Curragh Resources Inc.

VANGORDA PLATEAU DEVELOPMENT

COST-BENEFIT ANALYSIS FOR ALTERNATIVE ABANDONMENT PLANS

Prepared by:

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CONSULTING ENGINEERS AND SCIENTISTS

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COST-BENEFIT ANALYSIS
FOR
ALTERNATIVE ABANDONMENT PLANS

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1.0 INTRODUCTION

In response to comments from the Regional Environmental Review Committee (RERC) on the Vangorda Plateau Development Initial Environmental Evaluation (IEE) July, 1989, Steffen Robertson and Kirsten (SRK B.C.), has reviewed alternative plans to the mitigative measures currently proposed for this project. In conjunction with the review SRK prepared an impact assessment of each alternative scheme on the water quality in Vangorda Creek. The assessment was presented in a report entitled "Vangorda Plateau Development, Review of Alternative Abandonment Plans and Water Quality Prediction Methods" dated February, 1990. SRK has also completed a Cost-Benefit analysis of the alternative schemes which includes construction and water treatment cost estimates and water quality predictions. The results of the analysis are presented in this report.

2.0 METHODOLOGY

The analysis presented in this report is based on the alternative schemes presented in the Water Quality Review document for the proposed Vangorda Plateau Development. Three major components of the development have been identified as potential sources of Acid Mine Drainage (AMD) which might impact on the water quality in Vangorda creek. Alternative mitigation schemes were considered for each of the three components and incremental cost estimates were prepared for each alternative. The total cost estimate prepared for each component alternative included site maintenance and blending and liner replacement costs where required. To evaluate the overall project cost and impact, a number of combinations of each of the alternative components were the selected and total cost was calculated by summation of the component costs.

In addition to the construction costs, zinc loadings were estimated for each component alternative, based on the results in the Water Quality report. A total loading was then computed for each of the combinations by summation of the component loadings. The resultant water quality in Vangorda Creek at the Faro town site was derived for each combination by dividing the resultant mean monthly loading by the mean monthly flow at Faro. Background loadings were also added to the total zinc loading computed for each combination, to provide a resultant water quality impact.

Treatment of the discharge effluent from several of the alternative combinations were also considered and an estimate of the Capital and Operating costs were prepared for each alternative. The annual operating costs were converted to a present value growth fund which might be established to finance perpetual treatment of the mine effluent.

3.0 ALTERNATIVE COMPONENTS

3.1 Description

3.1.1 Vangorda Dumps

Seven alternative methods have been considered for the abandonment of waste rock from the Vangorda Pit. The waste rock consists of about 1,173,000 bank cubic metres (bcm) (3,392,700 tonnes) of Sulphide and 2,132,00 bcm (6,160,070 tonnes) of Phyllite, for a total of 3,305,000 bcm (9,552,770 tonnes). A summary of the rock quantities used for the project is presented in Table 3.1. The alternative schemes considered are listed as follows:

CODE	DESCRIPTION
1.1	Deposit waste in Vangorda Creek below the Pit, unsegregated, uncovered
1.2	Deposit Waste on a ridge above the Ck, below the Pit, unsegre., uncovered
1.3(4)*	Segregate and Cover Waste in Cells on Ridge
1.5	Return Sulphides to Pit, Cover Phyllites with till
1.5.1(2,3)*	Return of All Vangorda Waste to Vangorda Pit, overhaul to Grum Pit
1.6	Deposit Waste in Vangorda Ck., behind impervious Dam and flood
1.7	As per 1.3(4) but With HDPE Geomembrane

* Variations

The first scheme (1.1) involves random deposition of the waste rock into Vangorda Creek during operations. No provision would be made for any till cover or mitigation of potential acid generation after abandonment. However the plan would involve construction of a dam upstream of Vangorda pit which would divert Vangorda Creek around the pit and below the dump.

The second scheme (1.2) would involve unsegregated deposition of waste rock above the high water line of the creek on a ridge located immediately below the pit. Similarly after abandonment, no abatement measures for acid generation from the waste rock would be initiated.

The third scheme (1.3) would involve selective deposition of the waste rock into two till encapsulated cells. The Sulphide and Phyllite rock would be segregated into each cell and separated by till embankments. The cells would be located on the same ridge as used in Alternative 1.2. Based on recent volume calculations, the amount of till that will be available from the stripping operations for berm and cover construction was reduced from 7.6 to 6.47 million tonnes. This equates to a reduction

TABLE 3.1 : NET NEUTRALIZATION POTENTIAL AND QUANTITIES OF WASTE ROCK

Effective NP Grum Cal. Phy	104	KG CaCO3/t
Effective NP V. Sulphides	(691)	KG CaCO3/t
Effective NP Limestone	1,000	kg CaCO3/t
Volume of Vangorda Sulphides	1,173,000	cu.m (bank)
Weight of Vangorda Sulphides	3,392,700	tonnes
Volume of Vangorda Sul. & Phy.	3,305,000	cu.m (bank)
Weight of Vangorda Sul. & Phy.	9,552,770	tonnes
Effective NP V. Sul. & Phy(Combined)	(266)	KG CaCO3/t
Effective NP of V. Phyllites	(32)	KG CaCO3/t
Volume of Van. Phyllite	2,132,000	cu.m (bank)
Weight of V. Phyllite	6,160,070	tonnes
Effective NP Grum Sulphides	(364)	KG CaCO3/t
Volume of Grum Sulphides	2,237,108	cu.m (bank)
Weight Of Grum Sulphides	6,346,794	tonnes
Weight of Grum Altered Phy	2,162,843	tonnes
Volume of Grum Altered Phy	762,356	cu.m (bank)
ENP of Grum Sul. & Alt. PHy	(280)	KG CaCO3/t
Weight of Grum Sul. & Alt. Phy	8,509,637	tonnes
Volume of Grum Sul. not removed from Pit(Alt 2.2 & 2.4)	607,700	cu.m (bank)
Volume of Grum Sul. not removed from Pit(Alt 2.2 & 2.4)	760,000	cu.m (loose)
Weight of Grum Sul. not removed from Pit(Alt 2.2 & 2.4)	1,728,939	tonnes
Volume of Vangorda Overburden	3,080,000	cu.m (Bank)
Weight of Vangorda Overburden (Till)	6,470,000	tonnes
Rock Swell Factor	1.3	

9.5×10^6 tonnes from Vangorda

from 3.89 to 3.37 million cubic metres of till assuming an in-place density of 1.9 tonnes per cubic metre. As the overall excavated volume (rock and Till) would remain the same, the volume of rock excavation would increase by 1.13 million tonnes or about 520,000 bank cubic metres. The volumes quoted in Table 3.1 include this additional volume. The original abandonment plan as presented in the July 1989, IEE assumed that all stripped till would be used in the construction of the berms and covers. Consequently based on the original design there would be a shortfall of till. To accommodate this shortfall, the berms for the Vangorda Dumps were redesigned. The revision, which involves berms constructed during the latter stages of development, would require these berms to be constructed of both of till and waste rock. As stripping of the till overburden would preceded rock excavation, the berms would need to be constructed prior to placement of waste rock. Consequently careful planning would be required to enable use of small volumes of waste rock for the berm construction.

It is planned to construct the berms during the stripping operation to minimise stockpiling and rehandling of the till material. In preparing the cost estimates, it was assumed that there would be no rehandling of the till. A minimal cost of $0.10 per cu.m of till was, however, applied to the till placement to account for the selection procedure.

Foundation preparation for the dump would involve clearing, grubbing and stripping of the organic material. Till for the covers, however, would be stockpiled during operations and hauled from the stockpile after the waste rock has been placed.

The till cover would be three metres thick with the lower one metre compacted to 95 percent of the Modified Proctor Maximum Dry Density. The upper two metres would be loosely compacted by dozer. Contouring and compaction of the final surface, however, would be necessary to provide good runoff conditions. An internal rock drain would also be provided to control seepage from the dump but inhibit re-entry of oxygen.

Alternative 1.4 is a variation on Alternative 1.3, whereby waste rock would not be deposited in the small gully which exits the pit at the south west corner. The surface area of the dump would be reduced from 43 hectares (ha) to 40 ha.

Alternative 1.5 would require return of the Sulphide waste rock to Vangorda Pit. The volume of rock that would be returned is 1,524,900 loose cubic metres (lcm) and was computed from the bank volume (1,173,000 bcm) times a swell factor of 1.3. The cost associated with segregating the Sulphide and Phyllite rock, was included in the cost estimate. The Phyllite rock would be encapsulated with till in a separate cell as per Alternative 1.3 and 1.4. The surface area of the Phyllite cell would be about 30 ha. and an internal rock drain would also be required. The available capacity of the Vangorda pit below the proposed water level of 1122.5 metres, is about 3.4 million cu.m and would therefore accommodate the returned rock.

The return of all the Vangorda waste to Vangorda pit is referenced in the Water Quality Report as Alternative 1.5.1. In this report, as the total volume of waste rock that would be returned to the pit (4,296,500 lcm) exceeds the available capacity, Alternative 1.5.1 was divided into two scenarios, 1.5.2 and 1.5.3. Alternative 1.5.2 assumes an association with the Vangorda option to use till covers (ALT. 3.2). ALT. 1.5.3 assumes an association with the Vangorda pit option to construct an in-pit dam (ALT. 3.5). As discussed later, the combination of these alternative components reduces the total combined cost.

Alternative 1.6 would involve construction of an engineered embankment located in Vangorda Creek to retain the waste. The dam would be constructed to El. 1125m and would flood the area upstream inundating the waste rock. A wetland environment could be established on top of the dump.

The last scheme considered for this component (1.7) is a variation on the till cover options and would involve placing an 80 mil HDPE geomembrane over both the sulphide and Phyllite cells. The thickness of the till cover would be reduced to 2.5m, 1m below and 1.5m above.

3.1.2 Grum Sulphide Dump

Five alternative schemes were considered for the abandonment procedures associated with the Grum Sulphide waste rock. The current mine plan for the Grum Pit involves the excavation of 2,237,108 bcm (6,160,070 tonnes) of Sulphide waste. Approximately 607,700 bcm of the excavated waste would not be removed from the pit and therefore has not been included in the volume calculations for costing purposes. The volume of rock removed from the pit and deposited in a dump is estimated to be 2,118,230 lcm (4,616,000 tonnes) using swell factor of 1.3. The five scenarios considered for this component are listed as follows:

CODE	DESCRIPTION
2.1	Uncovered, unsegregated Grum Sulphide Waste
2.2	Till covered Waste Cell within Main Dump
2.3	Return Sulphide and Altered Phyllite Waste to Grum Pit
2.4	Till Covered Waste cell outside Main Dump
2.5	As per 2.4 but including a HDPE geomembrane

The first option (2.1) involves random deposition of the waste rock into the main Grum dump. For the purposes of this analysis the cost of this option was assumed to be zero.

Alternative 2.2 would involve selective placement of the waste rock within the Main Grum dump with a three metre thick till cover. The till cover would be constructed as for Alternatives 1.3 and 1.4.

Alternative 2.3 would require the return of all the Sulphide waste to Grum pit including the altered Phyllite waste. The total volume of rock that would be returned to the pit is estimated to be 3,575,700 lcm comprising 2,118,230 lcm of Sulphide, 991,062 lcm of Altered Phyllite and a 15 percent dilution to account for extraneous rock collected in the process.

Alternative 2.4 offers the advantage of isolating the material to an area above the Grum pit. The rock, which for this alternative includes the Sulphide rock only, would be encapsulated in till in a similar way to Alternatives 1.3 and 1.4. A variation on this alternative and Alternative 2.2 was also considered which would involve reducing the till thickness and placing an 80 mil HDPE geomembrane liner.

The fifth scheme considered for this component (2.5) is a variation of Alternative 2.4. which would involve placing the rock in isolation but without till covers.

3.1.3 Vangorda Pit

Six alternative schemes were considered for the abandonment procedures associated with the Vangorda pit. The pit walls at the southeast end of the Vangorda pit contain potentially acid generating Sulphide rock and if left exposed could produce additional AMD which would impact on the water quality in Vangorda Creek. A list of the alternatives considered is presented below.

CODE	DESCRIPTION
3.1	Flood pit to El. 1122.5, without Till Covers
3.1	Flood Pit to EL. 1122.5, with Till Covers
3.3	Flood Pit to El. 1122.5, with Till Covers and Geomembrane
3.4	Flood Pit to El. 1122.5, Shotcrete Walls
3.5	Construct In-Pit Dam to El. 1140 and Flood Pit
3.6	Remove Sulphide from Pit Walls

The first alternative (3.1) would involve flooding the pit to El. 1122.5 and leaving the exposed Sulphide rock above the water line exposed. A seepage collection ditch would be constructed along the 1128 bench to collect AMD for treatment. Other facilities would include an inlet spillway at the southeast wall of the pit and an outlet spillway and graded stream outfall at the north end of the pit.

Alternative 3.2, in addition to the above features, would require till covers on the pit walls east of section 12. The pit would be backfilled with Vangorda waste rock to El. 1122.5 (the natural water level of the pit) and a further 2.5 metre layer of non-acid generating rock would be placed over this backfill to provide a working platform on which to place the till covers. The portion of the pit wall in which Sulphide rock is exposed would be covered with till placed at a 3:1 (horizontal to vertical) overall slope. The till cover would then be vegetated to help prevent erosion. It is estimated that about 260,000 cubic metres of rock would be required to construct the working platform. However if this option is combined with the option to return part or all of the Vangorda waste to the pit, the additional volume of non-acid generating rock would be only 10,000 cubic metres. If all of the Vangorda waste is returned (ALT. 1.5.2), the excess rock of 896,000 cubic metres would need to be hauled to the Grum pit.

The third alternative (3.3) is similar to Alt. 3.2 with the exception that an HDPE geomembrane is included in the cover. The till material however would have to be placed at a slope of no less than 4:1 (horizontal to vertical) to prevent the liner from sliding.

Alternative 3.4 would require the use of shotcrete as a pit wall seal as an option to using till.

The fifth alternative (3.5) considered would involve construction of a Dam to El. 1140 located within the pit. The zone behind the dam, east of section 12 would be flooded to El. 1137.5 to submerge the Sulphide bearing rock in the pit walls. It is estimated that the dam would require about 678,500 cubic metres of rock and 287,700 cubic metres of till. This alternative would most likely be constructed in combination with total return of the Vangorda waste rock. Consequently much of the rock required to construct the dam would be come from this operation. It is estimated that an additional 172,000 cubic metres of non-acid generating rock would be required to build the dam. It is estimated that the capacity of the pit with the dam in place is about 3.8 million cubic metres and therefore in combination with ALT. 1.5.3 about 496,500 cubic metres of Vangorda Waste would have to be hauled to the Grum pit.

The final alternative considered for this component was the removal of all the potentially acid generating materials from the pit walls and placement of this waste, under water, in either the Vangorda or Grum pits. It is estimated that the additional quantities of rock involved with this option include 768,000 bcm of overburden, 442,000 bcm of Sulphide and 479,000 bcm of Altered Phyllite.

