,442	\$0

CURRAGH INC. REVISED VANGORDA WASTE DUMP PLAN

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APPENDIX I

REFERENCES

APPENDIX I

REFERENCES

1.0 Curragh Resources Inc. Vangorda Plateau Development Review of Alternative Abandonment Plans and Water Quality Prediction Methods. Steffen, Robertson, Kirsten (B.C.) Inc. Report # 60609 February 1990

- 2.0 Curragh Resources Inc. "Stage Two" Initial Environment Evaluation Volumes I, II and III 1989
- 3.0 Northern Affairs Program Vangorda Plateau Development Mine Abandonment Plan Evaluation Report PBK Engineering Ltd. Project # 90086 June 1990
- 4.0 Northern Affairs Program Curragh Resources - Faro Mine Report on 1992 Inspection. GEO-ENGINEERING (M.S.T.) LTD. Report # G052-4 September 1992