3.2 Component Cost Estimates

3.2.1 General

Cost estimates prepared for each component alternative included construction costs, blending costs if required, and annual site maintenance costs. The base construction costs for each alternative included only those costs that would be incurred as a direct result of implementing the abandonment plan. Therefore costs associated with any construction related to the abandonment, such as till haul for berm construction which would be incurred during the operational phase of the mine, were not included in the base cost.

3.2.2 Construction Costs

The construction cost estimates for each component alternative were developed jointly by SRK, and Curragh Resources. Quantities were calculated from detailed plans and sections that were prepared by SRK for each scenario. These plans are presented in the Water Quality Report. Waste rock quantities used to size the different structures are summarized in Table 3.1. The unit costs were based on figures provided by personnel at Curragh's Faro mine and costs from similar projects. Unit costs for placement of glacial till varied depending upon the end use. A summary of unit costs used in the analysis is shown on Table 3.2. The unit costs remain constant for each alternative scheme but should not be considered as absolute. The relative cost of each scenario is, however, considered realistic.

The unit cost for the placement of till for the cell berms does not include haulage costs because it is assumed that this cost would be incurred during the stripping phase of the mine development. Similarly the haulage costs for waste rock used in the construction of some of the berms have not been included in the costs estimates. In the event however that the stripping of till cannot be scheduled with the rock excavation, the additional cost of rehandling the till or rock to construct these berms would need to

be considered. Till cover costs would include haulage, placement and compaction because rehandling of the till would be required. It is also presumed that construction of the till berms and covers would be completed by mine personnel. Unit costs associated with the placement of till in dam structures were significantly higher as it was assumed that the work would be completed by outside contractors.

In general unit rates for rock haulage and placement were based on the assumption that the work would be completed by the mine. Construction of rock drains and filters used in any dam structure would be completed by contractors. A summary of the incremental costs to implement the alternative schemes for each of the three components is presented in the appendix in Tables A-1 to A-17.

TABLE 3.2 : UNIT COSTS

Foundation Excavation	cu.m	$2.00
Foundation Preparation	ha	$3,000.00
Till Haul Cover only(by mine)	cu.m	$1.00
Till- Place/Compact Cover only(by mine)	cu.m	$1.00
Blanket Drains Placement(mine)	cu.m	$2.50
Trench Excavation	cu.m	$2.00
Erosion Protection(Riprap)(by mine)	cu.m	$6.00
Blending Calcareous Phyllite w/all Waste	cu.m	$5.00
Blending Limestone w/ all Waste	tonnes	$40.00
Supply & Install Blanket	cu.m	$2.50
Supply & Install Finger Drains	cu.m	$2.50
Supply & Install 60 mil HDPE	sq.m	$20.00
Selective Placement of Waste	cu.m	$0.10
Erosion Protection(vegetation)	ha	$6,000.00
Replacement of Sul. Waste into Van. Pit	cu.m	$1.20
Clean Up Stockpile Area	ha	$3,000.00
Dam Spillway Excavation	cu.m	$3.00
Till Placement, Berms only (By mine)	cu.m	$0.10
Dam Till Haul/Place/compact(contractor)	cu.m	$5.00
Supply and Install 80 mil HDPE	sq.m	$12.00
Replacement of Sul. Waste into Grum Pit	cu.m	$1.20
Rock Haul(By Mine)	cu.m	$1.00
Rock Placement(By Mine)	cu.m	$0.20
Clean Loose Sulphides from Wall	sq.m	$0.50
Blanket Drains- Haul/Place(contractor)	cu.m	$10.80
Erosion Protection(riprap)(Contractor)	cu.m	$6.00
Supply and Place Bedding for HDPE	cu.m	$12.00
Prepare Rock Surface for Shotcrete	sq.m	$0.50
Shotcrete Rock Surface	sq.m	$40.00
Supply & place Sand Bedding for HDPE liner	cu.m	$20.00
Exc. of Sul. and Alt. Phy. from pit Wall	cu.m	$3.00

$1/tonne

3.2.3 Blending

Because of the moderately high acid generating potential of the Vangorda waste rock, alternatives which included blending of the waste rock with either acid-consuming rock or limestone were not considered practical. However, blending was considered in alternatives that required rehandling of waste rock for replacement into the pits. In these cases, two alternative blending methods were costed. They included blending the waste rock with 0.5 percent by weight of limestone or blending with 1.5 percent by volume with calcareous Phyllite. It was found that this percentage of rock would produce a Net Neutralization Potential of the combined rock similar to that calculated using the limestone. A summary of the blending costs associated with relevant alternative components is also presented in table A-1 to Table A-17.

3.2.4 Liner Replacement

It is assumed in this analysis that an HDPE liner would need to be replaced every 50 years. The initial cost estimate for HDPE liners for either the Grum Sulphide cell (2.4 or 2.2), the Vangorda cells (1.7), or the pit cover includes a Drainage layer, the liner supply and installation and the placement of a 1.5 metre till cover. Replacement of the liner however would involve the replacement costs of the HDPE and the till cover only. The cost of liner replacement was converted into a growth fund by dividing the capital cost by 50 times an assumed the annual real growth factor of 0.03 (3 percent). A summary of the calculations is presented below:

COMPONENT	REPLACEMENT CAPITAL COST	FUND
Vangorda Cell(3.3)	$6,000,000	$4,000,000
Grum Cell(2.4 or 2.2)	$780,000	$520,000
Pit Walls(3.3)	$1,050,000	$700,000

3.2.5 Site Maintenance

After abandonment of the mine site, it is assumed that earth-moving equipment will be required for use in maintaining the reclamation and mitigation structures. The cost estimate was based on three pieces of equipment each operating for approximately 75 hours over a 12 month period. The equipment included:

(a) Backhoe @ $110/hr
(b) D-8 Bulldozer @ $80/hr
(c) Front-End Loader @ $110/hr

The above rates assume that the work would be completed by contractors rather than company owned equipment. The resultant monthly expense was calculated to be $1875 or $22,500 per annum. This cost was divided equally and apportioned to each of the three components. The annual maintenance cost per component of $7,500 was converted to a Present Value Perpetuity Growth Fund assuming a

real growth factor of 3 percent. The real growth factor is defined as the numerical difference between the predicted interest rate and inflation. The amount of the fund, which was calculated by dividing the annual cost by the real growth factor, would be in the order of $250,000 per component.

A summary of the total component cost including blending, maintenance and liner replacement costs is presented in Table 3.3.

3.3 Component Water Quality Predictions

3.3.1 Loadings

As previously discussed water quality predictions were derived for each of the alternative components and are presented in the February 1990 Water Quality Report. In this analysis zinc loadings were extracted from the tables in that report for each component alternative. A summary of the mean monthly and the mean annual zinc loadings for each of the alternatives considered, is presented in Table 3.4. Mean monthly zinc loadings for general runoff from the site were also included.

4.0 COMBINATION ALTERNATIVES

4.1 General

As it is unlikely that a single mitigation measure would be implemented in isolation, alternative combinations of the component alternatives have been analyzed. A total of 24 different combinations were selected. Cost estimates for each of the combinations were derived by summation of the individual component costs tabulated in Table 3.3. Mean monthly zinc loadings for each combination were similarly derived from the individual and general runoff loadings presented in Table 3.4

4.2 Predicted Water Quality for Combination Alternatives

The first step in deriving the water quality in Vangorda Creek at the Faro Townsite for each of the alternative combinations, was to determine the mean monthly loading. This was achieved by summing the individual mean monthly loading from each of the components. A summary of the resultant mean monthly loadings for each alternative combination considered is presented in Table 4.1. The loadings presented in Table 4.1 represent the predicted total net impact of the project on Vangorda Creek. To evaluate the predicted resultant loading after abandonment, the mean monthly background loading in Vangorda Creek (Station VO8) was added to the predicted mean monthly loading and the result is presented in Table 4.2. The final step involved determining the mean monthly zinc concentrations in Vangorda Creek at Faro for each combination. This was achieved by dividing the total mean monthly zinc loadings by the mean monthly flow in the creek at Faro. The result is presented in Table 4.3

A plot of the predicted mean monthly zinc concentrations including the background for each combination has also been prepared and are presented in Figures 4.1 to 4.4

TABLE 3.3: SUMMARY OF COMPONENT COSTS AND WATER QUALITY PARAMETERS FOR ALTERNATIVE COMPONENTS

ALTERNATIVE COMPONENTS	COMPONENT BASE COST	POST ABNDMENT MAINTNCE FUND	LINER REPLMT FUND	BLENDING COST (w/limestone)	BLENDING COST (w/C. Phy.)	TOTAL COST W/O BLENDING	TOTAL W/Calc BLENDING	TOTAL W/Limestone BLENDING	COMP. TREATM FLOW (cu.m/d)	COMP. MEAN MTH Zn LOAD (Kg/mo)
VANGORDA WASTE DUMPS										
ALT. 1.1 – Waste in Vangorda Ck., unsegr.	$1,051,880	$250,000	"	"	"	$1,301,880	$1,301,880	$1,301,880	149	133
ALT. 1.2 – Waste on Ridge, uncovered	$156,400	"	"	"	"	$156,400	$156,400	$156,400	206	185
ALT. 1.3 – Waste on Ridge, Covered Cells	$2,880,865	$250,000	"	"	"	$3,130,865	$3,130,865	$3,130,865	67	44
ALT. 1.4 – As for ALT. 1.3 but out of ravine	$2,625,105	$250,000	"	"	"	$2,875,105	$2,875,105	$2,875,105	62	38
ALT. 1.5 – Return of Sulphides to pit	$4,426,345	$250,000	"	$678,540	$141,816	$4,676,345	$4,818,161	$5,354,885	59	21
ALT. 1.5.1 – Total Return of waste to pit	$5,714,450	"	"	$1,910,554	$399,575	$5,714,450	$6,114,025	$7,625,004	0	0
ALT. 1.5.2 – Return all Waste to pit, w/overHaul to Grum pit(3.2)	$5,893,750	"	"	$1,910,554	$399,575	$5,893,750	$6,293,325	$7,804,304	0	0
ALT. 1.5.3 – Return waste to pit, w/overhaul to Grum(3.5)	$5,813,750	"	"	$1,910,554	$399,575	$5,813,750	$6,213,325	$7,724,304	0	0
ALT. 1.6 – Waste Behind Dam in Ck., Flooded	$7,254,320	$250,000	"	"	"	$7,504,320	$7,504,320	$7,504,320	0	0
ALT. 1.7 – Till Cover with Geomembrane	$10,405,425	$250,000	$4,000,000	"	"	$14,655,425	$14,655,425	$14,655,425	12	8
GRUM WASTE DUMPS										
ALT. 2.1 – Unsegr., uncovered, Sulphide	$0	"	"	"	"	$0	$0	$0	752	114
ALT. 2.2 – Till Covered Cell within Main Dump	$575,355	$250,000	"	"	"	$825,355	$825,355	$825,355	9	14
ALT. 2.3 – Return All Sulphide to Pit w/15% dilution	$4,678,393	"	"	$1,356,140	$289,164	$4,678,393	$4,967,557	$6,034,532	0	12
ALT. 2.4 – Till Covered Cell Outside M/Dump	$667,955	$250,000	"	"	"	$917,955	$917,955	$917,955	9	14
ALT. 2.5 – As per 2.4 but uncovered	$211,823	"	"	"	"	$211,823	$211,823	$211,823	32	41
VANGORDA PIT										
ALT. 3.1 – Flood Pit, No Pit wall Covers	$135,600	"	"	"	"	$135,600	$135,600	$135,600	491	66
ALT. 3.2 – Flood Pit, Pit Wall Covers	$737,300	$250,000	"	"	"	$987,300	$987,300	$987,300	0	13
ALT. 3.3 – Till cover, Geomembrane, Flood Pit	$2,352,950	$250,000	$700,000	"	"	$3,302,950	$3,302,950	$3,302,950	0	3
ALT. 3.4 – Shotcrete Pit Walls	$1,930,800	$250,000	"	"	"	$2,180,800	$2,180,800	$2,180,800	32	13
ALT. 3.5 – In-pit Dam, Flood pit	$2,482,750	$250,000	"	"	"	$2,732,750	$2,732,750	$2,732,750	0	8
ALT. 3.6 – Remove Sulphides from Pit Walls	$5,215,800	"	"	"	"	$5,215,800	$5,215,800	$5,215,800	32	13

TABLE 3.4: MEAN MONTHLY ZINC LOADING FROM EACH COMPONENT ALTERNATIVE

MEAN MONTHLY ZINC LOADING(Kg)

COMPONENT ALTERNATIVES	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
1.1 – Waste in Vangorda Ck., unsegr.	8.81	13.22	28.20	158.47	412.51	370.53	181.30	156.46	130.94	105.42	25.80	9.03	133.39
1.2 – Waste on Ridge, uncovered	12.20	18.30	39.03	219.37	571.05	512.93	250.99	216.59	181.26	145.94	35.71	12.50	184.66
1.3 – Waste on Ridge, Covered Cells	2.85	5.41	10.50	61.41	135.07	111.18	59.42	52.18	41.41	36.00	10.00	3.00	44.04
1.4 – As for ALT. 1.3 but out of ravine	2.29	4.81	8.98	54.86	117.69	94.00	51.53	45.26	35.00	31.40	8.87	2.55	38.10
1.5 – Return of Sulphides to pit	1.09	2.91	4.70	34.00	67.00	49.00	29.00	26.00	18.00	18.00	5.30	1.20	21.35
1.52 – Return all waste to pit,o/h to Grum(3.2)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.53 – Return waste to pit, w/overhaul to Grum(3.5)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.6 – Waste Behind Dam in Ck., Flooded	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.7 – Till Cover with Geomembrane	0.67	1.27	2.72	11.64	21.26	17.14	9.72	9.03	7.40	6.80	2.00	0.80	7.54
2.1 – Unsegr., uncovered, Sulphide	8.57	8.57	11.40	70.00	284.00	523.00	158.00	132.00	106.00	43.00	14.00	14.00	114.38
2.2 – Till Covered Cell within Main Dump	1.05	1.37	2.67	13.68	39.04	48.31	18.94	16.32	13.54	8.88	2.43	1.37	13.97
2.3 – Return All Sulphide to Pit w/15% dilution	0.87	0.87	1.20	7.20	29.00	53.30	16.10	13.50	10.90	4.37	1.43	1.43	11.68
2.4 – Till Covered Cell Outside M/Dump	1.05	1.37	2.67	13.68	39.04	48.30	18.90	16.33	13.55	8.88	2.43	1.37	13.96
2.5 – As per 2.4 but uncovered	2.23	2.93	6.07	43.48	116.00	138.20	59.34	49.83	40.80	28.38	6.46	3.58	41.44
3.1 – Flood Pit, No Pit wall Covers	7.27	6.57	10.61	48.45	237.45	161.68	121.35	91.19	68.48	30.40	5.49	2.62	65.96
3.2 – Flood Pit, Pit Wall Covers	1.45	1.31	2.12	9.69	47.52	32.31	24.24	18.22	13.69	6.08	1.10	0.52	13.19
3.3 – Till cover, Geomembrane, Flood Pit	0.56	0.51	0.53	2.42	11.88	8.08	6.06	4.90	3.51	1.62	0.27	0.13	3.37
3.4 – Shotcrete Pit Walls	1.45	1.31	2.12	9.69	47.52	32.31	24.24	18.22	13.69	6.08	1.10	0.52	13.19
3.5 – In-pit Dam, Flood pit	0.77	0.70	1.15	5.02	26.80	21.02	13.67	9.96	7.54	3.54	0.66	0.35	7.60
3.6 – Remove Sulphides from Pit Walls	1.45	1.31	2.12	9.69	47.52	32.31	24.24	18.22	13.69	6.08	1.10	0.52	13.19
4 – General runoff	0.42	0.55	0.55	1.72	11.42	10.91	4.29	4.15	4.39	2.00	0.78	0.68	3.49

TABLE 4.1: SUMMARY OF ZINC LOADING FROM COMBINATION ALTERNATIVES

COMBINATION ALTERNATIVES			MEAN MONTHLY ZINC LOADING(Kg)												
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN ANNUAL
1.1	2.5	3.1	18.73	23.27	45.43	252.12	777.38	681.32	366.28	301.63	244.61	166.20	38.53	15.91	244.28
1.2	2.5	3.1	22.12	28.35	56.26	313.02	935.92	823.72	435.97	361.76	294.93	206.72	48.44	19.38	295.55
1.2	2.1	3.1	28.46	33.99	61.59	339.54	1103.92	1208.52	534.63	443.93	360.13	221.34	55.98	29.80	368.49
1.3	2.2	3.1	11.59	13.90	24.33	125.26	422.98	332.08	204.00	163.84	127.82	77.28	18.70	7.67	127.45
1.3	2.2	3.2	5.77	8.64	15.84	86.50	233.05	202.71	106.89	90.87	73.03	52.96	14.31	5.57	74.68
1.3	2.4	3.1	11.59	13.90	24.33	125.26	422.98	332.07	203.96	163.85	127.83	77.28	18.70	7.67	127.45
1.3	2.4	3.2	5.77	8.64	15.84	86.50	233.05	202.70	106.85	90.88	73.04	52.96	14.31	5.57	74.68
1.4	2.2	3.1	11.03	13.30	22.81	118.71	405.60	314.90	196.11	156.92	121.41	72.68	17.57	7.22	121.52
1.4	2.2	3.2	5.21	8.04	14.32	79.95	215.67	185.53	99.00	83.95	66.62	48.36	13.18	5.12	68.75
1.4	2.4	3.2	5.21	8.04	14.32	79.95	215.67	185.52	98.96	83.96	66.63	48.36	13.18	5.12	68.74
1.4	2.4	3.1	11.03	13.30	22.81	118.71	405.60	314.89	196.07	156.93	121.42	72.68	17.57	7.22	121.52
1.5	2.4	3.2	4.01	6.14	10.04	59.09	164.98	140.52	76.43	64.70	49.63	34.96	9.61	3.77	51.99
1.53	2.4	3.5	2.24	2.62	4.37	20.42	77.26	80.23	36.86	30.44	25.48	14.42	3.87	2.40	25.05
1.52	2.3	3.1	8.56	7.99	12.36	57.37	277.87	225.89	141.74	108.84	83.77	36.77	7.70	4.73	81.13
1.52	2.3	3.2	2.74	2.73	3.87	18.61	87.94	96.52	44.63	35.87	28.98	12.45	3.31	2.63	28.36
1.53	2.3	3.5	2.06	2.12	2.90	13.94	67.22	85.23	34.06	27.61	22.83	9.91	2.87	2.46	22.77
1.52	2.4	3.2	2.92	3.23	5.34	25.09	97.98	91.52	47.43	38.70	31.63	16.96	4.31	2.57	30.64
1.52	2.3	3.6	2.74	2.73	3.87	18.61	87.94	96.52	44.63	35.87	28.98	12.45	3.31	2.63	28.36
1.6	2.3	3.2	2.74	2.73	3.87	18.61	87.94	96.52	44.63	35.87	28.98	12.45	3.31	2.63	28.36
1.6	2.3	3.5	2.06	2.12	2.90	13.94	67.22	85.23	34.06	27.61	22.83	9.91	2.87	2.46	22.77
1.6	2.3	3.6	2.74	2.73	3.87	18.61	87.94	96.52	44.63	35.87	28.98	12.45	3.31	2.63	28.36
1.7	2.4	3.3	2.70	3.70	6.47	29.46	83.60	84.43	38.97	34.41	28.85	19.30	5.48	2.98	28.36
1.7	2.2	3.3	2.70	3.70	6.47	29.46	83.60	84.44	39.01	34.40	28.84	19.30	5.48	2.98	28.37
1.7	2.2	3.2	3.59	4.50	8.06	36.73	119.24	108.67	57.19	47.72	39.02	23.76	6.31	3.37	38.18

TABLE 4.2 : MEAN MONTHLY ZINC LOADINGS INCLUDING BACKGROUND AT FARO(VO8)

COMBINATION ALTERNATIVES			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN ANNUAL
1.1	2.5	3.1	22.61	35.29	50.99	253.54	824.61	772.65	398.50	328.93	262.28	179.39	46.68	35.30	267.56
1.2	2.5	3.1	26.00	40.37	61.82	314.44	983.15	915.05	468.19	389.06	312.60	219.91	56.59	38.77	318.83
1.2	2.1	3.1	32.34	46.01	67.15	340.96	1151.15	1299.85	566.85	471.23	377.80	234.53	64.13	49.19	391.77
1.3	2.2	3.1	15.47	25.92	29.89	126.68	470.21	423.41	236.22	191.14	145.49	90.47	26.85	27.06	150.73
1.3	2.2	3.2	9.65	20.66	21.40	87.92	280.28	294.04	139.11	118.17	90.70	66.15	22.46	24.96	97.96
1.3	2.4	3.1	15.47	25.92	29.89	126.68	470.21	423.40	236.18	191.15	145.50	90.47	26.85	27.06	150.73
1.3	2.4	3.2	9.65	20.66	21.40	87.92	280.28	294.03	139.07	118.18	90.71	66.15	22.46	24.96	97.96
1.4	2.2	3.1	14.91	25.32	28.37	120.13	452.83	406.23	228.33	184.22	139.08	85.87	25.72	26.61	144.80
1.4	2.2	3.2	9.09	20.06	19.88	81.37	262.90	276.86	131.22	111.25	84.29	61.55	21.33	24.51	92.03
1.4	2.4	3.2	9.09	20.06	19.88	81.37	262.90	276.85	131.18	111.26	84.30	61.55	21.33	24.51	92.02
1.4	2.4	3.1	14.91	25.32	28.37	120.13	452.83	406.22	228.29	184.23	139.09	85.87	25.72	26.61	144.80
1.5	2.4	3.2	7.89	18.16	15.60	60.51	212.21	231.85	108.65	92.00	67.30	48.15	17.76	23.16	75.27
1.53	2.4	3.5	6.12	14.64	9.93	21.84	124.49	171.56	69.08	57.74	43.15	27.61	12.02	21.79	48.33
1.52	2.3	3.1	12.44	20.01	17.92	58.79	325.10	317.22	173.96	136.14	101.44	49.96	15.85	24.12	104.41
1.52	2.3	3.2	6.62	14.75	9.43	20.03	135.17	187.85	76.85	63.17	46.65	25.64	11.46	22.02	51.64
1.53	2.3	3.5	5.94	14.14	8.46	15.36	114.45	176.56	66.28	54.91	40.50	23.10	11.02	21.85	46.05
1.52	2.4	3.2	6.80	15.25	10.90	26.51	145.21	182.85	79.65	66.00	49.30	30.15	12.46	21.96	53.92
1.52	2.3	3.6	6.62	14.75	9.43	20.03	135.17	187.85	76.85	63.17	46.65	25.64	11.46	22.02	51.64
1.6	2.3	3.2	6.62	14.75	9.43	20.03	135.17	187.85	76.85	63.17	46.65	25.64	11.46	22.02	51.64
1.6	2.3	3.5	5.94	14.14	8.46	15.36	114.45	176.56	66.28	54.91	40.50	23.10	11.02	21.85	46.05
1.6	2.3	3.6	6.62	14.75	9.43	20.03	135.17	187.85	76.85	63.17	46.65	25.64	11.46	22.02	51.64
1.7	2.4	3.3	6.58	15.72	12.03	30.88	130.83	175.76	71.19	61.71	46.52	32.49	13.63	22.37	51.64
1.7	2.2	3.3	6.58	15.72	12.03	30.88	130.83	175.77	71.23	61.70	46.51	32.49	13.63	22.37	51.65
1.7	2.2	3.2	7.47	16.52	13.62	38.15	166.47	200.00	89.41	75.02	56.69	36.95	14.46	22.76	61.46
			3.88	12.02	5.58	1.42	47.23	91.83	32.22	27.30	17.67	13.19	8.15	19.39	23.28

TABLE 4.3 : MEAN MONTHLY ZINC CONCENTRATIONS INCLUDING BACKGROUND AT FARO(YOU)

COMBINATION ALTERNATIVES			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN ANNUAL
1.1	2.5	3.1	0.09	0.15	0.21	1.05	0.18	0.13	0.13	0.12	0.12	0.12	0.06	0.07	0.14
1.2	2.5	3.1	0.11	0.17	0.26	1.30	0.21	0.15	0.15	0.15	0.14	0.15	0.08	0.08	0.17
1.2	2.1	3.1	0.13	0.19	0.28	1.41	0.25	0.21	0.18	0.18	0.17	0.16	0.09	0.10	0.21
1.3	2.2	3.1	0.06	0.11	0.12	0.53	0.10	0.07	0.07	0.07	0.07	0.06	0.04	0.06	0.08
1.3	2.2	3.2	0.04	0.09	0.09	0.36	0.06	0.05	0.04	0.04	0.04	0.05	0.03	0.05	0.05
1.3	2.4	3.1	0.06	0.11	0.12	0.53	0.10	0.07	0.07	0.07	0.07	0.06	0.04	0.06	0.08
1.3	2.4	3.2	0.04	0.09	0.09	0.36	0.06	0.05	0.04	0.04	0.04	0.05	0.03	0.05	0.05
1.4	2.2	3.1	0.06	0.11	0.12	0.50	0.10	0.07	0.07	0.07	0.06	0.06	0.04	0.06	0.08
1.4	2.2	3.2	0.04	0.08	0.08	0.34	0.06	0.05	0.04	0.04	0.04	0.04	0.03	0.05	0.05
1.4	2.4	3.2	0.04	0.08	0.08	0.34	0.06	0.05	0.04	0.04	0.04	0.04	0.03	0.05	0.05
1.4	2.4	3.1	0.06	0.11	0.12	0.50	0.10	0.07	0.07	0.07	0.06	0.06	0.04	0.06	0.08
1.5	2.4	3.2	0.03	0.08	0.06	0.25	0.05	0.04	0.03	0.03	0.03	0.03	0.02	0.05	0.04
1.53	2.4	3.5	0.03	0.06	0.04	0.09	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.05	0.03
1.52	2.3	3.1	0.05	0.08	0.07	0.24	0.07	0.05	0.06	0.05	0.05	0.03	0.02	0.05	0.06
1.52	2.3	3.2	0.03	0.06	0.04	0.08	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.05	0.03
1.53	2.3	3.5	0.02	0.06	0.04	0.06	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.05	0.02
1.52	2.4	3.2	0.03	0.06	0.05	0.11	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.05	0.03
1.52	2.3	3.6	0.03	0.06	0.04	0.08	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.05	0.03
1.6	2.3	3.2	0.03	0.06	0.04	0.08	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.05	0.03
1.6	2.3	3.5	0.02	0.06	0.04	0.06	0.02	0.03	0.02	0.02	0.02	0.02	0.02	0.05	0.02
1.6	2.3	3.6	0.03	0.06	0.04	0.08	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.05	0.03
1.7	2.4	3.3	0.03	0.07	0.05	0.13	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.05	0.03
1.7	2.2	3.3	0.03	0.07	0.05	0.13	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.05	0.03
1.7	2.2	3.2	0.03	0.07	0.06	0.16	0.04	0.03	0.03	0.03	0.03	0.03	0.02	0.05	0.03

VANGORDA PLATEAU DEVELOPMENT
Predicted Zn Conc. in Vangorda Ck, Faro

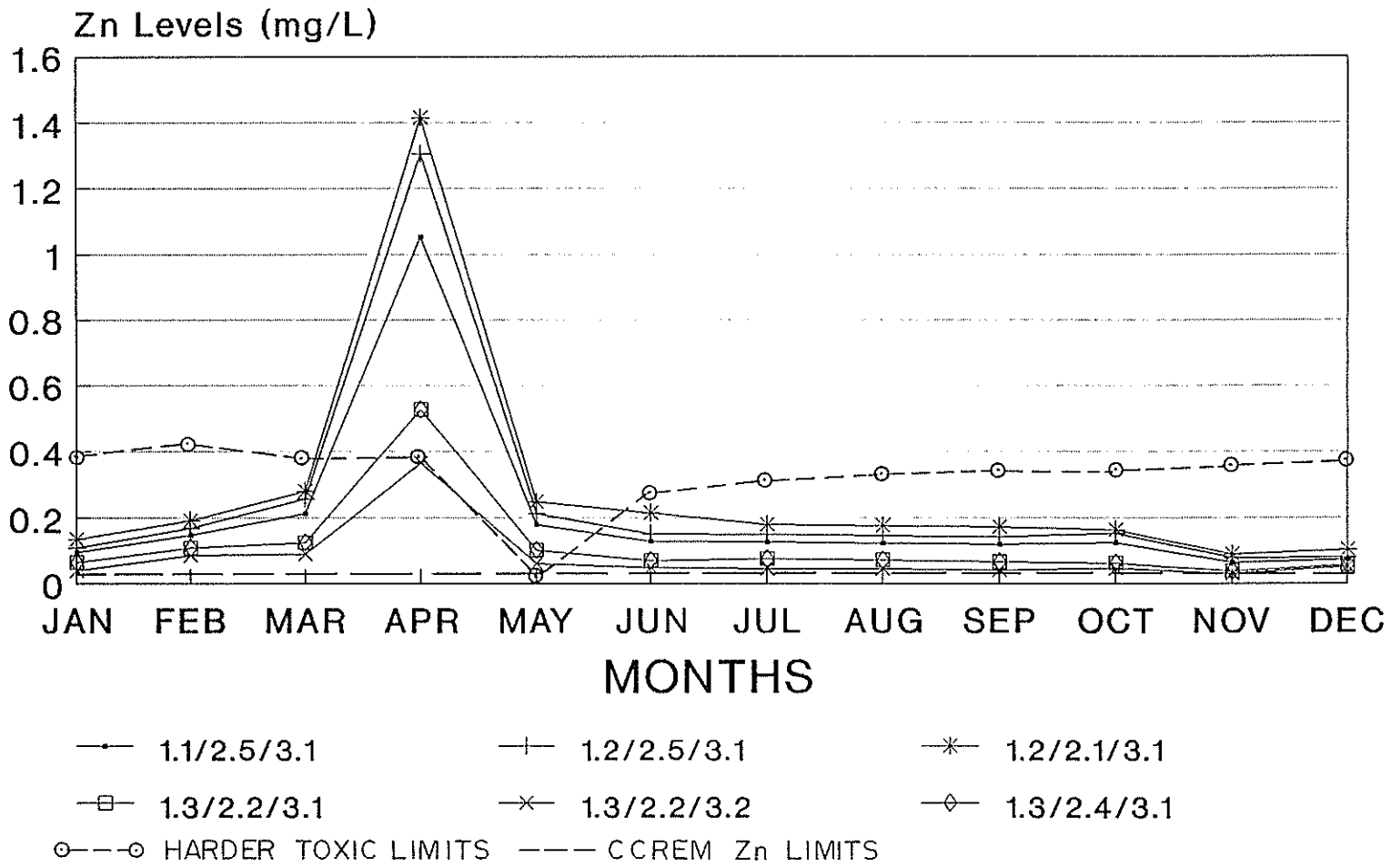

FIGURE 4.1

Note: Harders estimated toxic level for March has been applied to April, April has been applied to May, other months are unchanged.

VANGORDA PLATEAU DEVELOPMENT
Predicted Zn Conc. in Vangorda Ck, Faro

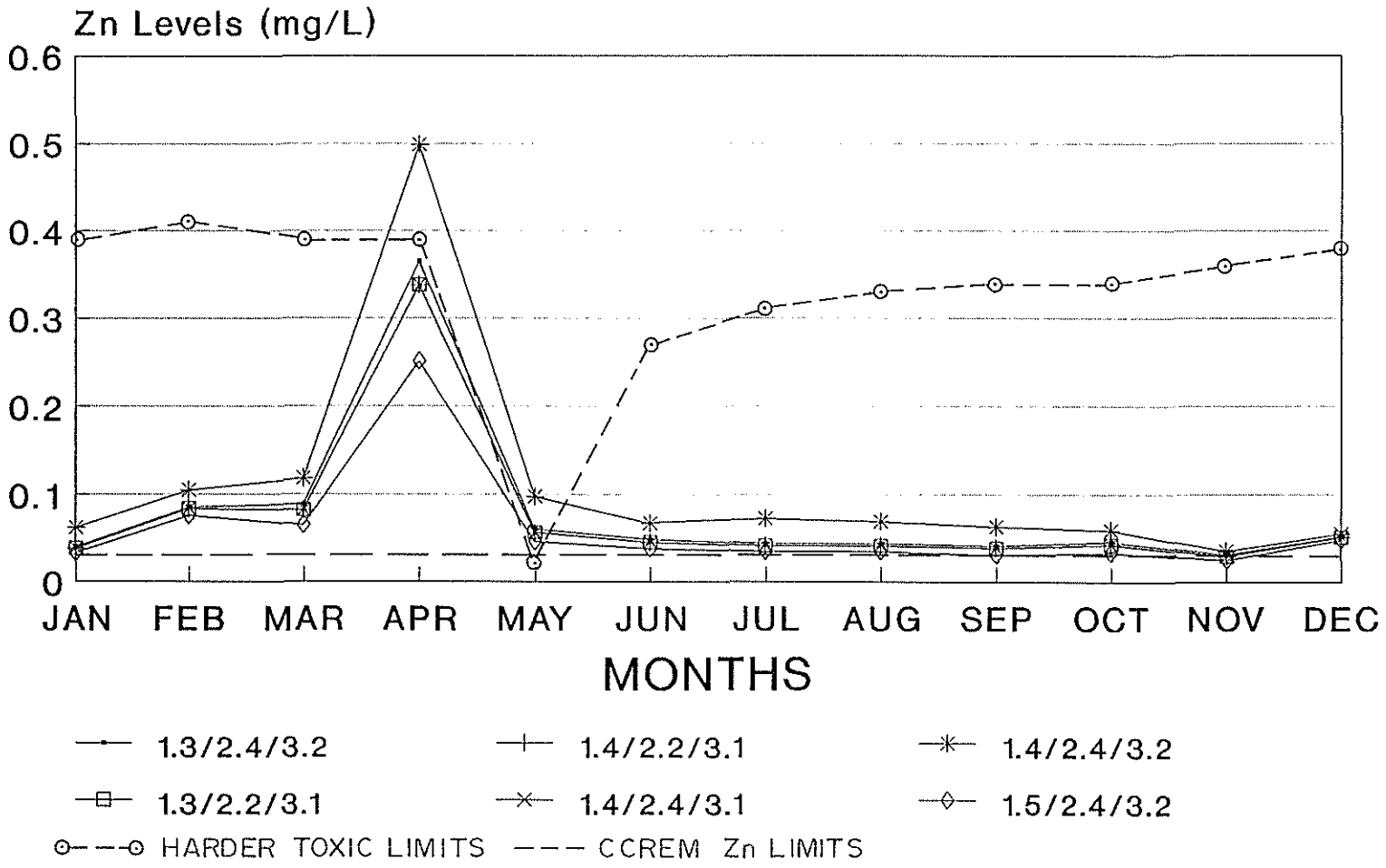

FIGURE 4.2

See Fig. 4.1 for notes

VANGORDA PLATEAU DEVELOPMENT
Predicted Zn Conc. in Vangorda Ck, Faro

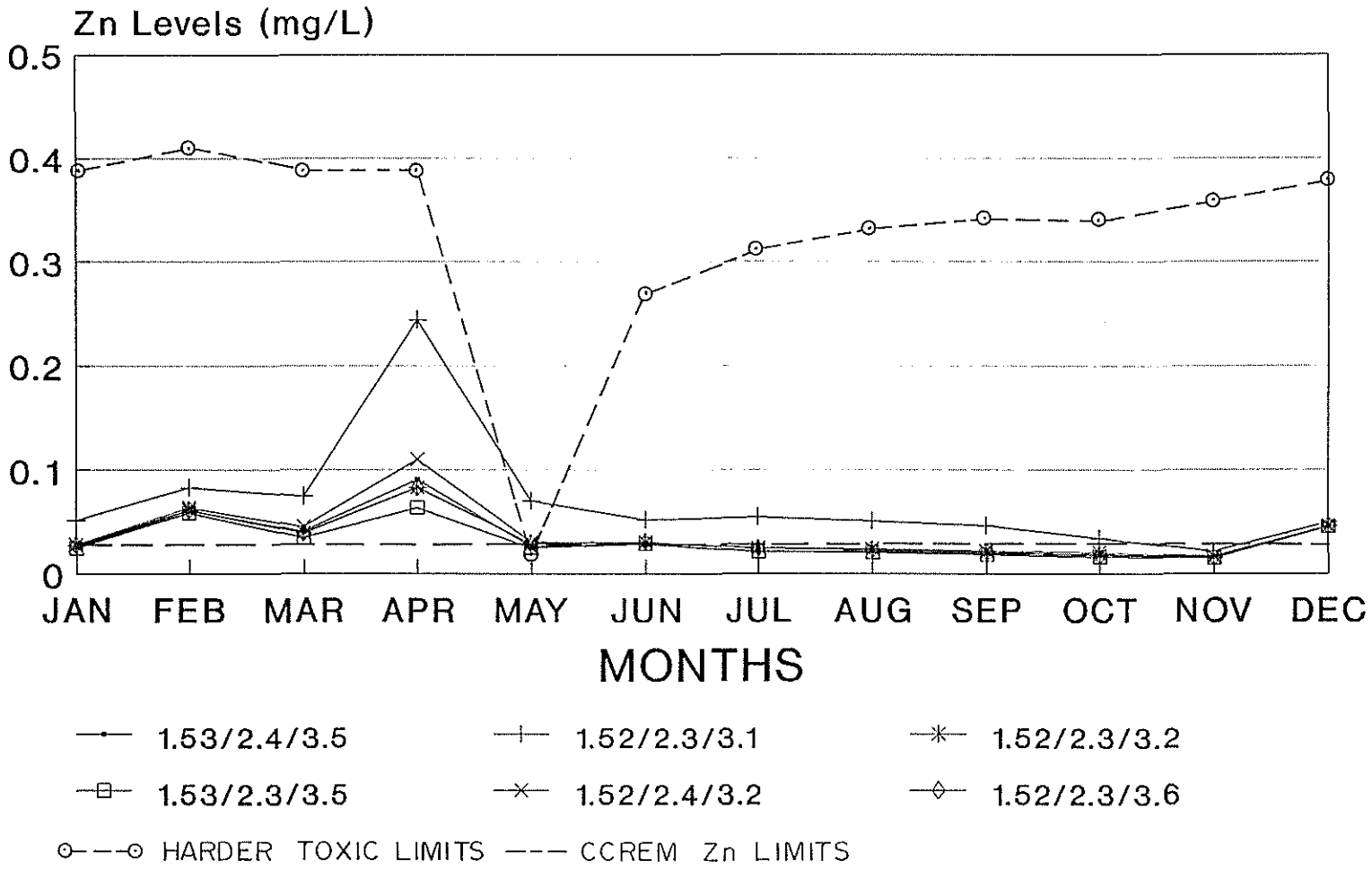

FIGURE 4.3

See Fig. 4.1 for notes

VANGORDA PLATEAU DEVELOPMENT
Predicted Zn Conc. in Vangorda Ck, Faro

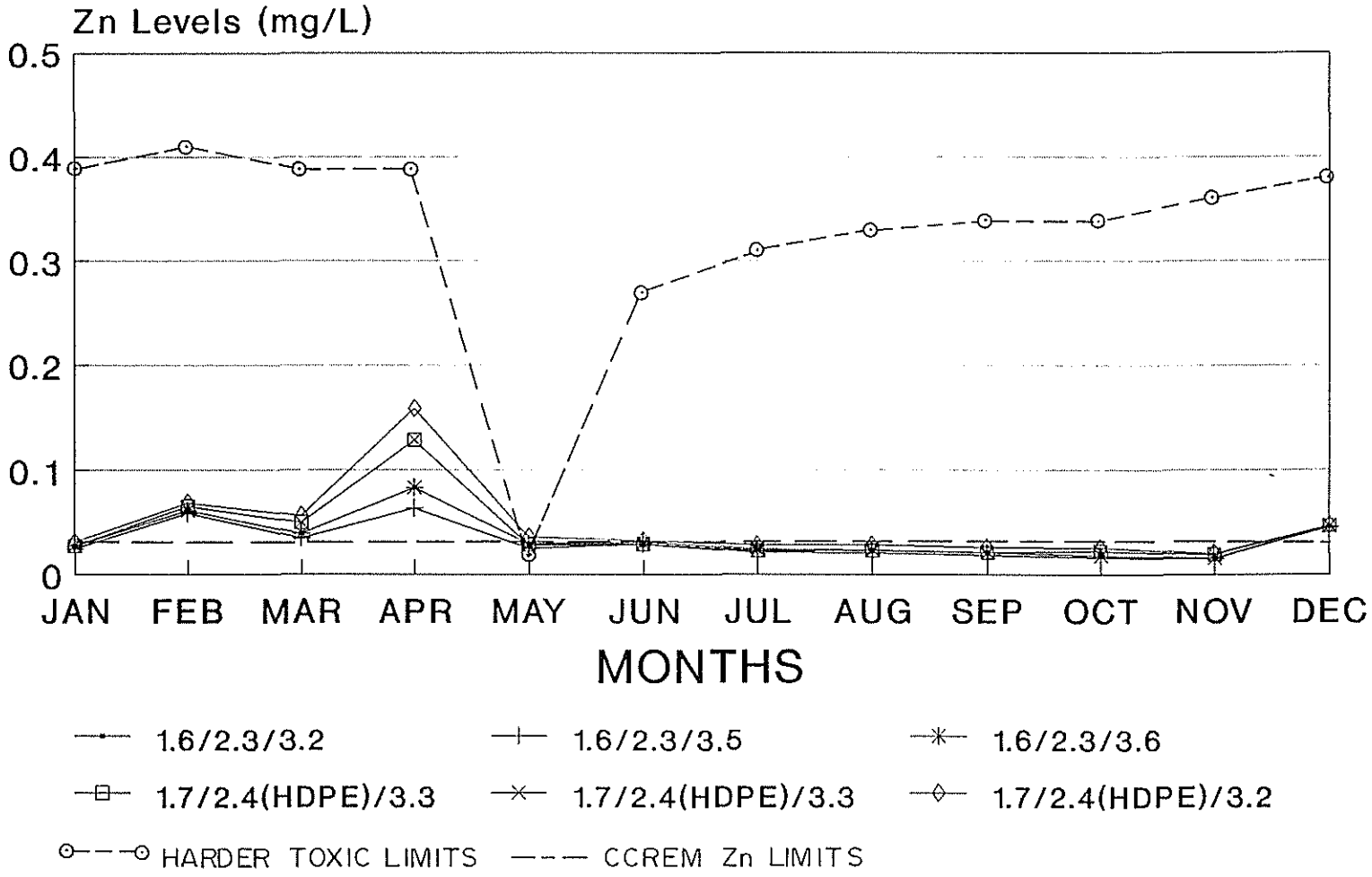

FIGURE 4.4

See Fig. 4.1 for notes.

4.3 Cost Estimates for Alternative Combinations

Total base cost estimates for each of the 24 alternative combinations were derived by summation of the component costs. Adjustments to certain combination costs however were made to compensate for duplication. As previously discussed in Section 3.0 combinations involving return of part or all of the Vangorda waste and either the in-pit dam or Till cover options have been adjusted to compensate for backhaul of the waste. In compiling the combination costs, it was assumed that blending would not used.

The total project cost for each combination comprised the sum of the base cost, the site maintenance fund and the liner replacement fund where required. A summary of the total cost for each of the combinations and the mean monthly zinc concentrations is presented in Table 4.4. A plot of the total cost excluding treatment versus the resultant zinc concentrations including background, is shown in Figure 4.5.

5.0 WATER TREATMENT

5.1 General

A Water Treatment Plant is currently planned for the Vangorda Development during operations to treat mine drainage prior to discharge into Vangorda Creek. Preliminary design for the Treatment plant was completed by Cominco Engineering Services Limited (CESL) in May 1989. The plant is designed to accommodate modulated drainage flows of 45 - 225 cu.m/hr from each of the Grum and Vangorda Pits which will be separately pumped to the plant and combined. The process design capacity of the plant is 450 cu.m/hr. After closure of the mine site and in the event that water quality of the effluent discharge does not meet acceptable levels, a scaled down treatment plant will be constructed below the proposed Vangorda dump for treatment of mine drainage,

For the analysis presented in this study, water treatment costs were developed for selected alternative combinations assuming that treatment would be required in perpetuity. Based on an estimated annual operating cost, a Perpetuity Growth Fund was computed assuming a real growth factor of 3 percent. Treatment costs derived included fixed and variable operating costs, capital costs and costs for groundwater monitoring, surface water collection, maintenance, and sludge disposal.

5.2 Capital Costs

The capital costs for post-abandonment water treatment would include costs for construction of sludge ponds, relocation of the treatment plant, surface and groundwater collection. Based on the preliminary design completed by CESL, the capital cost estimate for the Water Treatment Plant would be in the order of 2.6 million Canadian dollars. Costs to relocate the plant after abandonment were estimated

TABLE 4.4: SUMMARY OF CONSTRUCTION COSTS AND PREDICTED WATER QUALITY AT FARO FOR ALTERNATIVE COMBINATIONS

	WATER QUALITY (Zn) IN VANGORDA CRK AT FARO				IMPLEMENTATION COSTS			
HYPOTHETICAL ALTERNATIVE COMBINATION SCHEMES	MEAN MONTH LOAD (Kg/Mo.)	PEAK MONTH LOAD (Kg/Mo.)	MEAN MONTH CONC. (mg/L)	PEAK MONTH CONC. (mg/L)	COMBINED COMPONENT BASE COST W/O BLENDING	POST ABANDONMENT MAINTENANCE FUND	LINER REPLACEMENT FUND	TOTAL PROJECT COST (w/o TMT)
ALT. 1.1/2.5/3.1	267.56	824.61	0.14	1.05	$1,187,480	$250,000	*	$1,437,480
ALT. 1.2/2.5/3.1	318.83	983.15	0.17	1.30	$292,000	*	*	$292,000
ALT. 1.2/2.1/3.1	391.77	1299.85	0.21	1.41	$292,000	*	*	$292,000
ALT. 1.3/2.2/3.1	150.73	470.21	0.08	0.53	$3,591,820	$750,000	*	$4,341,820
ALT. 1.3/2.2/3.2	97.96	294.04	0.05	0.36	$4,193,520	$750,000	*	$4,943,520
ALT. 1.3/2.4/3.1	150.73	470.21	0.08	0.53	$3,684,420	$750,000	*	$4,434,420
ALT. 1.3/2.4/3.2	97.96	294.03	0.05	0.36	$4,286,120	$750,000	*	$5,036,120
ALT. 1.4/2.2/3.1	144.80	452.83	0.08	0.50	$3,336,060	$750,000	*	$4,086,060
ALT. 1.4/2.2/3.2	92.03	276.86	0.05	0.34	$3,937,760	$750,000	*	$4,687,760
ALT. 1.4/2.4/3.2	92.02	276.85	0.05	0.34	$4,030,360	$750,000	*	$4,780,360
ALT. 1.4/2.4/3.1	144.80	452.83	0.08	0.50	$3,428,660	$750,000	*	$4,178,660
ALT. 1.5/2.4/3.2**	75.27	231.85	0.04	0.25	$5,531,600	$750,000	*	$6,281,600
ALT. 1.5.3/2.4/3.5**	48.33	171.56	0.03	0.09	$8,362,655	$750,000	*	$9,112,655
ALT. 1.5.2/2.3/3.1**	104.41	325.10	0.06	0.24	$10,707,743	$750,000	*	$11,457,743
ALT. 1.5.2/2.3/3.2**	51.64	187.85	0.03	0.08	$11,009,443	$750,000	*	$11,759,443
ALT. 1.5.3/2.3/3.5**	46.05	176.56	0.02	0.06	$12,373,093	$750,000	*	$13,123,093
ALT. 1.5.2/2.4/3.2**	53.92	182.85	0.03	0.11	$6,999,005	$750,000	*	$7,749,005
ALT. 1.5.2/2.3/3.6**	51.64	187.85	0.03	0.08	$15,787,943	$750,000	*	$16,537,943
ALT. 1.6/2.3/3.2	51.64	187.85	0.03	0.08	$12,670,013	$750,000	*	$13,420,013
ALT. 1.6/2.3/3.5	46.05	176.56	0.02	0.06	$14,415,463	$750,000	*	$15,165,463
ALT. 1.6/2.3/3.6	51.64	187.85	0.03	0.08	$17,148,513	$750,000	*	$17,898,513
ALT. 1.7/2.4*/3.3	51.64	175.76	0.03	0.13	$14,432,530	$750,000	$5,220,000	$20,402,530
ALT. 1.7/2.2*/3.3	51.65	175.77	0.03	0.13	$14,339,930	$750,000	$5,220,000	$20,309,930
ALT. 1.7/2.2*/3.2	61.46	200.00	0.03	0.16	$12,724,280	$750,000	$4,520,000	$17,994,280

** Cost of Dam of Till cover rock base reduced to account for backhaul of waste

* Incl. HDPE cover

VANGORDA PLATEAU DEVELOPMENT
COST-BENEFIT ANALYSIS

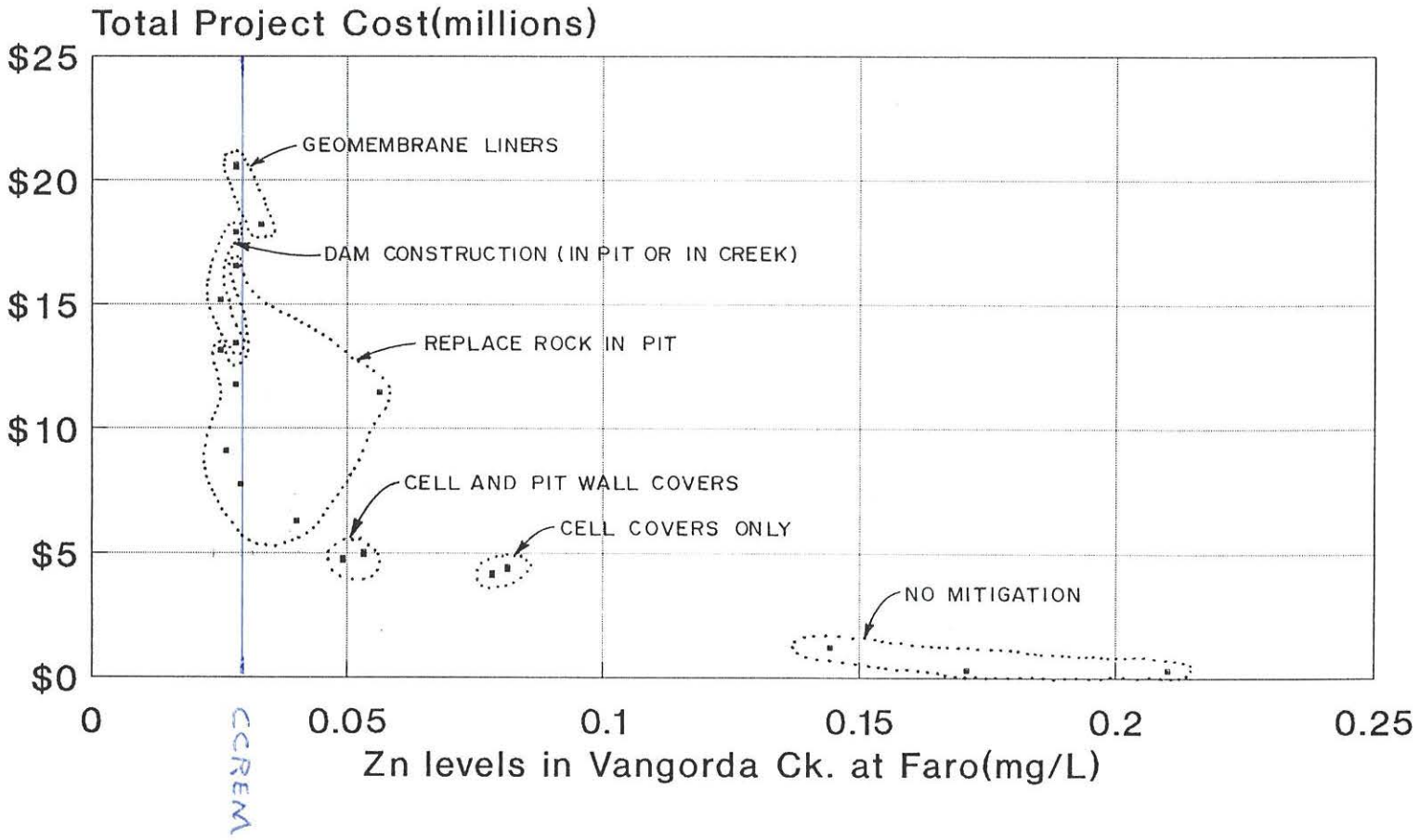

FIGURE 4.5

to be in the order of $400,000. This figure includes foundation construction, electrical services, field engineering and miscellaneous construction support. A summary of the estimated Capital costs is presented below:

DESCRIPTION	UNITS	QUANTITY	UNIT COST	TOTAL
Relocation of plant	L.S.			$400,000
Construction of Sludge Pond	L.S.			$400,000
Surface Water Collection				
Line ditch with Shotcrete	Lin.m	3000	$50.00	$150,000
Groundwater Wells	No.	10	$3000	$30,000

Total				$980,000

5.3 Operating Costs

5.3.1 General

The operating cost components comprise fixed and variable items. The fixed costs would include labour, operating supplies, maintenance supplies and replacement, collection ditch maintenance, site vehicles and monitoring and assays. The variable costs include lime and flocculant consumption and power costs and the flowrate of treated water.

5.3.2 Fixed Cost Components

On site labour is assumed to consist of one or two part time operators working the equivalent of 4 man-hours per day, seven days a week. Assuming an hourly rate of $18.00/hr including overhead the monthly cost would be about $2,160.

An allowance of $1000 per month was estimated to cover miscellaneous operating supplies such as testing reagents and strip charts.

In the course of estimating operating costs, a maintenance supplies and replacement cost was included to account for replacement of the mechanical equipment over time. This figure was calculated as 5 percent per annum of the current capital cost of equipment that would be salvaged for the relocated treatment plant. The equipment would include pumps and treatment equipment, piping within the treatment plant, electrical switchgear, and instrumentation. The total cost was estimated to be in the order of $600,000.

An allowance of $500 per month was also included to cover operating and depreciation costs for on-site vehicles. Monitoring costs including external lab work and assays were estimated to be about $1000 per month. No allowance in the operating cost were provided for general overhead and administration.

A summary of the fixed monthly operating costs for the treatment plant is presented as follows:

DESCRIPTION	UNITS	QUANTITY	UNIT COSTS	TOTAL
Operator	Man-mths	1	$2160	$2,160
Operating Supplies	l.s.			$1,000
Collection Ditch Maintce.	l.s.			$2,000
Maintce Supplies & repl.	l.s			$2,500
Site Vehicles	l.s.			$ 500
Monitoring & Assays	l.s.			$1,000

Total				$9,160

5.3.3 Variable Cost Components

The variable operating costs for the Water Treatment Plant include power, reagent costs and the volume of treated drainage. As there is presently insufficient data to accurately predict the water quality of the drainage after closure, the cost analysis assumes that the acidity and soluble metal content of mine drainage would remain constant. Consequently the rate of lime consumption would also remain constant. Based on laboratory testing completed by CESL during the feasibility study for the proposed treatment plant, the rate of lime consumption based on a soluble metal content of 40 mg/L was computed to be about 0.4 kg/cu.m of AMD treated. The rate of flocculant consumption was estimated to be .0013 kg/cu.m of AMD treated. The analysis assumes that these rates will apply to the post-closure plant.

The cost to deliver pebble quicklime to the mine site was estimated at $570 per tonne. Based on a rate of lime consumption of .4 kg/cu.m of AMD treated, the unit cost of lime consumption per cu.m of AMD treated was computed to be $0.2280. Similarly assuming a flocculant consumption rate of 0.0013 kg per cubic metre of treated AMD, cost of flocculant was computed to be about $.0065/cu.m of AMD treated based on a bulk flocculant cost of $5.00 per kilogram. Consequently the total reagent cost per cu.m of AMD treated is about $0.23.

Power consumption of the Treatment Plant during operation of the mine will primarily be governed by the pumping requirements. Because of the location of the treatment plant during operations in relation to the sumps in each of the pits, relatively high pumping costs are anticipated. After closure the plant will be relocated downhill of the mine site and much of the drainage will be gravity fed, significantly reducing the pumping requirements. This relocation is based on the fact that after

operations it will be demonstrated that sheep migration has not been affected by the mine development, thus a sheep corridor will no longer be required. Based on a treatment flow rate of 145 cu.m per hour, it is expected that the power requirement would be about 74 KW (100 hp) consumed at a rate of $0.10 per KWH. For the analysis in this study, the rate of power consumption was assumed to remain constant and was calculated to be about $0.05 per cu.m of treated drainage.

5.4 Treatment Costs for Alternative combinations

During the analysis it was considered that eight of the 24 combinations would require perpetual treatment in addition to other mitigation measures. The flow estimates for each of these combinations were calculated by summing the individual flow from each component alternative shown on Table 3.3. The annual operating cost was converted into a perpetuity growth fund assuming a real growth factor of 3 percent. A summary of the resultant treatment costs, total project costs (including treatment), flowrates and the predicted water quality in Vangorda Creek at Faro for each combination alternative, is presented in Table 5.1.

5.5 Treatment Cost Variables

Because of the relatively low anticipated rate of lime consumption in the Water Treatment process, the variable cost component represents, in most of the cases considered, about 20 to 40 percent of the total annual treatment costs. Consequently it was found that the total annual treatment cost estimated for each alternative was not sensitive to the volume of water treated. In the event that the acidity or soluble metal content of the drainage treated is significantly greater than anticipated, the lime consumption rate would increase and treatment costs would need to revised.

An analysis was completed to evaluate the effect of varying the lime consumption due to the possible increase in acidity, varying the lime costs per tonne and varying the flow rate through the plant. A summary of the reagent costs versus lime consumption is shown on Table 5.2 and Figure 5.1. Annual Treatment costs as a function of reagent costs and flow rates are presented on Table 5.3 and Figure 5.2

6.0 DISCUSSION AND RECOMMENDATIONS

Based on the results of the preceding analysis and the assumed water quality predictions, the approach to the abandonment of the Vangorda mine site should be to provide a plan that has the flexibility to accommodate several of the alternatives considered in this study. The abandonment plan should therefore be completed in several stages and each subsequent stage should be selected based on the results of a regular monitoring program. The monitoring program should include not only water quality but also temperature and gas pressure levels in the dumps.

The initial stages of the recommended abandonment plan would include Alternative 1.4 and 2.4 which involve constructing the rock/till berms during the till stripping phase of the development.. As waste

Sludge disposal ~ $10/cu yd. of sludge. (A.R.)

rock is deposited behind the berms, results from the monitoring program of seeps from waste rock and the pit walls would enable selection of the subsequent stages. Based on the results of the analysis in this report alternatives that would most likely be considered would include the return of the Vangorda sulphide rock to the pit combined with either pit wall covers or water covered behind an in-pit dam. The most cost effective plan would involve a combination that included Till covered pit walls and cells (1.4/2.4/3.2) as shown on Figure 4.5

TABLE 5.1: SUMMARY OF TREATMENT COSTS AND PREDICTED WATER QUALITY AT FARO FOR ALTERNATIVE COMBINATIONS

	WATER QUALITY (Zn) IN VANGORDA CRK AT FARO					TREATMENT COSTS								
						CAPITAL COSTS	OPERATING COST							
HYPOTHETICAL ALTERNATIVE COMBINATION SCHEMES	MEAN MONTH LOAD (Kg/Mo.)	PEAK MONTH LOAD (Kg/Mo.)	MEAN MONTH CONC. (mg/L)	PEAK MONTH CONC. (mg/L)	TOTAL PROJECT COST (w/o TMT)		TOTAL FLOW (cu.m/d)	MONTHL REAGENT COSTS (@$0.23 /cu.m)	MONTHLY POWER COSTS (@$0.05 /cu.m)	MONTHL FIXED COSTS	MONTHL TOTAL COSTS	ANNUAL TREATMT COSTS	AMD TREATMENT FUND	TOTAL PROJECT COST (w TMT)
ALT. 1.1/2.5/3.1	267.56	824.61	0.14	1.05	$1,437,480	$980,000	684	$4,784	$1,040	$9,160	$14,984	$179,808	$5,993,600	$8,411,080
ALT. 1.2/2.5/3.1	318.83	983.15	0.17	1.30	$292,000	$980,000	743	$5,198	$1,182	$9,160	$15,540	$186,480	$6,215,992	$7,487,992
ALT. 1.2/2.1/3.1	391.77	1299.85	0.21	1.41	$292,000	$980,000	1476	$10,327	$2,245	$9,160	$21,732	$260,784	$8,692,800	$9,964,800
ALT. 1.3/2.2/3.1	150.73	470.21	0.08	0.53	$4,341,820	$980,000	578	$4,043	$879	$9,160	$14,082	$168,989	$5,632,960	$10,954,780
ALT. 1.3/2.2/3.2	97.96	294.04	0.05	0.36	$4,943,520	"	78	"	"	"	"	"	"	$4,943,520
ALT. 1.3/2.4/3.1	150.73	470.21	0.08	0.53	$4,434,420	$980,000	578	$4,043	$879	$9,160	$14,082	$168,989	$5,632,960	$11,047,380
ALT. 1.3/2.4/3.2	97.96	294.03	0.05	0.36	$5,036,120	"	78	"	"	"	"	"	"	$5,036,120
ALT. 1.4/2.2/3.1	144.80	452.83	0.08	0.50	$4,086,060	$980,000	572	$4,002	$870	$9,160	$14,032	$168,384	$5,612,800	$10,678,860
ALT. 1.4/2.2/3.2	92.03	276.86	0.05	0.34	$4,687,760	"	72	"	"	"	"	"	"	$4,687,760
ALT. 1.4/2.4/3.2	92.02	276.85	0.05	0.34	$4,780,360	"	72	"	"	"	"	"	"	$4,780,360
ALT. 1.4/2.4/3.1	144.80	452.83	0.08	0.50	$4,178,660	$980,000	572	$4,002	$870	$9,160	$14,032	$168,384	$5,612,800	$10,771,460
ALT. 1.5/2.4/3.2**	75.27	231.85	0.04	0.25	$6,281,600	"	56	"	"	"	"	"	"	$6,281,600
ALT. 1.5.3/2.4/3.5**	48.33	171.56	0.03	0.09	$9,112,655	"	10	"	"	"	"	"	"	$9,112,655
ALT. 1.5.2/2.3/3.1**	104.41	325.10	0.06	0.24	$11,457,743	$980,000	500	$3,496	$760	$9,160	$13,416	$160,992	$5,366,400	$17,804,143
ALT. 1.5.2/2.3/3.2**	51.64	187.85	0.03	0.08	$11,759,443	"	0	"	"	"	"	"	"	$11,759,443
ALT. 1.5.3/2.3/3.5**	46.05	176.56	0.02	0.06	$13,123,093	"	0	"	"	"	"	"	"	$13,123,093
ALT. 1.5.2/2.4/3.2**	53.92	182.85	0.03	0.11	$7,749,005	"	10	"	"	"	"	"	"	$7,749,005
ALT. 1.5.2/2.3/3.6**	51.64	187.85	0.03	0.08	$16,537,943	"	33	"	"	"	"	"	"	$16,537,943
ALT. 1.6/2.3/3.2	51.64	187.85	0.03	0.08	$13,420,013	"	0	"	"	"	"	"	"	$13,420,013
ALT. 1.6/2.3/3.5	46.05	176.56	0.02	0.06	$15,165,463	"	0	"	"	"	"	"	"	$15,165,463
ALT. 1.6/2.3/3.6	51.64	187.85	0.03	0.08	$17,898,513	"	33	"	"	"	"	"	"	$17,898,513
ALT. 1.7/2.4*/3.3	51.64	175.76	0.03	0.13	$20,402,530	"	23	"	"	"	"	"	"	$20,402,530
ALT. 1.7/2.2*/3.3	51.65	175.77	0.03	0.13	$20,309,930	"	23	"	"	"	"	"	"	$20,309,930
ALT. 1.7/2.2*/3.2	61.46	200.00	0.03	0.16	$17,994,280	"	23	"	"	"	"	"	"	$17,994,280

** Cost of Dam of Till cover rock base reduced to account for backhaul of waste

* Incl. HDPE cover

TABLE 5.2 : REAGENT COSTS PER CU.M VERSUS LIME CONSUMPTION				
LIME CONSUMPTION (kg/cu.m)	ACIDITY (mg/L)	LIME COST PER TONNE		
		$200	$400	$600
0.2	200	$0.05	$0.09	$0.13
0.4	400	$0.09	$0.17	$0.25
0.6	600	$0.13	$0.25	$0.37
0.8	800	$0.17	$0.33	$0.49
1.0	1000	$0.21	$0.41	$0.61
1.2	1200	$0.25	$0.49	$0.73
1.4	1400	$0.29	$0.57	$0.85
1.6	1600	$0.33	$0.65	$0.97
1.8	1800	$0.37	$0.73	$1.09
2.0	2000	$0.41	$0.81	$1.21

TABLE 5.3 : ANNUAL TREATMENT COSTS VS REAGENT COSTS								
REAGENT COSTS ($/cu.m)	AMD FLOWS(cu.m per day)							
	500		1000		1500		2000	
	Annual	Fund*	Annual	Fund	Annual	Fund	Annual	Fund
0.2	$122,420	$4,080,667	$158,920	$5,297,333	$195,420	$6,514,000	$231,920	$7,730,667
0.4	$158,920	$5,297,333	$231,920	$7,730,667	$304,920	$10,164,000	$377,920	$12,597,333
0.6	$195,420	$6,514,000	$304,920	$10,164,000	$414,420	$13,814,000	$523,920	$17,464,000
0.8	$231,920	$7,730,667	$377,920	$12,597,333	$523,920	$17,464,000	$669,920	$22,330,667
1.0	$268,420	$8,947,333	$450,920	$15,030,667	$633,420	$21,114,000	$815,920	$27,197,333
1.2	$304,920	$10,164,000	$523,920	$17,464,000	$742,920	$24,764,000	$961,920	$32,064,000
1.4	$341,420	$11,380,667	$596,920	$19,897,333	$852,420	$28,414,000	$1,107,920	$36,930,667
1.6	$377,920	$12,597,333	$669,920	$22,330,667	$961,920	$32,064,000	$1,253,920	$41,797,333
1.8	$414,420	$13,814,000	$742,920	$24,764,000	$1,071,420	$35,714,000	$1,399,920	$46,664,000

* Based on 3% Real Growth

VANGORDA PLATEAU DEVELOPMENT
LIME CONSUMPTION VS REAGENT COSTS

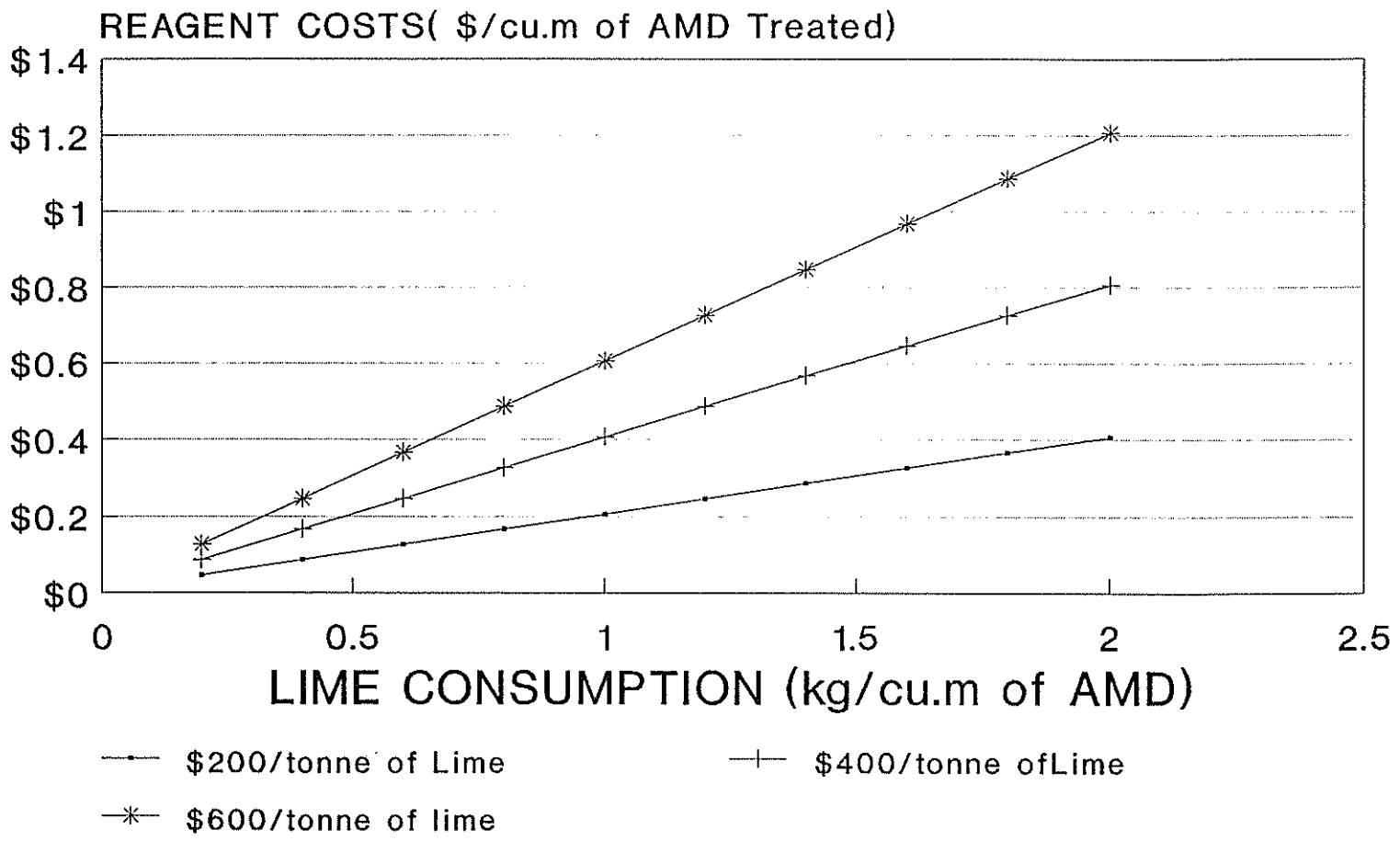

FIGURE 5.1

VANGORDA PLATEAU DEVELOPMENT
ANNUAL TREATMENT COSTS vs FLOW

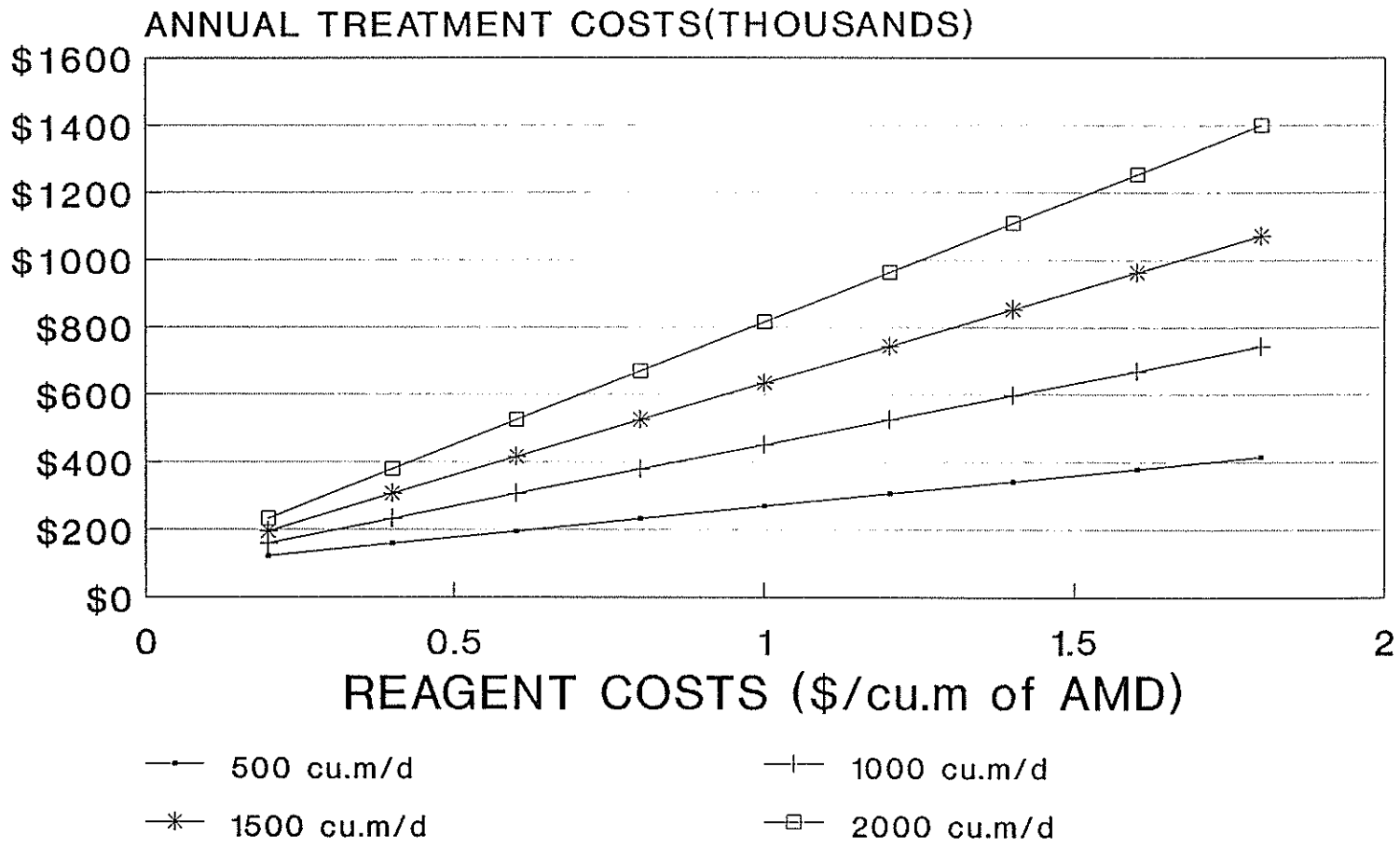

FIGURE 5.2

APPENDIX A

TABLE A.1 : Component Base Costs - Alternative 1.1

- Construct dry dump in Vangorda Creek below Vangorda Pit
- Construct permanent diversion of Vangorda Creek.
- No waste segregation or selective placement.
- No till covers.
- Collection and treatment required for seepage from dump and runoff above the Dump.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Diversion Dam				
Foundation Excavation	cu.m	1,000.00	$2.00	$2,000
Foundation Preparation	ha	1.80	$3,000.00	$5,400
Till - Haul/ Place / Compact(By Contractor)	cu.m	105,000.00	$5.00	$525,000
Haul Road Constr.	km	1.5	$30,000.00	$45,000
Rock - Haul/place (Mine)	cu.m	60,000.00	$1.20	$72,000
Blanket Drains - Haul/Place	cu.m	600.00	$10.80	$6,480
Spillway Excavation	cu.m	20,000.00	$3.00	$60,000
Spillway Riprap/Haul/place	cu.m	10,000.00	$6.00	$60,000
Diversion Trench				
Trench Excavation	cu.m	60,000.00	$2.00	$120,000
Erosion Protection(Riprap)	cu.m	26,000.00	$6.00	$156,000
Component Base Cost				$1,051,880

TABLE A.2 : Component Base Costs - Alternative 1.2

- Construct dry dump southwest of pit
- No Waste Segregation
- No till Covers
- Collection and Treatment of AMD from Vangorda Waste Dump Only
- No Diversion

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Collection Ditches				
Excavation	cu.m	12,800.00	$2.00	$25,600
Clearing and Grubbing	ha	3.20	$3,000.00	$9,600
Erosion Protection (riprap)	cu.m	2,000.00	$6.00	$12,000
Collection pond				
Clearing and Grubbing	ha	1.00	$3,000.00	$3,000
Foundation Excavation	cu.m	1,900.00	$2.00	$3,800
Till- Haul/Place/ Compact(By Contractor)	cu.m	18,600.00	$5.00	$93,000
Diversion Trench				
Trench Excavation	cu.m	3,200.00	$2.00	$6,400
Erosion Protection(Riprap)	cu.m	500.00	$6.00	$3,000
Component Base Cost				$156,400

TABLE A.3 : Component Base Costs - Alternative 1.3(Original Scheme)

- Construct dump east of the Vangorda Creek and Below the pit
- Selective placement of the Sulphide and Phyllite Material
- Construct till berms around each waste type to form two cells. Cover waste with 3 metre thick layer of till. Provide rock drain with air return control.
- Internal till layers to limit water infiltration.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Berms and Internal Layer				
Foundation Preparation	ha	59.00	$3,000.00	$177,000
Till Placement	cu.m	2,170,000.00	$0.10	$217,000
Dump Cover(Lower 1m)				
Till Haul	cu.m	396,000.00	$1.00	$396,000
Till Placement and Compaction	cu.m	396,000.00	$1.00	$396,000
Dump Cover(Upper 2m)				
Till Haul	cu.m	804,000.00	$1.00	$804,000
Till Placement	cu.m	804,000.00	$0.10	$80,400
Rock Drain				
Supply & Install Blanket	cu.m	6,000.00	$2.50	$15,000
Supply & Install Finger Drains	cu.m	1,350.00	$2.50	$3,375
Supply & INstall 60 mil HDPE	sq.m	350.00	$20.00	$7,000
Supply & Place Bedding	cu.m	120	$12.00	$1,440
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Erosion Protection(vegetation)	ha	59.00	$6,000.00	$354,000
Component Base Cost				$2,880,865

TABLE A.4 : Component Base Costs - Alternative 1.4

- Construct dump east of the Vangorda Creek and below the pit moving sulphides out of the ravine immediately below the pit
  Option allows establishment of a Spillway from the Southwest end of the pit
- Selective placement of the Sulphide and Phyllite Material
- Construct till berms around each waste type to form two cells.
- Cover waste with 3 metre thick cover of till
  Provide rock drain with air return control.
- Internal till layers to limit water infiltration.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Berms and Internal Layer				
Foundation Preparation	ha	56.30	$3,000.00	$168,900
Till Placement	cu.m	2,370,000.00	$0.10	$237,000
Dump Cover(Lower 1m)				
Till Haul	cu.m	336,600.00	$1.00	$336,600
Till Placement and Compaction	cu.m	336,600.00	$1.00	$336,600
Dump Cover(Upper 2m)				
Till Haul	cu.m	683,400.00	$1.00	$683,400
Till Placement	cu.m	683,400.00	$0.10	$68,340
Rock Drain				
Supply & Install Blanket	cu.m	6,000.00	$2.50	$15,000
Supply & Install Finger Drains	cu.m	1,350.00	$2.50	$3,375
Supply & Install 60 mil HDPE	sq.m	350.00	$20.00	$7,000
Supply & Place Bedding	cu.m	120	$12.00	$1,440
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Erosion Protection	ha	56.30	$6,000.00	$337,800
Component Base Cost				$2,625,105

TABLE A.5 : Component Base Costs - Alternative 1.5

- Return sulphide waste, low-grade and oxidized ore to pit beneath water.
- Phyllite waste to have 3 meter till cover with berms. Provide rock drain with air return control.
- Stockpile and Blend Sulphide with Limestone or Cal. Phy. during Operations.
- Clean up stockpile area

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Phyllite Cell Berm Construction				
Foundation Preparation	ha	48.50	$3,000.00	$145,500
Till Placement	cu.m	2,200,000.00	$0.10	$220,000
Phyllite Dump Cover(Lower 1m)				
Till Haul	cu.m	336,600.00	$1.00	$336,600
Till Placement and Compaction	cu.m	336,600.00	$1.00	$336,600
Phyllite Dump Cover(Upper 2m)				
Till Haul	cu.m	683,400.00	$1.00	$683,400
Till Placement	cu.m	683,400.00	$0.10	$68,340
Rock Drain				
Supply & Install Blanket	cu.m	6,000.00	$2.50	$15,000
Supply & Install Finger Drains	cu.m	1,350.00	$2.50	$3,375
Supply & INstall 80 mil HDPE	sq.m	350.00	$20.00	$7,000
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Erosion Protection(vegetation)	ha	48.50	$6,000.00	$291,000
Replacement of Sul. Waste into Vangorda Pit	cu.m	1,524,900.00	$1.20	$1,829,880
Clean up Stockpile Area	ha	20.00	$3,000.00	$60,000
Component Base Cost				$4,426,345

Blend All Segregated Vangorda Waste by:

Either (a)				
Blending Calc. Phy. w/sulphide Waste(1.5% by Vol.)	cu.m	22,873.50	$5.00	$114,368
Addition Calc. Phy. hauled to pit	cu.m	22,873.50	$1.20	$27,448
Total				$141,816
Or (b)				
Blending Limestone w/Sulphide Waste(0.5% by wgt)	tonnes	16,963.50	$40.00	$678,540
Total		16,963.50		$678,540

TABLE A.6 : Component Base Costs - Alternative 1.5.1

- Return all Waste, segregated to Vangorda Pit and Below Water.
- Stockpile and Blend waste with Limestone or Cal. Phy
- Clean Up Stockpile Area
- May Require Construction of In-pit Dam or overhaul to Grum pit

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Replacement of All Waste into Vangorda Pit	cu.m	4,296,500.00	$1.20	$5,155,800
Clean up Stockpile Area	ha	43.00	$3,000.00	$129,000
Component Base Cost				$5,714,450
Blend All Segregated Vangorda Waste by:				
Either (a)				
Blending Calc. Phy. w/sulphide Waste(1.5% by Vol)	cu.m	22,873.50	$5.00	$114,368
Blending Cal. Phy. w/Phyllite waste(1.5% by vol)	cu.m	41,574.00	$5.00	$207,870
Addition Calc. Phy. hauled to pit	cu.m	64,447.50	$1.20	$77,337
Total				$399,575
Or (b)				
Blending Limestone w/Sulphide Waste(0.5% by Wgt)	tonnes	16,963.50	$40.00	$678,540
Blending Limestone w/Phyllite Waste(0.5% by Wgt)	tonnes	30,800.35	$40.00	$1,232,014
Total				$1,910,554
Optional overhaul to Grum pit with ALT.3.5(1.5.3)	cu.m	496,500	$0.20	$99,300
Optional overhaul to Grum pit with Alt. 3.2(1.5.2)	cu.m	896,500	$0.20	$179,300
Total				

TABLE A.7 : Component Base Costs - Alternative 1.6

- Construct engineered embankment in Vangorda Creek to retain waste and allow to flood. Dam crest 1125 m.
- Provide spillway for Vangorda Creek.
- Construct artificial wetland environment on top of Dump
- No Segregation of waste rock

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Dam Construction in Vangorda Creek				
Foundation Excavation	cu.m	125,000.00	$2.00	$250,000
Foundation Preparation	ha	18.00	$3,000.00	$54,000
Till - Haul/ Place/ Compact(Contractor)	cu.m	680,000.00	$5.00	$3,400,000
Filter - Haul/Place/Compact(Contractor)	cu.m	190,000.00	$10.80	$2,052,000
Rockfill - Haul/Place(mine)	cu.m	1,000,000.00	$1.20	$1,200,000
Piezometers	No.	20.00	$400.00	$8,000
Settlement Markers	No.	20.00	$50.00	$1,000
Emergency Spillway				
Excavation	cu.m	17,000.00	$3.00	$51,000
Erosion Protection(Riprap)	cu.m	5,400.00	$10.80	$58,320
Wetland Environment	ha	30.00	$6,000.00	$180,000
Component Base Cost				$7,254,320

TABLE A.8 : Component Base Costs - Alternative 1.7

- Construct Dump east of Vangorda Creek and Below Pit
- Selective Placement of Sulphide and Phyllite Material
- Construct till berms as for 1.3.
- Place 1 metre till cover beneath Liner.
- Place synthetic 80 mil HDPE cover.
- Place 1.5m Till Cover over liner

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Berm Construction				
Foundation Preparation	ha	59.00	$3,000.00	$177,000
Till Placement	cu.m	2,170,000.00	$0.10	$217,000
Dump Cover(1m.)				
Till Haul	cu.m	400,000.00	$1.00	$400,000
Till Placement and Compaction(Mine)	cu.m	400,000.00	$1.00	$400,000
Geomembrane Liner				
Supply & Place Drainage Layer	cu.m	120,000.00	$20.00	$2,400,000
Supply and Install 80mil HDPE membrane	sq.m	400,000.00	$12.00	$4,800,000
Haul/Place/Compact Till cover(1.5m)	cu.m	600,000.00	$2.00	$1,200,000
Rock Drain				
Supply & Install Blanket	cu.m	6,000.00	$2.50	$15,000
Supply & Install Finger Drains	cu.m	1,350.00	$2.50	$3,375
Supply & Place Bedding	cu.m	120.00	$20.00	$2,400
Supply & Install 80 mil HDPE	sq.m	350.00	$20.00	$7,000
Erosion Protection	ha	59.00	$6,000.00	$354,000
Component Base cost				$10,405,425
Perpetuity Growth Fund for Liner Cover Replacement (50 yr Life)	L.S.			$4,000,000

2.0 GRUM WASTE DUMP

TABLE A.9 : Component Base Costs - Alternative 2.2

- Selective placement of sulphide waste.
- 3 m. thick till cover over sulphide waste with no berms

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Selective Placement of Sulphide Waste**	lcu.m	2,118,230.40	$0.10	$211,823
Sulphide Dump Cover(Lower 1m)				
Till Haul	cu.m	51,480.00	$1.00	$51,480
Till Placement and Compaction	cu.m	51,480.00	$1.00	$51,480
Sulphide Dump Cover(Upper 2m)				
Till Haul	cu.m	104,520.00	$1.00	$104,520
Till Placement	cu.m	104,520.00	$0.10	$10,452
Internal Till Layers(1m)				
Till Haul	cu.m	104,000.00	$1.00	$104,000
Till Placement	cu.m	104,000.00	$0.10	$10,400
Erosion Protection of Till Cover	ha	5.20	$6,000.00	$31,200
Component Base Cost				$575,355

** excl. 607,000 bcu.m not removed from pit

TABLE A.10 : Component Base Costs - Alternative 2.3

- Segregation of Sulphide and Altered Phyllite Waste during operation
- Stockpile and blend with limestone, all sulphide and altered phyllite waste.
- Return Sulphide and Altered Phy. waste to Grum pit.
- Clean Up Stockpile Area
- No till covers.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Selective Stockpiling of Grum Sul. and Altered Phy. Waste*	lcu.m	3,575,686.54	$0.10	$357,569
Replacement of Grum Sulphide and Altered Phy. to Grum Pit*	lcu.m	3,575,686.54	$1.20	$4,290,824
Clean up Stockpile Area	ha	10.00	$3,000.00	$30,000
Component Base Cost				$4,678,393

Blending Sulphide and Altered Phyllite Waste Rock from Grum with:

Either (a)				
Blending Calc. Phy. w/Sul. & Alt. Phy.(1.5% by Vol	cu.m	46,639.39	$5.00	$233,197
Addition Calc. Phy. hauled to pit	cu.m	46,639.39	$1.20	$55,967
Total				$289,164
Or(b)				
Blending L/stone w/Sul. & Alt. Phy.(0.5% by Wgt)	tonnes	33,903.49	$40.00	$1,356,140
Total				$1,356,140

* incl. 15% Dilution but excl. 607,700 cu.m of Sulphide not removed from pit

TABLE A.11: Component Base Costs - Alternative 2.4

- Selective placement of sulphide waste.
- 3 m. thick till cover over sulphide waste with berms

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Selective Placement of Sulphide Waste	lcu.m	2,118,230.40	$0.10	$211,823
Berm Construction				
Foundation Preparation	ha	59.00	$3,000.00	$177,000
Till Placement	cu.m	300,000.00	$0.10	$30,000
Sulphide Dump Cover(Lower 1m)				
Till Haul	cu.m	51,480.00	$1.00	$51,480
Till Placement and Compaction	cu.m	51,480.00	$1.00	$51,480
Sulphide Dump Cover(Upper 2m)				
Till Haul	cu.m	104,520.00	$1.00	$104,520
Till Placement	cu.m	104,520.00	$0.10	$10,452
Erosion Protection of Till Cover	ha	5.20	$6,000.00	$31,200
Component Base Cost				$667,955

Adjustment for the option to use HDPE liner with reduced thickness of till cover

Geomembrane Liner				
Supply & Place Drainage Layer	cu.m	15,600.00	$20.00	$312,000
Supply and Install 80mil HDPE membrane	sq.m	52,000.00	$12.00	$624,000
Haul/Place/Compact Till cover(1.5m)	cu.m	78,000.00	$2.00	$156,000
Deduction for till volume reduction	cu.m	78,000.00	$1.10	($85,800)
Total				$1,006,200

3.0 VANGORDA PIT

TABLE A.12 : Component Base Costs - Alternative 3.1

- Flood pit to El. 1122.5
- No till covers on pit walls.
- Removal Of Access Road

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Outlet Spillway Construction at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$6.00	$24,000
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Seepage Collection Ditch along Bench 1128				
Excavation	cu.m	2,000.00	$3.00	$6,000
Component Base Cost				$135,600

TABLE A.13 : Component Base Costs - Alternative 3.2

- Flood pit to El. 1122.5.
- Backfill east of Section 12 with rock to El. 1122.5 and cover pit walls with till and vegetation.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Outlet Spillway at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$10.80	$43,200
Rock Backfill East of Section 12				
Rock Haul*	cu.m	260,000.00	$1.00	$260,000
Rock Placement*	cu.m	260,000.00	$0.20	$52,000
Till Cover on Vangorda Pit Walls				
Till Haul	cu.m	203,000.00	$1.00	$203,000
Till PLacement	cu.m	203,000.00	$0.10	$20,300
Clean Loose Sulphides from Pit Walls	sq.m	44,000.00	$0.50	$22,000
Erosion Protection of Till Cover	ha	5.20	$6,000.00	$31,200
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Component Base Cost				$737,300

* Vol of rock may be reduced to 10,000 cu.m if completed in combination with either 1.5, 1.5.1, 1.5.1 or 1.5.3

TABLE A.14 : Component Base Costs - Alternative 3.3

- Flood pit to El. 1122.5
- Backfill east of Section 12 with rock to El. 1122.5 and cover pit walls with till and a geo-membrane synthetic liner.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Outlet Spillway Construction at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$10.80	$43,200
Rock Backfill East of Section 12				
Rock Haul	cu.m	260,000.00	$1.00	$260,000
Rock Placement	cu.m	260,000.00	$0.20	$52,000
Till Cover on Vangorda Pit Walls				
Till Haul	cu.m	336,500.00	$1.00	$336,500
Till PLacement	cu.m	336,500.00	$0.10	$33,650
Clean Loose Sulphides from Pit Walls	sq.m	44,000.00	$0.50	$22,000
Geomembrane Liner				
Supply & Place Sand Bedding	cu.m	22,500.00	$20.00	$450,000
Supply and Install 80mil HDPE membrane	sq.m	75,000.00	$12.00	$900,000
Haul/Place/Compact Till cover(1.0m)	cu.m	75,000.00	$2.00	$150,000
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Component Base Costs				$2,352,950
Perpetuity Growth Fund for Liner Cover Replacement (50 yr Life)	L.S.			$700,000

TABLE A.15: Component Base Costs - Alternative 3.4

- Flood pit to 1122.5
- Shotcrete exposed sulphide bearing rock.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Outlet Spillway Construction at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$10.80	$43,200
Shotcrete Exposed Sulphides on Pit walls				
Prepare Rock Surface	sq.m	44,000.00	$0.50	$22,000
Shotcrete Rock Surface	sq.m	44,000.00	$40.00	$1,760,000
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Component Base Cost				$1,930,800

TABLE A.16 : Component Base Costs - Alternative 3.5

- Construct a dam at about Section 12 to El. 1140 to submerge sulphide-bearing rock and allow to flood.
- Flood remainder of pit to the west to El. 1122.5.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Outlet Spillway Construction at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$6.00	$24,000
Dam Construction At Section 12				
Foundation Preparation	ha	0.80	$3,000.00	$2,400
Till - Haul/ Place/ Compact	cu.m	287,700.00	$5.00	$1,438,500
Rockfill-Haul/place*	cu.m	673,500.00	$1.20	$808,200
Blanket Drains	cu.m	9,100.00	$2.50	$22,750
Piezometers	No.	10.00	$400.00	$4,000
Settlement Markers	No.	10.00	$50.00	$500
Emergency Spillway				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	2,000.00	$10.80	$21,600
Upstream Slope Protection(Riprap)	cu.m	4,000.00	$10.80	$43,200
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Component Base Cost				$2,482,750

* Rock volume would be reduced to 172,000 cu. m if combined with 1.5, 1.5.1, 1.5.2 or 1.5.3

TABLE A.17 : Component Base Costs - Alternative 3.6

- Excavate Sulphide and Altered Phyllite from Pit Walls
- Place Waste Rock In Pit

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Outlet Spillway Construction at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$10.80	$43,200
Excavate Sulphides & Alt. Phy. in Pit walls				
Excavation & Place in Pit	cu.m	921,000.00	$3.00	$2,763,000
Excavate Till Overburden				
Excavation of till	cu.m	768,000.00	$3.00	$2,304,000
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Component Base Cost				$5,215,800

TABLE A.18 : Combination Base Costs - Alternative 1.5.3/2.4/3.5

- Return all Vangorda Waste, segregated to Vangorda Pit and Below Water
- Stockpile and Blend all Vangorda waste prior to replacement in pit
- Clean Up Stockpile area
- Construct a dam at about Section 12 to El. 1140 to submerge sulphide-bearing rock and allow to flood to El. 37.5
- Flood remainder of pit to the west to El. 1122.5.
- Haul excess waste to Grum Pit

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Replacement of All Waste into Vangorda Pit	cu.m	4,296,500.00	$1.20	$5,155,800
Clean up Stockpile Area	ha	43.00	$3,000.00	$129,000
Outlet Spillway Construction at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$6.00	$24,000
Dam Construction At Section 12				
Foundation Preparation	ha	0.80	$3,000.00	$2,400
Till - Haul/Place/ Compact	cu.m	287,700.00	$5.00	$1,438,500
Rockfill-Haul/place/	cu.m	172,000.00	$1.20	$206,400
Blanket Drains	cu.m	9,100.00	$2.50	$22,750
Piezometers	No.	10.00	$400.00	$4,000
Settlement Markers	No.	10.00	$50.00	$500
Emergency Spillway				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	2,000.00	$10.80	$21,600
Upstream Slope Protection(Riprap)	cu.m	4,000.00	$10.80	$43,200
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Grum Sulphide Cell (alternative 2.4)				$667,955
Component Base Cost				$8,263,355

TABLE A.19 : Combination Base Costs - Alternative 1.5/2.4/3.2

- Return Vangorda sulphide waste, low-grade and oxidized ore to pit beneath water.
- Phyllite waste to have 3 meter till cover with berms. Provide rock drain with air return control.
- Stockpile and Blend Sulphide with Limestone or Cal. Phy. during Operations.
- Clean up stockpile area
- Flood pit to El. 1122.5.
- Backfill east of Section 12 with rock to El. 1122.5 and cover pit walls with till and vegetation.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Phyllite Cell Berm Construction				
Foundation Preparation	ha	48.50	$3,000.00	$145,500
Till Placement	cu.m	2,200,000.00	$0.10	$220,000
Phyllite Dump Cover(Lower 1m)				
Till Haul	cu.m	336,600.00	$1.00	$336,600
Till Placement and Compaction	cu.m	336,600.00	$1.00	$336,600
Phyllite Dump Cover(Upper 2m)				
Till Haul	cu.m	683,400.00	$1.00	$683,400
Till Placement	cu.m	683,400.00	$0.10	$68,340
Rock Drain				
Supply & Install Blanket	cu.m	6,000.00	$2.50	$15,000
Supply & Install Finger Drains	cu.m	1,350.00	$2.50	$3,375
Supply & INstall 80 mil HDPE	sq.m	350.00	$20.00	$7,000
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Erosion Protection(vegetation)	ha	48.50	$6,000.00	$291,000
Replacement of Sul. Waste into Vangorda Pit	lcu.m	1,524,900.00	$1.20	$1,829,880
Clean up Stockpile Area	ha	20.00	$3,000.00	$60,000
Outlet Spillway at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$10.80	$43,200
Rock Backfill East of Section 12 to El.1125				
Rock Haul	cu.m	10,000.00	$1.00	$10,000
Rock Placement	cu.m	10,000.00	$0.20	$2,000
Till Cover on Vangorda Pit Walls				
Till Haul	cu.m	203,000.00	$1.00	$203,000
Till Placement	cu.m	203,000.00	$0.10	$20,300
Clean Loose Sulphides from Pit Walls	sq.m	44,000.00	$0.50	$22,000
Erosion Protection of Till Cover	ha	5.20	$6,000.00	$31,200
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Grum Sulphide Cell (alternative 2.4)				$667,955
Base Cost				$5,531,600

TABLE A.20 : Combination Base Costs - Alternative 1.5.2/2.4/3.2

- Return some Waste, segregated to Vangorda Pit and below Water and some to Grum.
- Stockpile and Blend waste with Limestone or Cal. Phy
- Clean Up Stockpile Area
- Flood pit to El. 1122.5.
- Backfill east of Section 12 with rock to El. 1122.5 and cover pit walls with till and vegetation
- Haul excess waste to Grum Pit

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Replacement of All Waste into Vangorda Pit	lcu.m	4,296,500.00	$1.20	$5,155,800
Clean up Stockpile Area	ha	43.00	$3,000.00	$129,000
Outlet Spillway at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$10.80	$43,200
Rock Backfill East of Section 12 to El.1125				
Rock Haul	cu.m	10,000.00	$1.00	$10,000
Rock Placement	cu.m	10,000.00	$0.20	$2,000
Till Cover on Vangorda Pit Walls				
Till Haul	cu.m	203,000.00	$1.00	$203,000
Till Placement	cu.m	203,000.00	$0.10	$20,300
Clean Loose Sulphides from Pit Walls	sq.m	44,000.00	$0.50	$22,000
Erosion Protection of Till Cover	ha	5.20	$6,000.00	$31,200
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Grum Sulphide Cell (alternative 2.4)				$667,955
Overhaul to Grum pit	cu.m	896,500.00	$0.20	$179,300
Component Base Cost				$6,999,005

TABLE A.21 : Combination Base Costs - Alternative 1.4/2.4/3.1

- Construct dump east of the Vangorda Creek and below the pit moving sulphides
- out of the ravine immediately below the pit
  Option allows establishment of a Spillway from the Southwest end of the pit
- Selective placement of the Sulphide and Phyllite Material
- Construct till berms around each waste type to form two cells.
- Cover waste with 3 metre thick cover of till
  Provide rock drain with air return control.
- Internal till layers to limit water infiltration.

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Berms and Internal Layer				
Foundation Preparation	ha	56.30	$3,000.00	$168,900
Till Placement	cu.m	2,370,000.00	$0.10	$237,000
Dump Cover(Lower 1m)				
Till Haul	cu.m	336,600.00	$1.00	$336,600
Till Placement and Compaction	cu.m	336,600.00	$1.00	$336,600
Dump Cover(Upper 2m)				
Till Haul	cu.m	683,400.00	$1.00	$683,400
Till Placement	cu.m	683,400.00	$0.10	$68,340
Rock Drain				
Supply & Install Blanket	cu.m	6,000.00	$2.50	$15,000
Supply & Install Finger Drains	cu.m	1,350.00	$2.50	$3,375
Supply & Install 60 mil HDPE	sq.m	350.00	$20.00	$7,000
Supply & Place Bedding	cu.m	120	$12.00	$1,440
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Erosion Protection	ha	56.30	$6,000.00	$337,800
Selective Placement of Grum Sulphide Waste	lcu.m	2,118,230.40	$0.10	$211,823
Grum Sulphide Cell Berm Construction				
Foundation Preparation	ha	59.00	$3,000.00	$177,000
Till Placement	cu.m	300,000.00	$0.10	$30,000
Grum Sulphide Dump Cover(Lower 1m)				
Till Haul	cu.m	336,600.00	$1.00	$336,600
Till Placement and Compaction	cu.m	336,600.00	$1.00	$336,600
Grum Sulphide Dump Cover(Upper 2m)				
Till Haul	cu.m	683,400.00	$1.00	$683,400
Till Placement	cu.m	683,400.00	$0.10	$68,340
Erosion Protection of Till Cover	ha	5.20	$6,000.00	$31,200
Vangorda pit	l.s			$135,600
Component Base Cost				$4,635,668

TABLE A.20 : Combination Base Costs - Alternative 1.5.2/2.4/3.2

- Return some Waste, segregated to Vangorda Pit and below Water and some to Grum.
- Stockpile and Blend waste with Limestone or Cal. Phy
- Clean Up Stockpile Area
- Flood pit to El. 1122.5.
- Backfill east of Section 12 with rock to El. 1122.5 and cover pit walls with till and vegetation
- Haul excess waste to Grum Pit

CONSTRUCTION ITEM	UNITS	QUANTITY	UNIT COSTS	SUBTOTAL
Selective Placement of Waste	cu.m	4,296,500.00	$0.10	$429,650
Replacement of All Waste into Vangorda Pit	lcu.m	4,296,500.00	$1.20	$5,155,800
Clean up Stockpile Area	ha	43.00	$3,000.00	$129,000
Outlet Spillway at North End of Pit				
Excavation	cu.m	4,000.00	$3.00	$12,000
Erosion Protection(Riprap)	cu.m	4,000.00	$10.80	$43,200
Rock Backfill East of Section 12 to El.1125				
Rock Haul	cu.m	10,000.00	$1.00	$10,000
Rock Placement	cu.m	10,000.00	$0.20	$2,000
Till Cover on Vangorda Pit Walls				
Till Haul	cu.m	203,000.00	$1.00	$203,000
Till Placement	cu.m	203,000.00	$0.10	$20,300
Clean Loose Sulphides from Pit Walls	sq.m	44,000.00	$0.50	$22,000
Erosion Protection of Till Cover	ha	5.20	$6,000.00	$31,200
Inlet Spillway at Northeast Wall				
Excavation	cu.m	12,000.00	$3.00	$36,000
Erosion Protection(riprap)	cu.m	9,000.00	$6.00	$54,000
Graded Streambed Outfall				
Excavation	cu.m	1,200.00	$3.00	$3,600
Grum Sulphide Cell (alternative 2.4)				$667,955
Overhaul to Grum pit	cu.m	896,500.00	$0.20	$179,300
Base Cost				$6,999,005